

**SECTION 00 0101  
PROJECT TITLE PAGE**

**PROJECT MANUAL**

**FOR**

**HABERSHAM ANIMAL CONTROL CENTER  
51 CARTER GROVE BOULEVARD  
CORNELIA, GEORGIA 30120**

**OWNER**

**HABERSHAM COUNTY  
130 JACOBS WAY, SUITE 302  
CLARKSVILLE, GEORGIA 30523**

**ARCHITECT**

**CROFT & ASSOCIATES  
3380 BLUE SPRINGS ROAD  
KENNESAW, GEORGIA 30144  
770.529.7714**

**PROJECT NO. C&A - 2022-313**

**DATE: NOVEMBER 10, 2023**

**END OF SECTION 00 0101**

**SECTION 00 0103  
PROJECT DIRECTORY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Identification of project team members and their contact information.

**1.02 OWNER:**

- A. City of Cartersville, Georgia
1. Address Line 1: One North Erwin Street.
  2. City: Cartersville.
  3. State: Georgia.
  4. Zip Code: 30120.
- B. Primary Contact: All correspondence from the Contractor to the Architect will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. Name: \_\_\_\_\_.
  2. Email: \_\_\_\_\_.

**1.03 CONSULTANTS:**

- A. Architect: Design Professional of Record. All correspondence from the Contractor regarding construction documents authored by Architect's consultants will be through this party, unless alternate arrangements are mutually agreed upon at preconstruction meeting.
1. CROFT & Associates, Inc.
    - a. Address Line 1: 3380 Blue Springs Road.
    - b. City: Kennesaw.
    - c. State: Georgia.
    - d. Zip Code: 30144.
    - e. Telephone: 770.529.7714.
  2. Primary Contact:
    - a. Name: Oscar Herrera, Project Architect.
    - b. Email: oherrera@croftae.com.
- B. Civil Engineering Consultant:
1. Company Name: CROFT & Associates, Inc..
    - a. Address Line 1: 3380 Blue Springs Road.
    - b. City: Kennesaw.
    - c. State: Georgia.
    - d. Zip Code: 30144.
    - e. Telephone: 77.529.7714.
  2. Primary Contact:
    - a. Name: Chris Jung, P.E..
    - b. Email: cjung@croftae.com.
- C. Structural Engineering Consultant:
1. Company Name: Shear Structural, Inc..
    - a. Address Line 1: 3411 Pierce Drive, Suite 100.
    - b. City: Chamblee.
    - c. State: Georgia.
    - d. Zip Code: 30341.
    - e. Telephone: 678.438.2979.
  2. Primary Contact:
    - a. Name: Holly Jeffreys, P.E..
    - b. Email: hjeffreys@shearstructural.com.
- D. Mechanical Engineering Consultant - Plumbing & HVAC:

1. Company Name: CROFT & Associates, Inc..
    - a. Address Line 1: 3380 Blue Springs Road.
    - b. City: Kennesaw.
    - c. State: Georgia.
    - d. Zip Code: 30144.
    - e. Telephone: 770.529.7714.
  2. Primary Contact:
    - a. Name: Amy Hadlow, P.E..
    - b. Email: [ahadlow@croftae.com](mailto:ahadlow@croftae.com).
- E. Electrical Engineering Consultant:
1. Company Name: CROFT & Associates, Inc..
    - a. Address Line 1: 3380 Blue Springs Road.
    - b. City: Kennesaw.
    - c. State: Georgia.
    - d. Zip Code: 30144.
    - e. Telephone: 770.529.7714.
  2. Primary Contact:
    - a. Name: Robbie Rahn, P.E..
    - b. Email: [rrahn@croftae.com](mailto:rrahn@croftae.com).
- F. Fire Protection Consultant:
1. Company Name: CROFT & Associates, Inc..
    - a. Address Line 1: 3380 Blue Springs Road.
    - b. City: Kennesaw.
    - c. State: Georgia.
    - d. Zip Code: 30144.
    - e. Telephone: 770.529.7714.
  2. Primary Contact:
    - a. Name: Cynthia Hurell, P.E..
    - b. Email: [churell@croftae.com](mailto:churell@croftae.com).

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 00 0103**

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**SECTION 01 1000  
SUMMARY**

**PART 1 GENERAL**

**1.01 PROJECT**

- A. Project Name: Habersham Animal Control Center
- B. Owner's Name: Habersham County, Georgia.
- C. Architect's Name: CROFT & Associates, Inc..
- D. The Project consists of the construction of a new facility for the adoption and treatment for animals.

**1.02 CONTRACT DESCRIPTION**

**1.03 WORK BY OWNER**

**1.04 OWNER OCCUPANCY**

- A. Owner intends to occupy the Project upon Substantial Completion.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

**1.05 CONTRACTOR USE OF SITE AND PREMISES**

- A. Construction Operations: Limited to areas noted on Drawings.
  - 1. Locate and conduct construction activities in ways that will limit disturbance to site.
- B. 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.

**END OF SECTION 01 1000**

**SECTION 01 2300  
ALTERNATES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Description of Alternates.

**1.02 ACCEPTANCE OF ALTERNATES**

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

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 2300**

**SECTION 01 2500  
SUBSTITUTION PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

**1.02 DEFINITIONS**

- A. Substitutions: See General Conditions for definition.

**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.
  6. Agrees to reimburse Owner and Architect for review or redesign services associated with re-approval by authorities.
- B. 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.
- C. 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.
- D. Limit each request to a single proposed substitution item.
1. Submit an electronic document, combining the request form with supporting data into single document.

**3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

- A. Submittal Time Restrictions:
1. Owner will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.
- B. Submittal Form (before award of contract):

**3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

- A. 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.
- B. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, 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. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.

2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
3. Bear the costs engendered by proposed substitution of:
  - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
- C. 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. See Section 01 7800 - Closeout Submittals, for closeout submittals.

**END OF SECTION 01 2500**



**SECTION 01 3000  
ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General administrative requirements.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Submittals for review, information, and project closeout.
- G. Number of copies of submittals.
- H. Requests for Interpretation (RFI) procedures.
- I. Submittal procedures.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6000 - Product Requirements: General product requirements.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 PRECONSTRUCTION MEETING**

- A. Schedule 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, list of products, schedule of values, and progress schedule.
  - 5. Designation of personnel representing the parties to Contract, \_\_\_\_\_ and Architect.
  - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 7. 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.

**3.02 SITE MOBILIZATION MEETING**

- A. Schedule meeting at the Project site prior to Contractor occupancy.
- B. Attendance Required:
  - 1. Contractor.
  - 2. Owner.
  - 3. Architect.
  - 4. Contractor's superintendent.
- C. Agenda:
  - 1. Use of premises by Owner and Contractor.
  - 2. Owner's requirements.

3. Construction facilities and controls provided by Owner.
  4. Temporary utilities provided by Owner.
  5. Survey and building layout.
  6. Security and housekeeping procedures.
  7. Schedules.
  8. Application for payment procedures.
  9. Procedures for testing.
  10. Procedures for maintaining record documents.
  11. Requirements for start-up of equipment.
  12. Inspection and acceptance of equipment put into service during construction period.
- 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. Attendance Required:
1. Contractor.
  2. Owner.
  3. Architect.
  4. Contractor's superintendent.
- B. 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.
- C. 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 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 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. 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 in a format and with content acceptable to Owner.
  - 3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. 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. 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 6000 - Product Requirements)
    - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
  - 2. 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.
- D. 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.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. 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.
- G. Review Time: Architect will respond and return RFIs to Contractor within three (3) calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
- 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.
2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

### **3.06 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.

### **3.07 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 7800 - Closeout Submittals.

### **3.08 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.

### **3.09 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 7800 - 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.

### **3.10 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.

### **3.11 SUBMITTAL PROCEDURES**

- A. General Requirements:
  1. Use a separate transmittal for each item.
  2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
  3. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
  4. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
  5. 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.
  6. Schedule submittals to expedite the Project, and coordinate submission of related items.
    - a. For each submittal for review, allow 10 days excluding delivery time to and from the Contractor.
  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. 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.

### **3.12 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.
- D. Architect's and consultants' actions on items submitted for review:
  - 1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "No Exceptions Taken", or language with same legal meaning.
    - b. "Exceptions Noted, No Re-Submittal Required", or language with same legal meaning.
      - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
    - c. "Exceptions Noted, Re-Submit Record Copy", 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.
    - 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. "Received" - 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 3000**

**SECTION 01 3330**  
**STRUCTURAL SUBMITTALS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Structural submittals include shop drawings, design calculations, diagrams, illustrations, schedules, performance charts, nomenclature charts, samples, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier, fabricator, or distributor and which illustrate some portion of the Project.
- B. Submittals by the Contractor are not a part of the Contract Documents.

**1.02 RELATED SECTIONS**

- A. Section 01 33 00 - Submittals

**1.03 SUBMITTAL PROCEDURES**

- A. Prior to the initial submittal, Contractor shall submit to the Design Professional a completed Submittal Information and Schedules form given in Appendix I.
- B. Submittals shall be accompanied by a transmittal letter with the following information:
  - 1. Project name.
  - 2. Contractor's name.
  - 3. Date submitted.
  - 4. Description of items submitted; identify work and product by Specification Section.
  - 5. Number of drawings and other pertinent data.
- C. Provide blank space on each submittal for the Design Professional's review stamp.
- D. The type and number of submittals for each item shall be in accordance with Section 013000.
- E. Contractor shall direct specific attention on the submittal to any deviation from the Contract Documents.

**1.04 CONTRACTOR RESPONSIBILITY**

- A. Contractor shall make all submittals in advance of installation or construction to allow the Design Professional sufficient time for review.
- B. Contractor shall stamp and sign each sheet of shop drawings and product data, and sign or initial each sample to certify compliance with requirements of Contract Documents. SUBMITTALS RECEIVED WITHOUT THE CONTRACTOR'S STAMP OF REVIEW WILL BE RETURNED TO THE CONTRACTOR FOR REVIEW AND RESUBMITTAL.
- C. Contractor shall understand that the submittal of the required documents does not constitute compliance with the requirements of the Contract Documents; only submittals reviewed by the Design Professional constitute compliance.
- D. It is the Contractor's responsibility to furnish equipment, materials, and labor for the Project which meets the requirements of the codes and authorities quoted as well as the Contract Documents. Proprietary items specified herein only establish a minimum functional and aesthetic standard and it is incumbent upon the Contractor to ascertain conformance of these proprietary items or any proposed substitution with the codes and authorities.
- E. By reviewing, approving and submitting shop drawings, product data, or samples, Contractor thereby represents that he has determined and verified all field measurements, field construction criteria, materials, member sizes catalog numbers, and similar data and that he has checked and coordinated shop drawings with the requirements of the Project and of the Contract Documents.
- F. Work requiring shop drawings, whether called for by the Contract Documents or requested by the Contractor, shall not commence until the submission has been reviewed by the Design Professional. Work may commence if the Contractor verifies the accuracy of the Design Professional's corrections and notations and complies with them without exception and without requesting change in Contract Sum or Contract Time.

#### **1.05 DESIGN PROFESSIONAL REVIEW**

- A. Design Professional will review submittals with reasonable promptness.
- B. Design Professional's review or corrections refer only to the general arrangement and conformance of the subject of the submittals with the design concept of the project and with the information given in the Contract Documents. Under no conditions should the Contractor consider the review to include the dimensions, quantities, and details of the items nor the approval of an assembly in which the item functions.
- C. Design Professional's review shall not relieve the Contractor from responsibility for errors or omissions in the submittals.
- D. Design Professional's review of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has directed specific attention to the deviation at the time of submission and the Design Professional has given written approval to the specific deviation.
- E. Design Professional's review of submittals shall not be construed as authorizing any change in the Contract Sum or Contract Time.

#### **1.06 SHOP DRAWINGS**

- A. Present in a clear and thorough manner. Title each drawing with Project name and number; identify each element of drawings by reference to sheet number and detail of Contract Documents.
- B. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.
- C. Identify field dimensions; show relationship to adjacent or critical features of Work or products.
- D. A copy of the marked structural shop drawings with the Design Professional's review stamp is to be maintained at the job site.

#### **1.07 PRODUCT DATA**

- A. Submit only pages which are pertinent; mark each copy of standard printed data to identify pertinent products, referenced to Specification Section and Article number. Show reference standards, performance characteristics, and capacities; wiring and piping diagrams and controls; component parts; finishes; dimensions; and required clearances.
- B. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete information which is not applicable.
- C. Provide manufacturer's preparation, assembly, and installation instructions.

#### **1.08 SAMPLES**

- A. Submit full range of manufacturer's standard finishes except where more restrictive requirements are specified, indicating colors, textures, and patterns.
- B. Submit samples to illustrate functional characteristics of products, including parts and attachments as required by Design Professional.
- C. Approved samples which are of proper size may be incorporated in Work.
- D. Label each sample with identification.
- E. Field Finishes: Provide full samples at Project, at location acceptable to Design Professional, as required by individual Specification Section. Install each sample complete and finished. Acceptable finishes in place may be retained in completed work.

#### **1.09 RESUBMITTALS**

- A. When submittals are returned to the Contractor with the Design Professional's corrections the Contractor shall make the required corrections. Upon request, resubmit one corrected set.
- B. Contractor shall direct specific attention on the resubmittal to all revisions including those requested by the Design Professional on previous submission.

#### **1.10 DISTRIBUTION**



- A. Distribute reproductions of shop drawings, copies of product data, and samples which bear the Design Professional's review stamp to job site file, Record Documents file, subcontractors, suppliers, other affected contractors, and other entities requiring information.
- B. Work shall be in accordance with and performed from the reviewed drawings.

**PART 2 PRODUCTS**

Not Used.

**PART 3 EXECUTION**

Not Used.

**END OF SECTION 01 3330**

**APPENDIX I**  
**SUBMITTAL INFORMATION AND SCHEDULES**

PROJECT \_\_\_\_\_

CONTRACTOR \_\_\_\_\_

CONTRACTOR'S ADDRESS \_\_\_\_\_

PROJ. MANAGER \_\_\_\_\_

PHONE \_\_\_\_\_

FAX \_\_\_\_\_

SUPERINTENDENT \_\_\_\_\_

PHONE \_\_\_\_\_

FAX \_\_\_\_\_

MOBILIZATION DATE \_\_\_\_\_

**PROJECTED SUBMITTAL DATES**

| FOUNDATION,<br>CONCRETE &<br>REINFORCING |     | STRUCTURAL STEEL                     |     | MASONRY                      |     |
|------------------------------------------|-----|--------------------------------------|-----|------------------------------|-----|
| SUBMITTAL                                | DAT | SUBMITTAL                            | DAT | SUBMITTAL                    | DAT |
| Site Preparation & Equipment Information |     | Fabricator / Erect or Qualifications |     | Grout & Mortar Mix           |     |
| Concrete Mix Design                      |     | Anchor Bolt & Embedded Items         |     | Block Prism & Comp. Strength |     |
| Foundation Reinforcing                   |     | Erection & Detail Drawings           |     | Reinforcing                  |     |

|  |  |        |  |                                   |     |
|--|--|--------|--|-----------------------------------|-----|
|  |  |        |  | Written<br>Pro<br>ced<br>ure<br>s |     |
|  |  | Joists |  |                                   |     |
|  |  | Deck   |  | WOOD                              | DAT |
|  |  |        |  |                                   |     |

REMARKS: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

COMPLETED BY \_\_\_\_\_ DATE \_\_\_\_\_

END OF APPENDIX I

**SECTION 01 3553  
SECURITY PROCEDURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Security measures including .

**1.02 RELATED REQUIREMENTS**

- A. Section 01 5000 - Temporary Facilities and Controls: Temporary lighting.

**1.03 SECURITY PROGRAM**

- A. Protect Work , existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
- B. Initiate program in coordination with Owner's existing security system at project mobilization.

**1.04 ENTRY CONTROL**

- A. Restrict entrance of persons and vehicles into Project site and existing facilities.
- B. Allow entrance only to authorized persons with proper identification.

**1.05 PERSONNEL IDENTIFICATION**

- A. Provide identification badge to each person authorized to enter premises.
- B. Badge To Include: Personal photograph, name, assigned number , expiration date and employer.
- C. Require return of badges at expiration of their employment on the Work.

**1.06 GUARD SERVICE**

**1.07 RESTRICTIONS**

- A. Do not allow cameras on site or photographs taken except by written approval of Owner.
- B. Do no work on Sundays.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 3553**

**SECTION 01 4000  
QUALITY REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Inspection agencies and services.
- E. Control of installation.
- F. Mock-ups.
- G. Tolerances.
- H. Manufacturers' field services.
- I. Defect Assessment.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 4216 - Definitions.

**1.03 DEFINITIONS**

- A. 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 SUBMITTALS**

- A. See Section 01 3000 - 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.
- C. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.
    - i. Results of test/inspection.
    - j. Compliance with Contract Documents.
    - k. When requested by Architect, provide interpretation of results.
  - 2. 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.

2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- 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.

#### **1.05 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 in which the Project is located.

#### **1.06 REFERENCES AND STANDARDS**

- A. For products and 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 reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from Contract Documents by mention or inference otherwise in any reference document.

#### **1.07 TESTING AND INSPECTION AGENCIES AND SERVICES**

- A. Owner will employ and pay for services of an independent testing agency to perform specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

### **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. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- D. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- E. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- F. 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.
- G. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- H. 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. Testing Agency Duties:
  - 1. Test samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 3. Perform specified sampling and testing of products in accordance with specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
  - 5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
  - 6. Perform additional tests and inspections required by Architect.
  - 7. Submit reports of all tests/inspections specified.
- B. 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.

- C. 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 and to manufacturers' facilities.
  - 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.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. 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, and \_\_\_\_\_ as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
  - 1. Observer subject to approval of Architect.
  - 2. Observer subject to approval of Owner.
- C. 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 4000**



**SECTION 01 4216  
DEFINITIONS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

**1.02 DEFINITIONS**

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. 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.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 4216**

**SECTION 014525**  
**STRUCTURAL TESTING/INSPECTION AGENCY SERVICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section summarizes the responsibility of the Contractor and the Structural Testing/Inspection Agency in the performance of the testing/inspection specified in the Contract Documents.
- B. Neither the observation of the Design Professional in the administration of the contract, nor tests/inspections by the Testing/Inspection Agency, nor approvals by persons other than the Design Professional shall relieve the Contractor from his obligation to perform the work in accordance with the Contract Documents.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014000 - Quality Control Services.

**1.03 REFERENCES**

- A. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- B. ASTM E329 - Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction.
- C. American Council of Independent Laboratories - Recommended Requirements for Independent Laboratories Qualifications.

**1.04 SELECTION AND PAYMENT**

- A. Owner will employ and pay for the structural testing/inspection services that are required by the Contract Documents.
- B. Contractor shall pay for any additional structural testing/inspection required for work or materials not complying with Contract Documents due to negligence or nonconformance.
- C. Contractor shall pay for any additional structural testing/inspection required for his convenience.
- D. Qualifications: Minimum Special Inspector qualifications shall be per Table 1704.2 of 2022 Georgia State Amendments to the International Building Code (2018 Edition).

**1.05 STRUCTURAL TESTING/INSPECTION REQUIREMENT SUMMARY**

- A. Specific structural testing/inspection requirements are given in the following specification sections:

|                       |   |                                                        |
|-----------------------|---|--------------------------------------------------------|
| Specification 03 1000 | - | Concrete Formwork Inspection                           |
| Specification 03 2000 | - | Concrete Reinforcement Inspection                      |
| Specification 03 3000 | - | Concrete Testing/Inspection                            |
| Specification 03 6200 | - | Non-Shrink Grout Inspection                            |
|                       |   |                                                        |
| Specification 04 2200 | - | Masonry Testing/Inspection                             |
|                       |   |                                                        |
| Specification 05 1000 | - | Structural Steel Inspection                            |
| Specification 05 2000 | - | Steel Joists                                           |
| Specification 05 3000 | - | Metal Deck Inspection                                  |
|                       |   |                                                        |
| Specification 31 2301 | - | Excavating, Backfilling, and Compacting For Structures |

### **1.06 STATEMENT OF SPECIAL INSPECTIONS**

- A. Provide testing/inspection required to meet the provisions of the Schedule of Special Inspection Services below.

### **PART 2 MATERIALS**

Not Used.

### **PART 3 EXECUTION**

#### **3.01 STRUCTURAL PRECONSTRUCTION MEETING**

- A. A structural preconstruction meeting may be conducted at the construction site by the Design Professional to discuss quality issues. The parties involved may be the Design Professional, Contractor, Structural Testing/Inspection Agency, appropriate subcontractors, suppliers, and detailers.

#### **3.02 STRUCTURAL TESTING/INSPECTION AGENCY'S RESPONSIBILITIES**

- A. Cooperate with the Contractor and provide timely service.
- B. Upon arriving at the construction site, sign in and notify the Contractor of presence.
- C. Select the representative samples that are to be tested/ inspected.
- D. Perform tests/ inspections as outlined in Contract Documents, the applicable codes, and as directed by the Design Professional.
- E. Report work and materials not complying with Contract Documents immediately to the Contractor and Design Professional.
- F. Leave copies of field notes with the Contractor prior to leaving the construction site. Field notes shall include the message given to the Contractor, date, time of message, name of Contractor's representative informed, type and location of work or materials tested/inspected, whether the work or materials complies with Contract Documents and name of the Structural Testing/Inspection Agency's representative.
- G. Report and distribute results of tests/inspections promptly in the form of written reports as directed by the Design Professional.
- H. Structural Testing/Inspection Agency shall not alter requirements of Contract Documents, approve or reject any portion of the work, or perform duties of the Contractor.

#### **3.03 CONTRACTOR'S RESPONSIBILITIES**

- A. Provide copy of Contract Documents to the Structural Testing/Inspection Agency.
- B. Arrange the preconstruction meeting to discuss quality issues.
- C. Notify the Structural Testing/Inspection Agency sufficiently in advance of operations to allow assignment of personnel and scheduling of tests.
- D. Cooperate with Structural Testing/Inspection Agency and provide access to work.
- E. Provide samples of materials to be tested in required quantities.
- F. Furnish copies of mill test reports when requested.
- G. Provide storage space for Structural Testing/Inspection Agency's exclusive use, such as for storing and curing concrete testing samples.
- H. Provide labor to assist the Structural Testing/Inspection Agency in performing tests/inspections.

#### **3.04 OPTIONS**

- A. If the Structural Testing/Inspection Agency is located at such a distance from the project that travel expenses will be a consideration, or if the amount of sampling performed is minor, and by mutual agreement of the Design Professional and Contractor, the Contractor may be requested to take samples and forward them to the Structural Testing/Inspection Agency for testing/inspection.

**END OF SECTION 01 4525**

HABERSHAM COUNTY ANIMAL CONTROL  
2022-313

01 4525 - 3  
Structural Testing/Inspection Agency  
Services

SHEAR STRUCTURAL

VE CHANGES 03-07-2025

ALPHA SPEC SET 08-19-2025

**SECTION 01 5000  
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 and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Project identification sign.
- I. Field offices.

**1.02 TEMPORARY UTILITIES**

- A. Provide and pay for all electrical power, lighting, and water required for construction purposes.
- B. New permanent facilities may not be used.
- C. Use trigger-operated nozzles for water hoses, to avoid waste of water.

**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; DSL modem or faster.
  - 3. Facsimile Service: Minimum of one dedicated fax machine/printer, with dedicated phone line.

**1.04 TEMPORARY SANITARY FACILITIES**

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. New permanent facilities may not be used during construction operations.
- C. 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.

**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 SECURITY - SEE SECTION 01 3553**

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

**1.08 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 means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

**1.09 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.

**1.10 PROJECT IDENTIFICATION**

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Erect on site at location indicated.
- C. No other signs are allowed without Owner permission except those required by law.

**1.11 FIELD OFFICES**

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- 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.

**1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion 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.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION 01 5000**

**SECTION 01 5713**  
**TEMPORARY EROSION AND SEDIMENT CONTROL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for temporary and permanent erosion control structures indicated on drawings.
- B. Section 31 1000 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- C. Section 31 2200 - Grading: Temporary and permanent grade changes for erosion control.
- D. Section 31 3700 - Riprap: Temporary and permanent stabilization using riprap.
- E. Section 32 1123 - Aggregate Base Courses: Temporary and permanent roadways.

**1.03 REFERENCE STANDARDS**

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
- G. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Mulch: Use one of the following:
  - 1. Straw or hay.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

- C. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
  - 1. Average Opening Size: 30 U.S. Std. Sieve (0.600 mm), maximum, when tested in accordance with ASTM D4751.
  - 2. Permittivity:  $0.05 \text{ sec}^{-1}$ , minimum, when tested in accordance with ASTM D4491/D4491M.
  - 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
  - 4. Tensile Strength: 100 pounds-force (450 N), minimum, in cross-machine direction; 124 pounds-force (550 N), minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
  - 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.
  - 6. Tear Strength: 55 pounds-force (245 N), minimum, when tested in accordance with ASTM D4533/D4533M.
  - 7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
- D. Silt Fence Posts: One of the following, minimum 5 feet (1500 mm) long:
  - 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot (1.98 kg per linear m).
  - 2. Softwood, 4 by 4 inches (100 by 100 mm) in cross section.
  - 3. Hardwood, 2 by 2 inches (50 by 50 mm) in cross section.
- E. Gravel: See Section 32 1123 for aggregate.
- F. Riprap: See Section 31 3700.
- G. Concrete: See Section 03 3000.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.

#### **3.02 PREPARATION**

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

#### **3.03 SCOPE OF PREVENTIVE MEASURES**

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
  - 1. Width: As required; 20 feet (7 m), minimum.
  - 2. Length: 50 feet (16 m), minimum.
  - 3. Provide at each construction entrance from public right-of-way.
  - 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
  - 1. Provide linear sediment barriers:
    - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
    - b. Along the toe of cut slopes and fill slopes.
  - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
    - a. Slope of Less Than 2 Percent: 100 feet (30 m)..
    - b. Slope Between 2 and 5 Percent: 75 feet (23 m).
    - c. Slope Between 5 and 10 Percent: 50 feet (15 m).
    - d. Slope Between 10 and 20 Percent: 25 feet (7.5 m).
    - e. Slope Over 20 Percent: 15 feet (4.5 m).



- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
  - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
  - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
  - 1. Cover with polyethylene film, secured by placing soil on outer edges.
  - 2. Cover with mulch at least 4 inches (100 mm) thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches (150 mm) of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

### 3.04 INSTALLATION

- A. Traffic-Bearing Aggregate Surface:
  - 1. Excavate minimum of 6 inches (150 mm).
  - 2. Place geotextile fabric full width and length, with minimum 12 inch (300 mm) overlap at joints.
  - 3. Place and compact at least 6 inches (150 mm) of 1 1/2 to 3 1/2 inch (40 to 90 mm) diameter stone.
- B. Silt Fences:
  - 1. Store and handle fabric in accordance with ASTM D4873/D4873M.
  - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch (405 mm) high barriers with minimum 36 inch (905 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 4 inches (100 mm) in ground.
  - 3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch (710 mm) high barriers, minimum 48 inch (1220 mm) long posts spaced at 6 feet (1830 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
  - 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet (6 m), use nominal 32 inch (810 mm) high barriers with woven wire reinforcement and steel posts spaced at 4 feet (1220 mm) maximum, with fabric embedded at least 6 inches (150 mm) in ground.
  - 5. Install with top of fabric at nominal height and embedment as specified.
  - 6. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches (460 mm), with extra post.
  - 7. Fasten fabric to wood posts using one of the following:
    - a. Four nails per post with 3/4 inch (19 mm) diameter flat or button head, 1 inch (25 mm) long, and 14 gauge, 0.083 inch (2.11 mm) shank diameter.
    - b. Five staples per post with at least 17 gauge, 0.0453 inch (1.150 mm) wire, 3/4 inch (19 mm) crown width and 1/2 inch (12 mm) long legs.
  - 8. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
  - 9. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches (300 mm) high with post spacing not more than 4 feet (1220 mm).
- C. Temporary Seeding:
  - 1. When hydraulic seeder is used, seedbed preparation is not required.

2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft (0.5 kg per 100 sq m).
4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft (6 to 8 kg per 100 sq m).
5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch (12 to 25 mm) deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

### **3.05 MAINTENANCE**

- A. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches (13 mm) or more rainfall at the project site, and daily during prolonged rainfall.
- B. Repair deficiencies immediately.
- C. Silt Fences:
  1. Promptly replace fabric that deteriorates unless need for fence has passed.
  2. Remove silt deposits that exceed one-third of the height of the fence.
  3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- D. Place sediment in appropriate locations on site; do not remove from site.

### **3.06 CLEAN UP**

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

**END OF SECTION 01 5713**

**SECTION 01 5719**  
**TEMPORARY ENVIRONMENTAL CONTROLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Construction procedures to promote adequate indoor air quality after construction.

**1.02 PROJECT GOALS**

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
  - 1. Cleaning of ductwork is not contemplated under this Contract.
  - 2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
  - 1. Furnish products meeting the specifications.
  - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

**1.03 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.

**1.04 DEFINITIONS**

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

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Indoor Air Quality Management Plan: Describe, in detail, measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
  - 1. Submit not less than 60 days before enclosure of building.
  - 2. Identify potential sources of odor and dust.
  - 3. Identify construction activities likely to produce odor or dust.
  - 4. Identify areas of project potentially affected, especially occupied areas.
  - 5. Evaluate potential problems by severity and describe methods of control.
  - 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
  - 7. Describe cleaning and dust control procedures.
- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- D. Duct and Terminal Unit Inspection Report.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Low VOC Materials: See Section 01 6116.
- B. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

- C. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE Std 52.2.

### **PART 3 EXECUTION**

#### **3.01 CONSTRUCTION PROCEDURES**

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
  - 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
  - 2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
  - 3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
- D. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.
- E. HVAC equipment and supply air ductwork may be used for ventilation during construction:
  - 1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
  - 2. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
  - 3. Do not use return air ductwork for ventilation.
  - 4. Seal return air inlets or otherwise positively isolate return air system to prevent recirculation of air; provide alternate return air pathways.
- F. Do not store construction materials or waste in mechanical or electrical rooms.
- G. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
  - 1. Inspect duct intakes, return air grilles, and terminal units for dust.
  - 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
  - 3. Clean tops of doors and frames.
  - 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
  - 5. Clean return plenums of air handling units.
  - 6. Remove intake filters last, after cleaning is complete.
- H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- I. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

**END OF SECTION 01 5719**

**SECTION 01 6000  
PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. General product requirements.
- B. Transportation, handling, storage and protection.
- C. Product option requirements.
- D. Substitution limitations.
- E. Procedures for Owner-supplied products.
- F. Maintenance materials, including extra materials, spare parts, tools, and software.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- B. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- C. Section 01 7419 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

**1.03 REFERENCE STANDARDS**

- A. NEMA MG 1 - Motors and Generators; 2021.

**1.04 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 NEW PRODUCTS**

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. Use of products having any of the following characteristics is not permitted:
  - 1. Made using or containing CFC's or HCFC's.
  - 2. Made of wood from newly cut old growth timber.
  - 3. Containing lead, cadmium, or asbestos.
- C. Where other criteria are met, Contractor shall give preference to products that:
  - 1. If used on interior, have lower emissions, as defined in Section 01 6116.
  - 2. If wet-applied, have lower VOC content, as defined in Section 01 6116.
  - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
  - 4. Have longer documented life span under normal use.
  - 5. Result in less construction waste. See Section 01 7419
  - 6. Are Cradle-to-Cradle Certified.
  - 7. Have a published Environmental Product Declaration (EPD).
  - 8. Have a published Health Product Declaration (HPD).

- 9. Have a published Manufacturer's Inventory of Chemical Content.
- D. Motors: Refer to Section 22 0513 - Common Motor Requirements for Plumbing Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.
- E. Motors: Refer to Section 23 0513 - Common Motor Requirements for HVAC Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

## **2.02 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.

## **2.03 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 2500 - 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 7419.
- 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. Provide off-site storage and protection when site does not permit on-site storage or protection.
- H. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- I. Comply with manufacturer's warranty conditions, if any.
- J. Do not store products directly on the ground.
- K. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- L. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- M. Prevent contact with material that may cause corrosion, discoloration, or staining.
- N. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- O. 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 6000**

**SECTION 01 6116**  
**VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittal procedures.

**1.03 DEFINITIONS**

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Interior paints and coatings applied on site.
  - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Flooring.
  - 4. Products making up wall and ceiling assemblies.
  - 5. Thermal and acoustical insulation.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
  - 1. Exterior and interior paints and coatings applied on site.
  - 2. Exterior and interior adhesives and sealants applied on site, including flooring adhesives.
  - 3. Wet-applied roofing and waterproofing.
  - 4. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
  - 1. Stone.
  - 2. Concrete.
  - 3. Clay brick.
  - 4. Metals that are plated, anodized, or powder-coated.
  - 5. Glass.
  - 6. Ceramics.
  - 7. Solid wood flooring that is unfinished and untreated.

**1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- E. CHPS (HPPD) - High Performance Products Database; Current Edition.
- F. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.



- G. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- I. SCS (CPD) - SCS Certified Products; Current Edition.
- J. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.

**1.06 QUALITY ASSURANCE**

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
  - 1. Wet-Applied Products: State amount applied in mass per surface area.
  - 2. Paints and Coatings: Test tinted products, not just tinting bases.
  - 3. Evidence of Compliance: Acceptable types of evidence are the following;
    - a. Current UL (GGG) certification.
    - b. Current SCS (CPD) Floorscore certification.
    - c. Current SCS (CPD) Indoor Advantage Gold certification.
    - d. Current listing in CHPS (HPPD) as a low-emitting product.
    - e. Current CRI (GLP) certification.
    - f. Test report showing compliance and stating exposure scenario used.
  - 4. Product data submittal showing VOC content is NOT acceptable evidence.
  - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
  - 1. Evidence of Compliance: Acceptable types of evidence are:
    - a. Report of laboratory testing performed in accordance with requirements.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
  - 1. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
  - 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
  - 2. Joint Sealants: SCAQMD 1168 Rule.
  - 3. Paints and Coatings: Each color; most stringent of the following:
    - a. 40 CFR 59, Subpart D.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).
  - 4. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.

**PART 3 EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. Owner reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to Owner.
- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

**END OF SECTION 01 6116**

**SECTION 01 7000  
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. Surveying for laying out the work.
- E. Cleaning and protection.
- F. Starting of systems and equipment.
- G. Demonstration and instruction of Owner personnel.
- H. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- I. General requirements for maintenance service.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 3000 - Administrative Requirements: Submittals procedures.
- B. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

**1.03 SUBMITTALS**

- A. See Section 01 3000 - 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. Project Record Documents: Accurately record actual locations of capped and active utilities.

**1.04 QUALIFICATIONS**

- A. For demolition work, employ a firm specializing in the type of work required.
  - 1. Minimum of three years of documented experience.
- B. For surveying work, employ a land surveyor registered in the State in which the Project is located 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,
- C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.

- D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

#### **1.05 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. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. 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.
- F. 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. Minimize amount of bare soil exposed at one time.
  - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
  - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
  - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- G. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
  - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- H. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
  - 1. Pest Control Service: Weekly treatments.
- I. 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.

#### **1.06 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**

## **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 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; and \_\_\_\_\_.

- 2. Grid or axis for structures.
- 3. Building foundation, column locations, ground floor elevations, and \_\_\_\_\_.
- H. Periodically verify layouts by same means.
- I. 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 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.

### **3.07 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. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. 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.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

### **3.08 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.

### **3.09 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 7900 - Demonstration and Training.
- B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- D. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### **3.10 ADJUSTING**

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

### **3.11 FINAL CLEANING**

- A. Execute final cleaning prior to final project assessment.
- B. Use cleaning materials that are nonhazardous.
- C. 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.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

### **3.12 CLOSEOUT PROCEDURES**

- A. Make submittals that are required by governing or other authorities.
- B. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- C. 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.
- D. 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.
- E. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- F. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

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

**3.13 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 7000**



**SECTION 01 7419**  
**CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL**

**PART 1 GENERAL**

**1.01 WASTE MANAGEMENT REQUIREMENTS**

- A. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- B. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- C. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
  - 1. Aluminum and plastic beverage containers.
  - 2. Corrugated cardboard.
  - 3. Wood pallets.
  - 4. Clean dimensional wood.
  - 5. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
- D. Methods of trash/waste disposal that are not acceptable are:
  - 1. Burning on the project site.
  - 2. Burying on the project site.
  - 3. Dumping or burying on other property, public or private.
  - 4. Other illegal dumping or burying.
- E. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

**1.02 DEFINITIONS**

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
- C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- I. Return: To give back reusable items or unused products to vendors for credit.
- J. Reuse: To reuse a construction waste material in some manner on the project site.
- K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

- L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- N. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 WASTE MANAGEMENT PROCEDURES**

- A. See Section 01 3000 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 5000 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 6000 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01 7000 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

### **3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION**

- A. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- B. Meetings: Discuss trash/waste management goals and issues at project meetings.
- C. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
  - 1. As a minimum, provide:
    - a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
    - b. Separate dumpsters for each category of recyclable.
    - c. Recycling bins at worker lunch area.
  - 2. Provide containers as required.
  - 3. Provide adequate space for pick-up and delivery and convenience to subcontractors.
  - 4. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- D. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- E. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- F. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- G. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

**END OF SECTION 01 7419**

**SECTION 01 7800  
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 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 7000 - 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. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
  - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
  - 3. 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.
  - 4. 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.
  - 5. Reviewed shop drawings, product data, and samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- 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. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured depths of foundations in relation to finish first floor datum.
  - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 4. Field changes of dimension and detail.
  - 5. Details not on original Contract drawings.

### **3.02 OPERATION AND MAINTENANCE DATA**

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. 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.
- D. 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. For Each Product, Applied Material, and Finish:
  - 1. Product data, with catalog number, size, composition, and color and texture designations.
  - 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. 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.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions.

Include summer, winter, and any special operating instructions.

- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Additional Requirements: As specified in individual product specification sections.

### **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.

**END OF SECTION 01 7800**

**SECTION 01 7900  
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. Electrical systems and equipment.
  - 4. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
  - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
  - 2. Finishes, including flooring, wall finishes, ceiling finishes.
  - 3. Fixtures and fittings.
  - 4. Items specified in individual product Sections.

**1.02 SUBMITTALS**

- A. See Section 01 3000 - 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 as 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.

### **1.03 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. 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.
- D. 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 7900**

**SECTION 03 0516**  
**UNDERSLAB VAPOR BARRIER - STEGO**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sheet vapor barrier under concrete slabs on grade.

**1.02 REFERENCE STANDARDS**

- A. 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.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Samples: Submit samples of underslab vapor barrier to be used.
- E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Underslab Vapor Barrier:
  - 1. Water Vapor Permeance: Not more than 0.010 perms (0.6 ng/(s m<sup>2</sup> Pa)), maximum.
  - 2. Complying with ASTM E1745 Class A.
  - 3. Thickness: 15 mils (0.4 mm).
  - 4. Basis of Design:
    - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): [www.stegoindustries.com/#sle](http://www.stegoindustries.com/#sle).
    - b. Reef Industries, Inc.: [www.reefindustries.com](http://www.reefindustries.com).
    - c. W.R. Meadows, Inc.: [www.wrmeadows.com](http://www.wrmeadows.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

**3.02 INSTALLATION**

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches (150 mm).
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.

**END OF SECTION 03 0516**

**SECTION 03 1000**  
**CONCRETE FORMWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes the design and erection of formwork, shoring and reshoring for cast-in-place concrete and accessories.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 032000 - Concrete Reinforcement.
- C. Section 033000 - Cast-in-Place Concrete.

**1.03 REFERENCES**

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Standard Specifications for Structural Concrete.
- C. ACI 318 - Building Code Requirements for Structural Concrete.
- D. ACI 347 - Guide to Formwork for Concrete.
- E. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- F. ASTM E154 - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.

**1.04 SUBMITTALS**

- A. Product Data: For each of the following:
  - 1. Exposed surface form-facing material.
  - 2. Concealed surface form-facing material.
  - 3. Form liners.
  - 4. Form ties.
  - 5. Isolation joint filler.
  - 6. Inserts.
  - 7. Waterstops.
  - 8. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly and support of forms.
  - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
  - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.
    - a. Location of construction joints is subject to approval of the Architect.
  - 3. Indicate location of waterstops.
  - 4. Indicate form liner layout and form line termination details.
  - 5. Indicate proposed schedule and sequence of stripping of forms, shoring removal and reshoring installation and removal.

**PART 2 PRODUCTS**

**2.01 PERFORMANCE REQUIREMENTS**

- A. Concrete Formwork: Design, engineer, erect, shore and brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
  - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."

2. Design formwork to limit deflection of form-facing material to  $l/360$  of center-to-center spacing of supports.

## **2.02 FORM-FACING MATERIALS**

### **A. As-Cast Surface Form-Facing Material:**

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:
  - a. Plywood, metal, or other approved panel materials.
  - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    - 1) APA HDO (high-density overlay).
    - 2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
    - 3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
    - 4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

### **B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.**

1. Provide lumber dressed on at least two edges and one side for tight fit.

## **2.03 FORMWORK ACCESSORIES**

- ### **A. Formwork accessories that are embedded in concrete, including ties and hangers, shall be commercially manufactured products. Do not use nonfabricated wire form ties.**

## **2.04 FORM RELEASE AGENT**

- ### **A. Form release agent shall not bond with, stain, nor adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.**
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
  2. Form release agent for form liners shall be acceptable to form liner manufacturer.

## **2.05 FORM TIES**

- ### **A. Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.**
1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
  2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
  3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## **2.06 WATERSTOPS**

- ### **A. Waterstops at construction joints and control joints indicated by the Drawings shall be sized to suit the joints.**

## **2.07 DOVETAIL ANCHORS**

- ### **A. Dovetail anchors shall consist of 24 gage galvanized steel dovetail anchoring slots with filler strips and 16 gage galvanized dovetail anchors, unless otherwise noted on Drawings.**

## **2.08 VAPOR BARRIER**

- ### **A. Vapor barrier shall consist of polyethylene sheet. See Architect for thickness.**

## **2.09 ISOLATION JOINT FILLER**

- A. Asphalt impregnated premolded fiberboard isolation joint filler shall conform with ASTM D1751 and be 1/2-inch thick by full thickness of slab or joint, unless indicated otherwise on the Drawings.

## **2.10 CONSTRUCTION JOINTS**

- A. Provide key type steel forms by Vulcan screed joints, Burke Keyed Kold joint form or Form-A-Key.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION OF FORMWORK**

- A. Comply with ACI 301.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.
- C. Limit concrete surface irregularities as follows:
  - 1. Surface Finish-1.0: ACI 117 Class C, 1/2 inch (12 mm).
    - a. To be used on concrete surfaces not exposed to view.
  - 2. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
    - a. To be used on concrete surfaces exposed to view.
- D. Construct forms tight enough to prevent loss of concrete mortar.
  - 1. Minimize joints.
  - 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
  - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
  - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
  - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
  - 1. Provide and secure units to support screed strips
  - 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
  - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
  - 2. Locate temporary openings in forms at inconspicuous locations.
- I. Chamfer exterior corners and edges of permanently exposed concrete. Provide 3/4-inch chamfer at all corners.
- J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
  - 1. Determine sizes and locations from trades providing such items.
  - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
  - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
  - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Design Professional.
  - 3. Place joints perpendicular to main reinforcement.
  - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

- a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
- 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
- 6. Space vertical joints in walls per Specification 033000 Cast-In-Place Concrete.
  - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- 7. Provide construction joints in accordance with ACI 318.
- 8. Provide 1 1/2-inch-deep key type construction joints at end of each placement for slabs, beams, walls, and footings. Bevel forms for easy removal.
- 9. Remove loose particles and latency from surface prior to placing the next lift. Chip the surface to a depth sufficient to expose sound concrete.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
  - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
  - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement. Do not allow excess form release agent to accumulate in forms or come in contact with concrete surfaces against which fresh concrete will be placed.

### **3.02 CAMBER**

- A. Camber formwork for slabs and beams to compensate for anticipated deflections in formwork prior to hardening of concrete to maintain tolerances specified by ACI 117.
- B. Set screeds to a like camber to maintain specified concrete thickness.

### **3.03 FOUNDATION ELEMENTS**

- A. Form foundation elements if soil or other conditions are such that earth trench forms are unsuitable.
- B. Sides of foundation walls, and turned-down slabs shall be formed.
- C. Maintain minimum coverage of reinforcing steel as indicated on Structural Drawings.

### **3.04 INSTALLATION OF WATERSTOPS**

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
  - 1. Install in longest lengths practicable.
  - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
  - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
  - 4. Secure waterstops in correct position at 12 inches (305 mm) on center.
  - 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
    - a. Miter corners, intersections, and directional changes in waterstops.
    - b. Align center bulbs.
  - 6. Clean waterstops immediately prior to placement of concrete.
  - 7. Support and protect exposed waterstops during progress of the Work.

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

### **3.05 INSTALLATION OF EMBEDDED ITEMS**

- A. Set and secure embedded plates, bearing plates, and anchor bolts in accordance with approved setting drawings and in such a manner to prevent displacement during placement of concrete.
- B. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
- C. Install and secure in position required inserts, hangers, sleeves, anchors, and nailers.
- D. Install continuous vertical dovetail anchoring slots with filler strips at intersections of concrete and masonry walls unless indicated otherwise by the Drawings.
- E. Clean embedded items immediately prior to concrete placement.

### **3.06 VAPOR BARRIER**

- A. Where indicated on Drawings, place vapor barrier over sewer, piping, and granular subbase, but below conduits and ducts, and behind insulation and expansion joints at sidewalls.
- B. Lap vapor barrier six inches minimum at splices.
- C. Do not puncture vapor barrier.

### **3.07 REMOVING AND REUSING FORMS**

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
  - 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
  - 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
  - 1. Align and secure joints to avoid offsets.
  - 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### **3.08 SHORING AND RESHORING INSTALLATION**

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

### **3.09 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
  - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
  - 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

**END OF SECTION 03 1000**



**SECTION 03 2000**  
**CONCRETE REINFORCEMENT**

**PART 1 GENERAL**

**1.01 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.
- C. Section 031000 – Concrete Formwork
- D. Section 033000 – Cast-In-Place Concrete.

**1.02 REFERENCES**

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
- B. ACI 301 - Standard Specifications for Structural Concrete.
- C. ACI 318- Building Code Requirements for Structural Concrete.
- D. ASTM A1064- Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete Reinforcement.
- E. ASTM A615- Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- F. ASTM A706- Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
- G. AWS D1.4- Structural Weld Code - Reinforcing Steel.
- H. CRSI - Manual of Practice, and Documents 63 and 65.

**1.03 SUBMITTALS**

- A. Shop drawings:
  - 1. Notify Design Professional prior to detailing reinforcing steel shop drawings.
  - 2. Include placing drawings that detail fabrication, bending, and placement. Provide elevations of all wall reinforcement.
  - 3. Include locations of proposed construction joints for approval by EOR. Contractor to submit sequence of placing concrete.
  - 4. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement. Reinforcement detailing of standard hooks, splices and development lengths shall conform to ACI 318 unless noted otherwise on drawings.
  - 5. Include proposed field bending or cutting locations and cutting methods for approval by EOR.
  - 6. Written description of reinforcement without adequate sections, elevations, and details is not acceptable.
  - 7. All revisions to shop drawings shall be clouded.
  - 8. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.
- B. Submit a certification from each manufacturer or supplier stating that materials meet the requirements of the ASTM and ACI standards referenced.
- C. Submit mill test reports
- D. Submit manufacturer's data for tensile and compressive splicers.
- E. Submit manufacturer's data including installation recommendations for dowel adhesive.

**1.04 QUALITY ASSURANCE**

- A. Coordinate and schedule in a timely manner with the Structural Testing/Inspection Agency the following quality related items:
  - 1. Verify reinforcing steel for quantity, size, location, and support.
  - 2. Verify proper reinforcing steel concrete coverage.
  - 3. Inspect mechanical splice couplers and reinforcement welding.

- B. Structural Testing/Inspection Agency shall provide special inspections as required by Chapter 17 of the building code and as required by Specification 014525.
- C. The Structural Testing/Inspection Agency shall be qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

#### **1.05 STORAGE AND PROTECTING**

- A. Store reinforcing steel above ground so that it remains clean. Maintain steel surfaces free from materials and coatings which might impair bond.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Deformed reinforcing steel shall conform to ASTM A615, refer to Structural Drawings for grade (Grade 60 minimum).
- B. Welded steel wire fabric shall conform to ASTM A1064.

#### **2.02 ACCESSORY MATERIALS**

- A. Annealed steel tie wire shall be 16-1/2 gage minimum.
- B. Bar supports shall be plastic-tipped steel Class I bar supports conforming to CRSI Specifications. Concrete brick may be used to support reinforcement to obtain proper clearance from earth.

#### **2.03 SPLICERS**

- A. Tensile splicers shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength.
- B. Compression splicers shall be the mechanical type such that the compression stress is transmitted by end bearing held in concentric contact.

#### **2.04 DOWEL ADHESIVE**

- A. Adhesive for reinforcing dowels in existing concrete shall conform to ASTM C881-13, Type IV, Grade 3, CLASS A, B, & C except gel times and epoxy content. Adhesive shall consist of a two component adhesive system contained in side by side packaging connected to a mixing nozzle which thoroughly mixes the components as it is injected into the hole. Adhesive shall have passed ICC Evaluation Services, Inc. Acceptance Criteria 308 for long term creep and be specifically approved for use in cracked concrete.

### **PART 3 EXECUTION**

#### **3.01 FABRICATION**

- A. Fabricate steel in accordance with ACI 318 and CRSI standards.
- B. Bend bars cold. Do not heat or flame cut bars. No field bending of bars partially embedded in concrete is permitted, unless specifically approved Design Professional and checked by Testing and Inspection Agency for cracks.
- C. Weld only as indicated. Perform welding in accordance with AWS D1.4.
- D. Tag reinforcing steel for easy identification.

#### **3.02 INSTALLATION**

- A. Before placing concrete, clean reinforcement of foreign particles and coatings.
- B. Place, support on chairs, and secure reinforcement against displacement in accordance with ACI 318 and CRSI standards. Do not deviate from alignment or measurement. Maximum support spacing shall not exceed 48 inches.
- C. Place concrete beam reinforcement support parallel to main reinforcement.
- D. Install welded-wire reinforcement in longest practicable lengths.
  - 1. Locate welded wire fabric in the top third of slabs unless otherwise noted in drawings. WWF shall be supported on chairs.
  - 2. Overlap mesh one lap plus two inches at side and end joints. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wires.
  - 3. Support spacing of welded wire reinforcement shall not exceed 24 inches, unless noted otherwise on plans.

- E. Furnish and install dowels or mechanical splices at intersections of walls, columns and piers to permit continuous reinforcement or development lengths at such intersections.
- F. Maintain cover and tolerances in accordance with ACI and CRSI Specifications, unless indicated otherwise on Structural Drawings.
- G. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- H. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

**3.03 INSTALLATION TOLERANCES**

- A. Comply with ACI 117 for installation tolerances.

**3.04 SPLICES**

- A. Do not splice reinforcement except as indicated on Structural Drawings.
- B. Stagger splices in accordance with ACI 318.
- C. Tension couplers may be used and installed in accordance with manufacturer's specifications.

**3.05 DOWELS IN EXISTING CONCRETE**

- A. Install dowels and dowel adhesive in accordance with manufacturer's recommendations.
- B. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

**END OF SECTION 03 2000**

**SECTION 03 3000**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes cast-in-place concrete work indicated in the Contract Documents or otherwise required for proper completion of the work.

**1.02 RELATED SECTIONS**

- A. Section 013300 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.
- C. Section 031000 - Concrete Formwork.
- D. Section 032000 - Concrete Reinforcement.
- E. Section 036200 - Non-Shrink Grout.

**1.03 REFERENCES**

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 318 - Building Code Requirements for Structural Concrete.
- C. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- D. ASTM C33 - Standard Specification for Concrete Aggregates.
- E. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- F. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
- G. ASTM C138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- H. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
- I. ASTM C150 - Standard Specification for Portland Cement.
- J. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
- K. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
- L. ASTM C230 - Standard Specification for Flow Table or Use in Tests of Hydraulic Cement.
- M. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
- N. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
- O. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
- P. ASTM C618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- Q. ASTM E1155 - Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System.
- R. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.

**1.04 NOTICE**

- A. Notify Design Professional and Structural Testing/Inspection Agency not less than 48 hours prior to placing concrete.

**1.05 QUALITY ASSURANCE**

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Examine concrete in truck to verify that concrete appears properly mixed.
  - 2. Perform a slump test as deemed necessary for each concrete load. Record if water or admixtures are added to the concrete at the job site. Perform additional slump tests after job site adjustments.
  - 3. Concrete testing: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu yd. plus one sample for each additional 100 cu. yd.

- a. At a minimum, obtain 5 compressive strength tests for each concrete mixture per ACI 318.
4. Per composite sample taken, mold four standard cured specimens per set for compressive strength testing. For each set molded, record:
  - a. Slump
  - b. Air content
  - c. Unit weight
  - d. Temperature, ambient and concrete
  - e. Location of placement
  - f. Any pertinent information, such as addition of water, addition of admixtures, etc.
5. Report in writing, as directed by the Design Professional, on the same day that tests are performed. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing agency, concrete design compressive strength, location of concrete placement in structure, concrete mix proportions and materials, compressive breaking strength and type of break.
- B. The ready-mixed concrete plant shall be certified for conformance with the requirements of the National Ready Mix Concrete Association.
- C. Installer qualifications: Installer shall be experienced in placing concrete systems similar in complexity to this project as evidenced by 10 completed projects.
- D. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required in Specification 01 4525.

#### **1.06 CONCRETE MIX DESIGN**

- A. Establish concrete mix design proportions in accordance with ACI 318, Chapter 19 and 26 for each concrete strength noted on the contract drawings.
- B. Submit concrete mix designs. Include the following:
  1. Type and quantities of materials.
  2. Slump.
  3. Air content.
  4. Fresh unit weight.
  5. Aggregates sieve analysis.
  6. Design compressive strength.
  7. Location of placement in structure.
  8. Method of placement.
  9. Method of curing.
  10. Seven-day and 28-day compressive strengths.
- C. Concrete supplier shall submit certifications that the materials used meet applicable ASTM Specifications. Mix designs not conforming to the above will be rejected.
- D. Limits on cementitious material substitutes in concrete mix design:
  1. Fly ash (ASTM C618) 25%
  2. Slag Cement (ASTM C989) 30%
  3. Total of Fly Ash plus Slag Cement 40%

#### **1.07 SLUMP**

- A. Design concrete with a maximum slump of five inches.
- B. If a slump greater than five inches is desired it shall be achieved with a high-range water reducer. Design the concrete mix with a high range water reducer slump of two and one-half inches plus or minus one and one-half inches. The maximum slump after high-range water reducers are added shall be eight inches.

#### **1.08 FRESH UNIT WEIGHT**

- A. Normal weight concrete shall have a fresh unit weight of 140 to 152 pcf.

#### **1.09 AIR CONTENT**

- A. No entrained air content is required in concrete placed in the foundation.
- B. Provide entrained air content per the table below and exposure category specified on structural drawings. Tolerance on air content as delivered shall be +/-1.5 percent.

| Nominal maximum aggregate size, in.*                                                    | Air Content, percent |                            |
|-----------------------------------------------------------------------------------------|----------------------|----------------------------|
|                                                                                         | Exposure Class F1    | Exposure Classes F2 and F3 |
| 3/8                                                                                     | 6                    | 7.5                        |
| 1/2                                                                                     | 5.5                  | 7                          |
| 3/4                                                                                     | 5                    | 6                          |
| 1                                                                                       | 4.5                  | 6                          |
| 1-1/2                                                                                   | 4.5                  | 5.5                        |
| * See ASTM C33 for tolerance on oversize for various nominal maximum size designations. |                      |                            |

#### 1.10 WATER/CEMENT RATIO

- A. Concrete elements shall have a maximum water cement ratio of 0.50, unless noted otherwise.
- B. Air entrained concrete elements shall have a maximum water cement ratio of 0.45.
- C. Concrete elements within an aggressive environment (Exposure Class F2) shall have a maximum water/cement ratio of 0.45.

#### 1.11 SUBMITTALS

- A. Submit a concrete mix design as specified above for each type of concrete included in the work.
- B. Submit a certification from each manufacturer or supplier stating that materials meet the requirements of the ASTM and ACI standards referenced.
- C. Submit manufacturer's data including Product Data and installation instructions for the following items. Manufacturer's Data shall include the name of the manufacturer and date of the publication. All manufacturers' data shall be maintained at the project site by the contractor.
  - 1. Admixtures
  - 2. Curing materials
  - 3. Joint sealing materials
  - 4. Expansion joint filler
  - 5. Patching compounds
  - 6. Bonding agents

### PART 2 PRODUCTS

#### 2.01 MATERIALS

- A. Materials designated by specific manufacturer's trade names are approved, subject to compliance with the quality and performance indicated by the manufacturer. Instructions and specifications, published by the manufacturer of such materials are included in and are a part of these specifications. Upon request, provide certification from manufacturer or supplier that materials designated by reference to ASTM and ACI standards meet the requirements of these standards.

#### 2.02 CONCRETE STRENGTH

- A. Provide concrete strengths indicated on the Structural Drawings.

#### 2.03 CEMENTITIOUS MATERIALS

- A. Portland cement shall conform to ASTM C150, Type I.
- B. Blended Hydraulic Cement shall conform to ASTM C595, Type IL.
- C. Fly Ash shall conform to ASTM C618, Class C or F.
  - 1. Class F fly ash shall have a loss on ignition of less than five percent.
  - 2. Class C fly ash shall have a loss on ignition of less than one percent.
- D. Slag Cement shall conform to ASTM C989, Grade 100 or 120.

#### **2.04 AGGREGATE**

- A. Fine aggregate shall conform to ASTM C33.
- B. Coarse aggregate of gravel or crushed stone shall conform to ASTM C33, Class 3M. Size coarse aggregate in accordance with ACI 318.

#### **2.05 WATER**

- A. Water shall be potable and free of deleterious substances in accordance with ACI 318.

#### **2.06 AIR ENTRAINING AGENT**

- A. Air entraining agent shall conform to ASTM C260.

#### **2.07 WATER REDUCER**

- A. Water reducing agent shall conform to ASTM C494.

#### **2.08 HIGH-RANGE WATER REDUCER**

- A. High-range water reducers (superplasticizers) shall conform to ASTM C494.

#### **2.09 CHLORIDE**

- A. Use no chlorides of any form in concrete.

#### **2.10 CURING MATERIALS**

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.
  - 1. Color:
    - a. Ambient Temperature Below 50 deg F (10 deg C): Black.
    - b. Ambient Temperature between 50 deg F (10 deg C) and 85 deg F (29 deg C): Any color.
    - c. Ambient Temperature Above 85 deg F (29 deg C): White.
- D. Curing Paper: Eight-feet- (2438-mm-) wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.
- E. Water: Potable or complying with ASTM C1602/C1602M.
- F. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.
- G. Clear, Waterborne, Membrane-Forming, Nondissipating Curing Compound: ASTM C309, Type 1, Class B, certified by curing compound manufacturer to not interfere with bonding of floor covering].
- H. Clear, Waterborne, Membrane-Forming, Curing Compound: ASTM C309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering].
- I. Clear, Solvent-Borne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.
- J. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

#### **2.11 ACCELERATORS**

- A. Non-chloride accelerators shall conform to ASTM C494.

## **2.12 RETARDERS**

- A. Retarders shall conform to ASTM C494.

## **PART 3 EXECUTION**

### **3.01 HIGH-RANGE WATER REDUCERS**

- A. High-range water reducers are to be added at dosage recommended by the manufacturer. The slump of the concrete shall be one to four inches at the time the high-range water reducers are added. Do not permit fresh concrete containing superplasticizers to come in contact with fresh concrete not containing superplasticizers.

### **3.02 ADDITION OF WATER AT JOB SITE**

- A. Provide batch tickets indicating the amount of mix water withheld at the batch plant for each load of concrete delivered. Water may be added to the batch only if neither the maximum permissible water/cement ratio nor the maximum slump is exceeded.
- B. Water shall not be added to the batch after the required on-site testing has been performed.

### **3.03 PLACEMENT OF CONCRETE**

- A. Deposit concrete as near as practical to final position to prevent segregation of concrete.
- B. Do not use aluminum equipment in placing and finishing concrete.
- C. Place thickened slabs for partitions integral with floor slabs.
- D. Prepare place of deposit, mix, convey, place, and cure concrete in accordance with ACI 301 and ACI 318. Wet forms before placing concrete.
- E. Concrete Placement
1. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
    - a. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
    - b. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
  2. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
  3. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
    - a. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
  4. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M), but not to exceed the amount indicated on the concrete delivery ticket.
    - a. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
  5. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
    - a. If a section cannot be placed continuously, provide construction joints as indicated.
    - b. Deposit concrete to avoid segregation.
    - c. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
    - d. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301 (ACI 301M).
      - 1) Do not use vibrators to transport concrete inside forms



- 2) Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer.
  - 3) Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
  - 4) At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
6. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
- a. Do not place concrete floors and slabs in a checkerboard sequence.
  - b. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - c. Maintain reinforcement in position on chairs during concrete placement.
  - d. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - e. Level concrete, cut high areas, and fill low areas.
  - f. Slope surfaces uniformly to drains where required.
  - g. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
  - h. Do not further disturb slab surfaces before starting finishing operations.

### **3.04 TIME LIMIT**

- A. Deposit concrete within one and one-half hours after batching.

### **3.05 FINISHING FORMED SURFACES**

- A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
  - a. Patch voids larger than 1-1/2 inches (38 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1/2 inch (25 mm).
  - c. Tie holes do not require patching.
  - d. Surface Tolerance: ACI 117 Class C.
  - e. Apply to concrete surfaces not exposed to public view.
2. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
  - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1/4 inch (6 mm).
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class B.
  - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
3. ACI 301 Surface Finish SF-3.0:
  - a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
  - b. Remove projections larger than 1/8 inch (3 mm).
  - c. Patch tie holes.
  - d. Surface Tolerance: ACI 117 Class A.
  - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

### **3.06 CURING**

- A. Begin curing procedures immediately following the commencement of the finishing operation.
- B. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
1. Maintain moisture loss no more than 0.2 lb/sq. ft. x h (1 kg/sq. m x h), calculated in accordance with ACI 305.1, before and during finishing operations.

- C. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
  2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
  3. If forms remain during curing period, moist cure after loosening forms.
  4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
    - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
      - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
      - 2) Maintain continuity of coating and repair damage during curing period.
- D. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:
1. Begin curing immediately after finishing concrete.
  2. Interior Concrete Floors:
    - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
      - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - (a) Lap edges and ends of absorptive cover not less than 12-inches (300-mm).
        - (b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
        - (a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
        - (b) Cure for not less than seven days.
      - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
        - (a) Water.
        - (b) Continuous water-fog spray
    - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
      - 1) Absorptive cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
        - (a) Lap edges and ends of absorptive cover not less than 12 inches.
        - (b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
      - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides

- and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive.
- (a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
  - (b) Cure for not less than seven days.
- 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
- (a) Water.
  - (b) Continuous water-fog spray.
- c. Floors to Receive Polished Finish: Contractor has option of the following:
- 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
    - (a) Lap edges and ends of absorptive cover not less than 12 inches.
    - (b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
  - 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
    - (a) Water.
    - (b) Continuous water-fog spray.
- d. Floors to Receive Curing Compound:
- 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Maintain continuity of coating, and repair damage during curing period.
  - 4) Removal: After curing period has elapsed remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacture unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
- e. Floors to Receive Curing and Sealing Compound:
- 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
  - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
  - 3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

### 3.07 ENVIRONMENTAL PROVISIONS

#### A. Hot weather concrete

- 1. Procedure applies when concrete mix starts to exceed 77 degrees Fahrenheit.
- 2. Forms, reinforcing steel and subgrade shall be fogged or sprinkled with cool water. prior to concrete in placement.
- 3. Expedite all elements of the concrete placement.
- 4. Moist curing shall commence as soon as the surfaces are finished and shall continue for at least seven days.
- 5. Hot weather concreting shall comply with ACI 305.1.

#### B. Cold weather concrete

- 1. Procedure applies when a period of more than 3 successive days the average daily air temperature drops below 40 degrees Fahrenheit and stays below 50 degrees for more than one half of any 24-hour period.
- 2. Provide wind break or heated enclosure to protect freshly placed concrete.
- 3. During curing protect concrete with polyethylene sheets or insulating blankets for at least seven days.

4. In no instance shall the concrete temperature drop below 50 degrees Fahrenheit prior to stripping forms and reshoring the structure.
  5. Cold weather concreting shall comply with ACI 306.1.
- C. Protect concrete from drying and excessive temperature for the first seven days.
  - D. Protect fresh concrete from wind.

### **3.08 CONTRACTION JOINTS**

- A. Obtain Design Professional's approval for location of contraction joints.
- B. Do not place contraction joints in framed floors, composite slabs, or shear walls.
- C. Place contraction joints in slabs-on-grade with a maximum spacing of 36 times the slab thickness to form a regular grid. The long dimension of the grid shall not exceed 1.5 times the short dimension of the grid. Contraction joints may be saw cut after placement of concrete. Cut joints into concrete when cutting action does not tear, abrade or otherwise damage surface and before concrete develops random cracks. Sawing should be completed within the first six to 18 hours and never delayed more than 24 hours. Saw cuts shall be a depth equal to one-fourth the slab thickness by one-eighth inch wide. Alternately, in areas to receive carpeting or wood flooring contraction joints may be provided by preformed plastic strip inserts.
- D. Provide contraction joints in concrete foundation or retaining walls at a maximum spacing of 20-foot but not more than 1.5 or less than 0.7 times the wall height. Space contraction joints equally between column interruptions in the wall surface such as pedestals, corners, or construction joints. Coordinate location with Architect. Contraction joints shall be formed as a V-groove on both faces of the wall, 3/4-inch minimum depth.

### **3.09 CUTTING CONCRETE**

- A. Obtain Design Professional's written approval prior to cutting concrete for installation of other work.

### **3.10 PATCHWORK AND REPAIRS**

- A. Notify Design Professional of any defective areas in concrete to be patched or repaired. Repair and patch defective areas with non-shrink grout. Cut out defective areas over two inches in diameter to solid concrete, but not less than a depth of one inch. Make edges of cuts perpendicular to the concrete surface.

### **3.11 JOINT FILLING**

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least three months.
  2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

### **3.12 CONCRETE FINISHES**

- A. Finish concrete in accordance with ACI 301.
- B. Finish concrete slabs to flatness and levelness tolerances which correspond to FF 25/FL 20 minimum overall for composite of all measured values and FF 17/FL 12 minimum for any individual floor section.
- C. For concrete slabs to receive thin-set flooring, finish to flatness and levelness tolerances which correspond to FF 35/FL 25 minimum overall for composite of all measured values and FF 25/FL 20 minimum for any individual floor section.
- D. For concrete slabs to receive wood flooring, finish to flatness and levelness tolerances which correspond to FF 45/FL 30 minimum overall for composite of all measured values and FF 30/FL 20 minimum for any individual floor section.
- E. For metal deck construction, floors shall be finished to an FF 25.
- F. For shored construction, FL values do not apply if slab is tested after shoring is removed.

- G. Slabs, which do not meet the flatness and levelness criteria shall be repaired or replaced.

### 3.13 FIELD QUALITY CONTROL

- A. Special Inspections: Special inspector to perform field tests and inspections and prepare testing and inspection reports.
- B. Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
  - 1. Headed bolts and studs.
  - 2. Verification of use of required design mixture.
  - 3. Concrete placement, including conveying and depositing.
  - 4. Curing procedures and maintenance of curing temperature.
  - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
  - 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture for each 100 cubic yards per Section 1.
    - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 2. Slump: ASTM C143:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  - 3. Slump Flow: ASTM C1611:
    - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
    - b. Perform additional tests when concrete consistency appears to change.
  - 4. Air Content: ASTM C231 pressure method, for normal-weight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 5. Concrete Temperature: ASTM C1064:
    - a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
  - 6. Unit Weight: ASTM C138 fresh unit weight of structural concrete or ASTM C567 fresh unit weight of structural lightweight concrete.
    - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
  - 7. Compression Test Specimens: ASTM C31:
    - a. Cast and laboratory cure four 6-inch (150 mm) by 12-inch (300 mm) cylinder specimens for each composite sample. If testing agency chooses to use 4 inch by 8 inch cylinders an additional cylinder will be required.
  - 8. Compressive-Strength Tests: ASTM C39.
    - a. From each set:

- 1) Test one laboratory-cured specimen at seven days and two specimens at 28 days. Fourth specimen is to be held in reserve.
- b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated. If 4 inch by 8 inch cylinders are used, it shall be from a set of three specimens.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if both of the following conditions are met:
  - a. Every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength.
  - b. No compressive-strength test value falls below the specified compressive strength by: more than 500 psi (3.4 MPa) when specified compressive strength is less than or equal to 5000 psi (34.5 MPa) or more than 10 percent of specified compressive strength when the specified compressive strength is greater than 5000 psi (34.5 MPa).
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests:
  - a. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
  - b. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.

**END OF SECTION 03 3000**

**SECTION 03 3500  
CONCRETE FINISHING**

**CONCRETE FINISHING**

**1.01 SECTION 03 35 00 CONCRETE FINISHING**

**PART 1 GENERAL**

**2.01 SUMMARY**

- A. Section Includes:
  - 1. Double application cure-seal-hardener for new concrete floors.
  - 2. Precautions for avoiding staining concrete before and after application.
- B. Related Section:
  - 1. Cast-In-Place Concrete: Division 03 Cast-In-Place Concrete sections.

**2.02 REFERENCES**

- A. ASTM International (ASTM):
  - 1. ASTM C39 Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 2. ASTM C779 Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
  - 3. ASTM C805 Standard Test Method for Rebound Number of Hardened Concrete.
  - 4. ASTM C1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
  - 5. ASTM D3359 Standard Test Methods for Measuring Adhesion by Tape Test.
  - 6. ASTM G23 Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials (Withdrawn 2000).].

**2.03 ADMINISTRATIVE REQUIREMENTS**

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

**2.04 SUBMITTALS**

- A. See Section 01 3000-Administrative Requirements, for submittal procedures.
- B. Product Data: Submit product data, including manufacturer's SPEC-DATA® sheet, installation instructions and technical bulletins for specified products.
- C. Certificates: Manufacturer's certification that the installer is acceptable.
- D. Maintenance Data: Maintenance instructions, including precautions for avoiding staining after application. E.

**2.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Acceptable to the manufacturer.

**2.06 DELIVERY, STORAGE & HANDLING**

- A. General: Comply with Division 01 Product Requirements section.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
- D. Handling: Protect materials from dirt, corrosion, oil, grease and other contaminants.

**PART 2 PRODUCTS**

**3.01 MATERIAL**

- A. Manufacturer: Curecrete Distribution, Inc.

1. Contact: 1203 W. Spring Creek Place, Springville, UT 84663-0551; Telephone: (800) 998-5664, (801) 489-5663; Fax: (801) 489-3307; website: [www.ashfordformula.com](http://www.ashfordformula.com).

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1. Manufacturer's Representative: Steve Hutchings 770-490-9298 [shutchings@hughes.net](mailto:shutchings@hughes.net)
- B. Cure-Seal-Hardener: Ashford Formula, a water-based chemically reactive penetrating sealer and hardener that seals by densifying concrete so that water molecules cannot pass through but air and water vapor can, and allows concrete to achieve full compressive strength, minimizing surface crazing and eliminating dusting.
  1. Abrasion Resistance to Revolving Disks: At least a 32.5% improvement over untreated samples when tested in accordance with ASTM C779.
  2. Surface Adhesion: At least a 22% increase in adhesion for epoxy when tested in accordance with ASTM D3359.
  3. Hardening: As follows when tested in accordance with ASTM C39:
    - a. After 7 Days: An increase of at least 40% over untreated samples.
    - b. After 28 Days: An increase of at least 38% over untreated samples.
  4. Coefficient of Friction: 0.86 dry, 0.69 wet when tested in accordance with ASTM C1028.
  5. Rebound Number: An increase of at least 13.3% over untreated samples when tested in accordance with ASTM C805.
  6. Light Exposure Degradation: No evidence of adverse effects on treated samples when tested in accordance with ASTM G23.

#### **4.02 PRODUCT SUBSTITUTIONS**

- A. Substitutions: Substitutions: See Section 01 6000-Product Requirements.

### **PART 3 EXECUTION**

#### **5.01 MANUFACTURER'S INSTRUCTIONS**

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

#### **5.02 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared and are suitable for application of product.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **5.03 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.
- C. Do not use frozen material. Thaw and agitate prior to use.
- D. If construction equipment must be used for application, diaper all components that might drip oil, hydraulic fluid or other liquids.

#### **5.04 INSTALLATION.**

- A. All work must be performed by an applicator certified by the manufacturer. Certification credentials are required.
- B. New Concrete: 1st Application: Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application. 2nd Application: Apply 2nd application (spiff coat) of cure-seal-hardener closer to time of project turnover to owner. 2nd application shall include joint filling at this time.
  1. Spray on at rate of 200 ft<sup>2</sup>/gal (5 m<sup>2</sup>/L).



2. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 minutes without allowing it to dry out or become slippery. In hot weather, slipperiness may appear before the 30 minute time period has elapsed. If that occurs, apply additional cure-seal-hardener as needed to keep the entire surface in a non-slippery state for the first 15 minutes. For the remaining 15 minutes, mist the surface as needed with water to keep the material in a non-slippery state. In hot weather conditions, follow manufacturer's special application procedures.
3. When the treated surface becomes slippery after this period, lightly mist with water until slipperiness disappears.
4. Wait for surface to become slippery again, and then flush entire surface with water to remove all cure-seal-hardener residue.
5. Squeegee surface completely dry, flushing any remaining slippery areas until no residue remains.
6. Wet vacuum or scrubbing machines can be used in accordance with manufacturer's instructions to remove residue.

#### **5.05 PROTECTION**

- A. Protect installed floors for at least 3 months until chemical reaction process is complete.
  1. Do not allow traffic on floors for 3 hours after application.
  2. Do not allow parking of vehicles on concrete slab.
  3. If vehicles must be temporarily parked on slab, place dropcloths under vehicles during entire time parked.
  4. Do not allow pipe cutting using pipe cutting machinery on concrete slab.
  5. Do not allow temporary placement and storage of steel members on concrete slabs.
  6. Clean up spills immediately and spot-treat stains with degreaser or oil emulsifier.
  7. Clean floor regularly in accordance with manufacturer's recommendations.

**END OF SECTION 03 3500**

**SECTION 03 3511  
CONCRETE FLOOR FINISHES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface treatments for concrete floors and slabs.
- B. Concrete stains and dyes.
- C. Clear coatings.
- D. Color coatings.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.
- B. Section 09 6700 - Fluid-Applied Flooring.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate the work with concrete floor placement and concrete floor curing.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

**1.06 FIELD CONDITIONS**

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet (2.5 m) above the floor surface over each 20 foot (6 m) square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.

**PART 2 PRODUCTS**

**2.01 CONCRETE FLOOR FINISH APPLICATIONS**

- A. Concrete Stain:
  - 1. Use at following locations: As specified in the Drawings.
- B. Color Coatings:
  - 1. Use at following locations: As specified in the Drawings.
- C. High Gloss Clear Sealer
  - 1. Use at following locations: As specified in the Drawings.
- D. Slip Resistant Coating: High gloss clear sealer with plastic aggregate.
  - 1. Use at following locations: As specified in the Drawings.

**2.02 COATINGS**

- A. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.
  - 1. Number of Coats: Minimum of two.
  - 2. VOC: 100 g/L or less.
  - 3. Composition: Water-based, nonreactive.
- B. Semi-Gloss Clear Coating: Transparent, nonyellowing, acrylic polymer-based coating.
  - 1. Composition: Solvent-based.

2. Nonvolatile Content: 35 percent, minimum, when measured by volume.
3. Products:
  - a. Dayton Superior Corporation: [www.daytonsuperior.com](http://www.daytonsuperior.com)
  - b. Euclid Chemical Company: ULTRAGUARD: [www.euclidchemical.com](http://www.euclidchemical.com)
  - c. LATICRETE L&M: [www.lmcc.com](http://www.lmcc.com)
  - d. PROSOCO, Inc; LSGuard: [www.prosoco.com/consolideck](http://www.prosoco.com/consolideck)
  - e. SpecChem, LLC; Aqua Shine: [www.specchemllc.com](http://www.specchemllc.com)
  - f. W. R. Meadows, Inc; Deck-O-Grip W/B (slip-resistant): [www.wrmeadows.com](http://www.wrmeadows.com)
  - g. Substitutions: See Section 01 6000 - Product Requirements.
- C. Color Coating: Pigmented coating recommended by manufacturer for finishing concrete floors and slabs.
  1. Gloss: Satin.
  2. Color(s): As selected by Architect from manufacturer's standard range.
  3. Type: High solids acrylic; one-component; fast-curing.
- D. Clear Coating: Clear coating recommended by manufacturer for finishing concrete floors and slabs.
  1. Gloss: High gloss.
  2. Color(s): As selected by Architect from manufacturer's standard range.
  3. Type: High solids polyurethane; two-component.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

#### **3.02 GENERAL**

- A. Apply materials in accordance with manufacturer's instructions.

#### **3.03 COATING APPLICATION**

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

**END OF SECTION 03 3511**

**SECTION 03 3543  
POLISHED CONCRETE - PROSOCO**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Polished concrete system.
- B. Surface treatments for concrete floors and slabs.
- C. Densifiers and hardeners.
- D. Coatings.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Finishing of concrete surface; curing.
- B. Section 07 9200 - Joint Sealants.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. CPC: Concrete Polishing Council.

**1.04 REFERENCE STANDARDS**

- A. ANSI/NFSI B101.1 - Test Method for Measuring the Wet SCOF of Hard-Surface Walkways; 2020.
- B. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways; 2020.
- C. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Coating Systems; 2020.
- D. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces; 2009 (Reapproved 2020).
- E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.
- F. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces; 2018.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- H. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2023.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Product Data: Manufacturer's published data and installation instructions for concrete polishing system and finishing products, including manufacturer's installation instructions, information on compatibility of different products, and limitations.
- D. Product Data: Submit certification that products comply with regulations controlling use of volatile organic compounds.
- E. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- F. Installer's qualification statement.
- G. Executed warranty.

**1.06 QUALITY ASSURANCE**

- A. Comply with national, state, and local VOC regulations.

- B. Installer Qualifications:
  - 1. Company specializing in installing products specified in this section, having completed minimum of five projects of similar size and complexity.
  - 2. Company is listed applicator of concrete finishes, having completed manufacturer's training program.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.
- B. Store materials per manufacturer's product data sheets:
  - 1. Store containers upright in cool, dry, well-ventilated place, out of the sun, at temperature between 40 degrees F (8 degrees C) and 100 degrees F (38 degrees C).
  - 2. Store away from other chemicals and potential sources of contamination.
  - 3. Keep containers tightly closed when not in use.

#### **1.08 FIELD CONDITIONS**

- A. Ambient Conditions:
  - 1. Apply treatments and coatings when surface and air temperature is between 40 degrees F (8 degrees C) and 95 degrees F (35 degrees C).
  - 2. Apply treatments and coatings when surface and air temperature is expected to remain above 40 degrees F (8 degrees C) for a minimum of eight hours after application.
  - 3. Maintain ambient temperature of 50 degrees F (10 degrees C) minimum.
  - 4. Apply treatments and coatings during calm wind conditions; provide adequate ventilation of enclosed or confined area.
  - 5. Apply treatments and coatings minimum 24 hours after rain exposure; suspend application when rain is anticipated within 8 hours of application.
  - 6. Do not apply to frozen substrate.

#### **1.09 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the date of Substantial Completion of project.

### **PART 2 PRODUCTS**

#### **2.01 POLISHED CONCRETE SYSTEM**

- A. Polished Concrete System: Materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified sheen.
  - 1. Basis of Design: PROSOCO, Inc; Consolideck Polished Concrete System: [www.prosoco.com/consolideck](http://www.prosoco.com/consolideck)
  - 2. Elite Crete Systems: [www.elitecrete.com](http://www.elitecrete.com)
  - 3. Peach State Concrete Polishing: [www.peachstateepoxy.com](http://www.peachstateepoxy.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 SURFACE TREATMENTS**

- A. Cutting Aid: Clear, water-based blended surfactant treatment spray-applied to wet concrete.
  - 1. Product: PROSOCO, Inc; Consolideck First Cut: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
- B. Repair Material: Low-odor, liquid fill material.
  - 1. Product: PROSOCO, Inc; Consolideck Grind-N-Fill: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
- C. Cleaner: Pre-densifier concrete cleaner for existing slab surfaces.
  - 1. Product: PROSOCO, Inc; Consolideck Cleaner/Degreaser: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).

#### **2.03 DENSIFIERS AND HARDENERS**

- A. Liquid Densifier and Hardener: Penetrating chemical compound, reacts with concrete, filling pores, hardening, and dustproofing.

1. Composition: Lithium silicate.
2. VOC Content: 50 g/L or less.
3. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
4. Water Vapor Transmission: Zero perms compared to untreated sample when tested according to ASTM E96/E96M Method B.
5. UV Stability: No degradation or yellowing when tested in accordance with ASTM G154.
6. Product: PROSOCO, Inc; Consolideck LS: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).

## **2.04 COATINGS**

- A. Coatings, General:
  1. Treated Material Slip Resistance: High traction range when tested according to ANSI/NFSI B101.1 and ANSI/NFSI B101.3.
  2. Stain Resistance: No adverse effect when tested according to ASTM D1308.
  3. UV Stability: No degradation or yellowing when tested according to ASTM G154.
- B. Clear Coating:
  1. High Gloss: Film forming protective treatment.
    - a. Composition: Lithium silicate.
    - b. Adhesion: Greater than 10 percent increase in pull off strength compared to untreated sample when tested according to ASTM D4541.
    - c. Product: PROSOCO, Inc; Consolideck LSGuard: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
  2. Medium Gloss: Film forming protective treatment.
    - a. Product: PROSOCO, Inc; Consolideck PolishGuard: [www.prosoco.com/consolideck/#sle](http://www.prosoco.com/consolideck/#sle).
- C. Penetrating Sealer:

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that floor surfaces are clean and free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes and allow complete curing before application of concrete hardener and densifier. See Section 07 9200.

### **3.02 GENERAL**

- A. Apply materials in accordance with manufacturer's instructions.

### **3.03 PREPARATION**

- A. Protect adjacent non-coated areas from drips, overflow, and overspray; avoid contact with metal, glass, and painted surfaces; immediately remove excess material.

### **3.04 CONCRETE POLISHING**

- A. Grind and polish in multiple passes with each full pass in direction perpendicular to previous pass.
- B. Fill gaps, voids, and pop-outs during grinding operation.
- C. Apply densifier and hardener at specified rates and intervals.
- D. Final Polished Concrete Aggregate Exposure: Not to exceed CPC Class A - Cement Fines; cement fines, 85 to 95 percent; fine aggregates, 5 to 15 percent based on visual observation of overall area of polished floor versus Polished Concrete Aggregate Exposure Chart.
- E. Final Polished Concrete Appearance: CPC Level 4 - Highly Polished, image clarity value 70 to 100 percent with haze index less than 10.

### **3.05 PROTECTIVE TREATMENT**

- A. Apply coatings in accordance with manufacturer's instructions. Match approved mock-ups for color, texture, sealing, and workmanship.
- B. Apply manufacturer's recommended protective treatment material to clean, dry slab after mechanically polishing.
  - 1. High gloss protective treatment:
    - a. Stop spreading treatment material when drying begins.
    - b. Avoid overlapping treatment material.
    - c. Allow to dry tack-free before burnishing slab surface in accordance with manufacturer's recommendations.
    - d. Repeat treatment up to three coats.
  - 2. Medium gloss protective treatment:
    - a. Stop spreading treatment material when drying begins.
    - b. Avoid overlapping treatment material.
    - c. For increased gloss, allow final coat to dry before burnishing slab surface in accordance with manufacturer's recommendations.
  - 3. Low gloss protective treatment:
    - a. Allow to dry tack-free before burnishing slab surface in accordance with manufacturer's recommendations.
    - b. Repeat treatment up to two coats.
    - c. For reduced haze, allow final coat to dry before burnishing slab surface in accordance with manufacturer's recommendations.
  - 4. No gloss protective treatment: Do not burnish slab.
- C. Clean spills on slab surfaces immediately, with manufacturer's recommended chemicals and absorptive materials.
- D. No haze, white residue, streaking, or burnish marks permitted.

### **3.06 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Final Polished Concrete Appearance: Test image clarity value and haze index prior to application of sealer at a rate of three tests per 1000 sq ft of polished concrete.
  - 1. Image clarity: Test with Image Clarity Meter in accordance with ASTM D5767.
  - 2. Haze index: Test with Glossmeter in accordance with ASTM D4039.
  - 3. Match approved mock-ups for texture, appearance, and workmanship.

### **3.07 PROTECTION**

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Protect finished surface as required and as recommended by manufacturer of polishing system until date of Substantial Completion of project.

**END OF SECTION 03 3543**

**SECTION 03 6200**  
**NON-SHRINK GROUT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes non-shrink grout under base plates, bearing plates, and where specified in Contract Documents.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.

**1.03 REFERENCES**

- A. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- B. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).

**1.04 QUALITY ASSURANCE**

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Perform compressive strength tests in accordance with ASTM C109 with 2-inch x 2-inch cubes. Test one cube at three days, two cubes at seven days and three cubes at 28 days. Perform one test for each ten bags of grout used or one test in accordance with day of grouting.

**1.05 SUBMITTALS**

- A. Submit product data sheets for review.

**PART 2 PRODUCTS**

**2.01 GROUT**

- A. Provide a non-shrink, non-metallic grout that complies with ASTM C1107.
- B. Grout shall have a minimum compressive strength of 5000 psi at 28 days.

**2.02 WATER**

- A. Provide clean, potable water.

**PART 3 EXECUTION**

**3.01 HANDLING**

- A. Store and protect non-shrink grout from moisture and contamination.

**3.02 PREPARATION**

- A. Remove mud, dirt and other foreign materials from areas to be grouted.

**3.03 MIXING**

- A. Mix grout to its fluid, self-leveling consistency in accordance with manufacturers recommendations. Do not retemper grout. Do not exceed manufacturer's maximum limit on water content or use at a consistency which produces free bleeding. Mix grout in a paddle-type mortar mixer. Do not mix by hand.

**3.04 PLACEMENT**

- A. Consolidate grout to provide uniformity. Do not vibrate grout.
- B. Use forms to contain grout.

**3.05 PROTECTION**



- A. Protect grout and areas to be grouted from excessive heat and cold in accordance with manufacturer's specifications. Protect grout from excessive drying shrinkage resulting from wind or direct sunlight. Protect areas grouted from excessive vibrations for three days.

**END OF SECTION 03 6200**

**SECTION 04 0511**  
**MASONRY MORTARING AND GROUTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Mortar for masonry.
- B. Grout for masonry.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 2000 - Unit Masonry: Installation of mortar and grout.
- B. Section 04 7200 - Cast Stone Masonry: Installation of mortar.
- C. Section 08 1113 - Hollow Metal Doors and Frames: Products and execution for grouting steel door frames installed in masonry.

**1.03 REFERENCE STANDARDS**

- A. ASTM C5 - Standard Specification for Quicklime for Structural Purposes; 2018.
- B. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.
- D. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
- E. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- F. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- G. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- H. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- I. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
- K. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include design mix and indicate whether the Proportion or Property specification of ASTM C270 is to be used. Also include required environmental conditions and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.

**1.05 QUALITY ASSURANCE**

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

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

**1.07 FIELD CONDITIONS**

- A. Cold and Hot Weather Requirements: Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

## **PART 2 PRODUCTS**

### **2.01 MORTAR AND GROUT APPLICATIONS**

- A. Field-mix all mortar and grout.
- B. Mortar Mix Designs: ASTM C270, Property Specification.
  - 1. Exterior Masonry Veneer: Type N.
- C. Grout Mix Designs:
  - 1. Bond Beams and Lintels: 3,000 psi (21 MPa) strength at 28 days; 8-10 inches (200-250 mm) slump; provide premixed type in accordance with ASTM C 94/C 94M.

### **2.02 MATERIALS**

- A. Portland Cement: ASTM C150/C150M.
  - 1. Type: Type I - Normal; ASTM C150/C150M.
  - 2. Color: Standard gray.
- B. Masonry Cement: ASTM C91/C91M.
  - 1. Type: Type N; ASTM C91/C91M.
  - 2. Colored Mortar: Premixed cement as required to match Architect's color sample.
  - 3. Manufacturers:
    - a. Solomon Colors; Solomon Colors Concentrated A, H, and X Series:  
[www.solomoncolors.com](http://www.solomoncolors.com)
- C. Hydrated Lime: ASTM C207, Type S.
- D. Quicklime: ASTM C5, non-hydraulic type.
- E. Mortar Aggregate: ASTM C144.
- F. Grout Aggregate: ASTM C404.
- G. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
  - 1. Color(s): As selected by Architect from manufacturer's full range.
- H. Water: Clean and potable.

### **2.03 MORTAR MIXING**

- A. Thoroughly mix mortar ingredients using mechanical batch mixer, in accordance with ASTM C270 and in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper only within two hours of mixing.

### **2.04 GROUT MIXING**

- A. Mix grout in accordance with ASTM C94/C94M.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 for fine and coarse grout.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install mortar and grout to requirements of section(s) in which masonry is specified.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not displace reinforcement while placing grout.
- D. Remove excess mortar from grout spaces.

### **3.02 GROUTING**

- A. Use either high-lift or low-lift grouting techniques, at Contractor's option, subject to other limitations of Contract Documents.
- B. Low-Lift Grouting:
  - 1. Limit height of pours to 12 inches (300 mm).
  - 2. Limit height of masonry to 16 inches (400 mm) above each pour.
  - 3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
  - 4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.
- C. High-Lift Grouting:
  - 1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
  - 2. Place grout for spanning elements in single, continuous pour.

**END OF SECTION 04 0511**

**SECTION 05 1000**  
**STRUCTURAL STEEL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes fabrication and erection of structural steel indicated in the Contract Documents or otherwise required for proper completion of the work.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.
- C. Section 052000 - Steel Joists.
- D. Section 053000 - Metal Decking.

**1.03 REFERENCES**

- A. AISC - Code of Standard Practice for Steel Buildings and Bridges.
- B. AISC 360-16 - Standard Specification for Structural Steel Buildings, 15th Edition.
- C. RCSC - Specification for Structural Joints Using High-Strength Bolts.
- D. AWS A5.1 - Specification for Carbon Steel Electrodes for Shield Metal Arc Welding.
- E. AWS A5.5 - Specification for Low-Alloy Steel Covered Arc Welding Electrodes.
- F. AWS A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
- G. AWS A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
- H. AWS D1.1 - Structural Welding Code.
- I. ASTM A36 - Standard Specification for Structural Steel.
- J. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- K. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- L. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- M. ASTM F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength, Inch and Metric Dimensions.
- N. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Tubing in Rounds and Shapes.
- O. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- P. ASTM A563 - Standard Specifications for Carbon and Alloy Steel Nuts.
- Q. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- R. ASTM A992 - Standard Specification for Steel for Structural Shapes For Use in Building Framing
- S. ASTM F436 - Standard Specification for Hardened Steel Washers.
- T. ASTM F844 - Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
- U. ASTM A563 - Standard Specifications for Carbon and Alloy Steel Nuts.
- V. SSPC - Steel Structures Painting Manual.

**1.04 SUBMITTALS**

- A. Contact Design Professional prior to detailing structural steel shop drawings.
- B. Reproduction of Structural Drawings for shop drawings is not permitted. Electronic drawing files will not be provided to the Contractor.
- C. Submit shop drawings for review.
- D. Shop drawings shall clearly indicate the profiles, sizes, ASTM Grade, spacings and locations of all structural steel members, including connections, attachments, anchorages, framed openings, sizes and types of fasteners, method of tightening fasteners, cambers, and the number, type and spacing of the headed shear connectors.

- E. For connections and elements designed by the contractor, submit shop drawings and calculations sealed by an engineer licensed in the project state.
- F. For record only, submit written welding procedures for each type of welded joint used in accordance with Appendix E of the AWS Structural Welding Code. Submit manufacturer certifications for welding consumables/materials.
- G. Maintain at construction office mill certification that the steel supplied meets the specifications.
- H. Maintain at construction office certification that high strength bolts supplied meet the specifications.
- I. Submit certification that the fabricator meets the required qualifications. If fabricator must have an independent testing agency to inspect fabrication as required by these specifications, submit the name and qualifications of the independent testing agency.
- J. For each approved fabricator that is exempt from Special Inspections of shop fabrications and implementation procedures in accordance with Section 1704.2 of the Building Code, submit "Fabricator's Certificate of Compliance". Provide copies of fabricator's certification or building code evaluation services report and fabricator's quality control manual.
- K. Submit certification that the erector meets the required qualifications.
- L. Upon request, submit the erection sequence and procedures to be used by the steel erector.
- M. Manufacturer's recommendations for expansion anchor installation.
- N. Manufacturer's recommendations for adhesive anchor installation.
- O. Qualification Data: For Erector, manufacturer, professional engineer, land surveyor and testing agency.

#### **1.05 QUALITY ASSURANCE**

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Anchor Bolts
    - a. Anchor bolt size, configuration, and embedment shall be verified prior to placement of concrete.
  - 2. Welded Connections
    - a. Inspection shall be in accordance with AWS Structural Welding Code.
    - b. Visually inspect all field welded connections. Visual inspection of welded joints includes periodic examination of fitup.
    - c. Ultrasonically inspect 100% of the complete penetration welds.
    - d. Review approved welding procedures. Verify that welding procedures are being adhered to during field welding.
    - e. Verify welder qualifications.
  - 3. Bolted Connections
    - a. Inspection and testing shall be in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
    - b. Prior to visual and physical testing, tension testing using a calibration device must indicate tensions at least 5% in excess of the AISC minimum. Structural steel erector shall supply the tension calibration device.
    - c. Test a minimum of 10% of the bolted connections.
- B. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required by Specification 01 4525.

#### **1.06 FABRICATOR'S QUALIFICATIONS**

- A. Steel fabricator shall be certified by the American Institute of Steel Construction (AISC) Quality Certification Program for Conventional Steel Buildings (BU).
- B. Fabricator not certified by the AISC Quality Certification Program shall have fabrication procedures and fabricated steel tested and inspected by the Materials Testing and Special Inspection Agency contracted by the Owner. Payment of these tests and inspections shall be by the fabricator. Tests and inspections shall be performed by AWS Certified Welding Inspectors. Prior to delivery of structural steel to the project, submit copies of the inspection reports to the

Design Professional. The purpose of this inspection is to enable the testing/inspection agency to verify that, in general, the steel is being fabricated in accordance with the Contract Documents. A minimum of one trip per week is recommended. The first trip should be scheduled at the first requirement for inspections as required by IBC Chapter 17. Contact Design Professional prior to initial inspection. Tests and inspections shall include the following:

1. Examine mill test reports and verify that material being used is the same as the mill test reports.
2. Review the fabricator's written welding procedures. Verify that the fabricator's welding procedures are being followed. Verify that welders are certified with current papers and that they demonstrate proper techniques.
3. Observe high strength bolting procedures. Verify that shop installation of high strength bolts conform to AISC specifications.
4. Examine joint preparation for complete penetration joints. Ultrasonically inspect 100% of the complete penetration welds.
5. Examine fillet welds for proper size, profile, throat, porosity and end returns.
6. Examine steel members for lamellar tearing. Spot check dimensions and hole sizes.
7. Examine bolted areas for burrs.

#### **1.07 ERECTOR'S QUALIFICATION**

- A. Erector shall be experienced in erecting structural systems similar in complexity to this project as evidenced by 10 completed projects.
- B. Erector shall have a minimum of 5 years' experience in the erection of structural steel or is an AISC Certified Advanced Steel Erector.

#### **1.08 WELDER'S QUALIFICATIONS:** Qualify procedures and personnel in accordance with AWS D1.1.

#### **1.09 STORAGE**

- A. Store materials off ground to permit easy access for inspection and identification. Store steel members and packaged items in a manner that provides protection against contact with deleterious materials.

### **PART 2 PRODUCTS**

#### **2.01 ANCHOR ROD**

- A. Anchor rods shall conform to ASTM F1554, Grade 36 (unless noted otherwise on drawings) and shall be a headed rod or threaded rod with a double heavy hexagonal nut at the bottom of the threaded rod, Grade A563A, unless noted otherwise.
- B. Provide two heavy hexagonal nuts at the base of the anchor rod conforming to ASTM A563 Grade C with one plain steel washer between conforming to ASTM F844. Provide one hexagonal nut at the top with plate washer listed below.
- C. Provide 3/8-inch-thick plate washers (3-inch x 3-inch) in lieu of top steel washer on base plates with oversized holes conforming to ASTM A36, unless noted otherwise on drawings.

#### **2.02 ROLLED STEEL WIDE FLANGE, CHANNEL AND WT SHAPES**

- A. Rolled steel wide flange, channels and WT shapes shall conform to ASTM A992.

#### **2.03 PLATES, ANGLES AND BARS**

- A. Plates, angles and bars shall conform to ASTM A36.

#### **2.04 ROUND STRUCTURAL STEEL TUBING**

- A. Round structural steel tubing shall conform to ASTM 500, Grade C, 46 ksi minimum yield strength.

#### **2.05 RECTANGULAR STRUCTURAL STEEL TUBING**

- A. Rectangular structural steel tubing shall conform to ASTM A500, Grade C, 50 ksi minimum yield strength.

#### **2.06 NON-HIGH-STRENGTH FASTENERS**

- A. Non-high-strength bolts shall conform to ASTM A307, Grade A, 60 ksi minimum, where noted on the Structural Drawings.
- B. Hardened steel washers shall conform to ASTM F436.

#### **2.07 HIGH-STRENGTH FASTENERS**

- A. High-strength bolts shall conform to ASTM F3125 Type 1, 120 ksi as noted on the Structural Drawings.
- B. Provide 3/4-inch minimum diameter bolts, unless noted otherwise.
- C. Hardened steel washers shall conform to ASTM F436.
- D. Spline-type tension control bolts, plain hardened washers and suitable nuts are an acceptable alternate design bolt assembly.
- E. Do not use load indicating washers.

#### **2.08 HEADED STUDS**

- A. Headed steel studs shall conform to the requirements of AWS D1.1.
- B. Provide 3/4-inch diameter headed steel studs, unless noted otherwise.
- C. Provide heat-resistant ceramic arc shields with studs.

#### **2.09 EXPANSION ANCHORS**

- A. Expansion anchors shall have been evaluated by the ICC Evaluation Services, Inc. (ICC-ES) or IAPMO Uniform ES (UES) with a published evaluation report. Anchors shall be evaluated by ICC-ES Acceptance Criteria 193 and be specifically approved for use in cracked concrete. All anchors shall be approved for resisting wind and seismic loads.

#### **2.10 ADHESIVE ANCHORS**

- A. Adhesive anchors shall consist of:
  - 1. An all-thread steel anchor conforming to ASTM A307, Grade A or ASTM A36, zinc plated in accordance with ASTM B633, unless noted otherwise on the Structural Drawings, and
  - 2. An adhesive conforming to ASTM C881-02, Type IV, Grade 3, CLASS A, B, & C except gel times and epoxy content. Adhesive shall consist of a two-component adhesive system contained in side-by-side packaging connected to a mixing nozzle which thoroughly mixes the components as it is injected into the hole. Adhesive shall have passed ICC Evaluation Services, Inc. Acceptance Criteria 308 for long term creep and be specifically approved for use in cracked concrete.

#### **2.11 WELD ELECTRODES**

- A. E-70 series low hydrogen electrodes shall conform to AWS A5.1, A5.5, A5.17, or A5.20.
- B. Properly store electrodes to maintain flux quality.

#### **2.12 PAINT**

- A. Oxide primer shall conform to AISC Specifications, Code of Standard Practice, and SSPC Steel Structure Painting Manual, unless indicated otherwise.
- B. Paint primer shall be free of lead and chromate and shall comply with State and Federal volatile organic compound (VOC) requirements.
- C. Paint primer shall be compatible with finish coating.

#### **2.13 GALVANIZING**

- A. Galvanized coating shall conform to ASTM A123.
- B. Galvanize bolts, nuts, and washers in accordance with ASTM A153 when used to connect steel members that are specified to be galvanized.
- C. Expansion anchors or adhesive anchors specified to be galvanized shall be mechanically galvanized in accordance with ASTM B695, Class 65, Type I.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. Fabricate and erect structural steel in accordance with AISC Specifications and Code of Standard Practice.



- B. Notify Design Professional and Structural Testing/Inspection Agency at least 48 hours prior to structural steel fabrication and erection.

### **3.02 ANCHOR BOLT SETTING**

- A. Provide templates for setting anchor bolts. Position anchor bolts by using templates with two nuts to secure in place prior to placement of concrete.
- B. Do not erect steel where anchor bolt nuts will not have full threads.

### **3.03 CONNECTIONS**

- A. Provide a minimum of two fasteners at each bolted connection.
- B. Ensure fasteners are lubricated prior to installation.
- C. Provide high-strength bolted connections in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts using ASTM F3125 Bolts.
- D. Provide connections for expansion and contraction where steel beams connect to concrete walls or concrete columns and at expansion joints. Secure nuts on bolts against loosening. (Dent threads with a chisel.)

### **3.04 FASTENER INSTALLATION**

- A. Bolts shall be installed in holes of the connection and brought to snug tight condition. Tighten connection progressing systematically from the most rigid part to the free edges of the connection to minimize relaxation of the bolts.
- B. High-strength bolts installed shall have a hardened washer under the element turned in tightening.
- C. Installation and tightening of bolts shall conform to the RCSC Specification for Structural Joints Using High-Strength Bolts

### **3.05 HEADED STUDS**

- A. Headed studs shall be welded in accordance with AWS D1.1.
- B. Locate shear studs directly over the web of beams with flanges less than 0.3 inches thick.
- C. The minimum center spacing shall be 6 diameters along the longitudinal axis of the beam and 4 diameters transverse to the longitudinal axis of the beam.
- D. Where double rows of shear studs are required, begin double rows at each end of the beam.
- E. Remove shields after welding studs.

### **3.06 EXPANSION ANCHOR INSTALLATION**

- A. Install in accordance with manufacturer's recommendation.
- B. Minimum embedment shall be equal to 4.5 times the anchor diameter unless noted otherwise.

### **3.07 ADHESIVE ANCHOR INSTALLATION**

- A. Install in accordance with manufacturer's recommendation.
- B. Minimum embedment shall be equal to 4.5 times the anchor diameter unless noted otherwise.

### **3.08 WELDING**

- A. Comply with AWS D1.1 Structural Welding Code. Use prequalified weld procedures.
- B. Provide end returns where fillet welds terminate at end or sides. Returns shall be continuous for a distance of not less than two times the nominal size of the weld.
- C. Complete penetration joints shall be back gouged to sound metal before the second side is welded or have 1/4-inch root opening with 3/16 x 1 inch backing bar. Access holes are required. Filling access holes is not required.
- D. Remove all slag and weld splatter from deposited weld metal.

### **3.09 SPLICING**

- A. Splice members only where indicated unless authorized in writing by the Design Professional.
- B. Provide shim plates at bottom flange splice at continuous beam splices with different depths.

### **3.10 CUTTING**

- A. Do not use flame cutting to correct errors unless authorized in writing.

- B. Re-entrant corners shall have a minimum radius of one inch and be free of notches. Notches and gouges resulting from flame cutting shall be finished to a smooth appearance.

**3.11 MILL SCALE**

- A. Remove loose mill scale.

**3.12 BOLT HOLES**

- A. Cut, drill, or punch holes perpendicular to metal surfaces. Do not enlarge holes by burning. Drill or punch holes in bearing plates. Remove burrs.

**3.13 PAINTING**

- A. Paint steel that is not encased in concrete, plaster, or sprayed fireproofing. Do not shop paint in areas to be field welded, contact surfaces of slip critical connections, or areas to receive special finishes.
- B. Field paint as required steel that has been welded or that is unpainted after connections have been tightened.

**3.14 GALVANIZING**

- A. Galvanize shelf angles that support the exterior building veneer, for example brick shelf angles.
- B. Galvanize environmentally exposed steel, for example mechanical equipment or balcony supports.
- C. Touch-up welds and abrasions in galvanized members in accordance with ASTM A780.

**3.15 REPAIR**

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780.

**3.16 FIELD QUALITY CONTROL**

- A. Special inspector to perform the following special inspections in accordance with specification section 01 4525
  - 1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
  - 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1.
    - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1 and the following inspection procedures, at testing agency's option:
      - 1. Liquid Penetrant Inspection: ASTM E165.
      - 2. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      - 3. Ultrasonic Inspection: ASTM E164.
      - 4. Radiographic Inspection: ASTM E94.

**END OF SECTION 05 1000**

**SECTION 04 2000  
UNIT MASONRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete block.
- B. Clay facing brick.
- C. Mortar and grout.
- D. Reinforcement and anchorage.
- E. Flashings.
- F. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 6200 - Sheet Metal Flashing and Trim: Through-wall masonry flashings.
- B. Section 07 9200 - Joint Sealants: Sealing control and expansion joints.

**1.03 REFERENCE STANDARDS**

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
- D. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
- E. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2022.
- F. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- G. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- H. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.
- I. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- J. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
- K. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- L. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.
- M. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023a.
- N. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
- O. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
- P. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
- Q. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls; 2005.
- R. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.
- S. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum five 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.

#### **1.06 MOCK-UPS**

- A. Construct a masonry wall as a mock-up panel sized 8 feet (2.4 m) long by 6 feet (1.8 m) high; include mortar, accessories, structural backup, and flashings (with lap joint, corner, and end dam) in mock-up.
- B. Locate where directed.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

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

### **PART 2 PRODUCTS**

#### **2.01 CONCRETE MASONRY UNITS**

- A. Manufacturers:
  - 1. Standard of Quality: Georgia Masonry Supply Company, Adams Products, Oldcastle: [www.georgiamasonrystore.com](http://www.georgiamasonrystore.com)
  - 2. Block USA, CEMEX: [www.cemexusa.com](http://www.cemexusa.com)
  - 3. Argos Masonry: [www.argos-us.com](http://www.argos-us.com)
- B. Concrete Block: Comply with referenced standards and as follows:
  - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches (400 by 200 mm) and nominal depth of 8 inches (200 mm).
  - 2. Load-Bearing Units: ASTM C90, normal weight.
    - a. Hollow block, as indicated.
    - b. Exposed Faces: Manufacturer's standard color and texture where indicated.
  - 3. Nonloadbearing Units: ASTM C129.
    - a. Hollow block, as indicated.
    - b. Lightweight.
  - 4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
    - a. Performance of Units with Integral Water Repellent:
      - 1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
        - (a) No water visible on back of wall above flashing at the end of 24 hours.
        - (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour (0.05 L per hour) at the end of 24 hours.

- (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
- 2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
- 3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
- 4) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
- b. Use only in combination with mortar that also has integral water repellent admixture.
- c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
- d. Manufacturers:
  - 1) Standard or Split Face (as indicated on drawings for locations).
  - 2) Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 BRICK UNITS**

- A. Manufacturers:
  - 1. Basis of Design Manufacturer: Echelon, An Oldcastle Company:  
[www.echelonmasonry.com](http://www.echelonmasonry.com)
  - 2. Cherokee Brick: [www.cherokeebrick.com](http://www.cherokeebrick.com)
  - 3. General Shale Brick: [www.generalshale.com](http://www.generalshale.com)
  - 4. Meridian Brick LLC: [www.meridianbrick.com](http://www.meridianbrick.com)
  - 5. Substitutions: See section 01 6000 - Product Requirements.
- B. Facing Brick: ASTM C216, Type FBS Smooth, Grade SW.
  - 1. Color and texture to match Architect's sample.
  - 2. Nominal size: As indicated on drawings.
  - 3. Special shapes: Molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.

## **2.03 MORTAR AND GROUT MATERIALS**

- A. Masonry Cement: ASTM C91/C91M, Type N.
  - 1. Colored Mortar: Premixed cement as required to match Architect's color sample.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Grout Aggregate: ASTM C404.
- E. Water: Clean and potable.

## **2.04 REINFORCEMENT AND ANCHORAGE**

- A. Manufacturers:
  - 1. Blok-Lok Limited: [www.blok-lok.com](http://www.blok-lok.com)
  - 2. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com)
  - 3. WIRE-BOND: [www.wirebond.com](http://www.wirebond.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed billet bars; galvanized.
- C. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
  - 1. Anchor plates: Not less than 0.075 inch (1.91 mm) thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
  - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch (4.75 mm) thick.
  - 3. Vertical adjustment: Not less than 3-1/2 inches (89 mm).

## **2.05 FLASHINGS**

- A. Metal Flashing Materials: Stainless Steel, as specified in Section 07 6200.

- B. Membrane Asphaltic Flashing Materials:
  - 1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) (1.0 mm) minimum total thickness; 8 mil (0.20 mm) cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.
- C. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- D. Drip Edge: Stainless steel; angled drip with hemmed edge; compatible with membrane and adhesives.
- E. Lap Sealants and Tapes: As recommended by flashing manufacturer; compatible with membrane and adhesives.

## **2.06 ACCESSORIES**

- A. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available.
- B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
  - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
    - a. Manufacturers:
      - 1) Advanced Building Products, Inc: [www.advancedbuildingproducts.com](http://www.advancedbuildingproducts.com)
      - 2) Mortar Net Solutions: [www.mortarnet.com](http://www.mortarnet.com)
      - 3) York Manufacturing, Inc.: [www.yorkmfg.com](http://www.yorkmfg.com)
- C. Weeps:
  - 1. Color(s): As selected by Architect from manufacturer's full range.
  - 2. Manufacturers:
    - a. Blok-Lok Limited: [www.blok-lok.com](http://www.blok-lok.com)
    - b. Hohmann & Barnard, Inc: [www.h-b.com](http://www.h-b.com)
    - c. WIRE-BOND: [www.wirebond.com](http://www.wirebond.com)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## **2.07 MORTAR AND GROUT MIXING**

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
  - 1. Masonry below grade and in contact with earth: Type S.
  - 2. Exterior, loadbearing masonry: Type N.
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches (50 mm) or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches (50 mm).

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

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

### **3.02 COLD AND HOT WEATHER REQUIREMENTS**

- A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

### **3.03 COURSING**

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

- C. Concrete Masonry Units:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches (200 mm).
  - 3. Mortar Joints: Concave.
- D. Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches (200 mm).

### **3.04 PLACING AND BONDING**

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Interlock intersections and external corners, except for units laid in stack bond.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

### **3.05 WEEPS/CAVITY VENTS**

- A. Install weeps in veneer and cavity walls at 24 inches (600 mm) on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

### **3.06 CAVITY MORTAR CONTROL**

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar control panels continuously throughout full height of exterior masonry cavities during construction of exterior wythe, complying with manufacturer's installation instructions.

### **3.07 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER**

- A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches (400 mm) on center vertically and 36 inches (900 mm) on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches (200 mm) on center.

### **3.08 MASONRY FLASHINGS**

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
  - 1. Extend flashings full width at such interruptions and at least 6 inches (152 mm), minimum, into adjacent masonry or turn up flashing ends at least 1 inch (25.4 mm), minimum, to form watertight pan at nonmasonry construction.
  - 2. Remove or cover protrusions or sharp edges that could puncture flashings.
  - 3. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend laminated flashings to within 1/2 inch (12 mm) of exterior face of masonry and adhere to top of stainless steel angled drip with hemmed edge.
- C. Lap end joints of flashings at least 6 inches (152 mm), minimum, and seal watertight with flashing sealant/adhesive.

### **3.09 GROUTED COMPONENTS**

- A. Lap splices minimum 24 bar diameters.
- B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch (13 mm) of dimensioned position.
- C. Place and consolidate grout fill without displacing reinforcing.

### **3.10 CONTROL AND EXPANSION JOINTS**

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Size control joints as indicated on drawings; if not indicated, 3/4 inch (19 mm) wide and deep.

### **3.11 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 ft (6 mm/3 m) and 1/2 inch in 20 ft (13 mm/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 ft (3 mm/m) and 1/4 inch in 10 ft (6 mm/3 m); 1/2 inch in 30 ft (13 mm/9 m).
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch (minus 6.4 mm, plus 9.5 mm).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch (6 mm).

### **3.12 CUTTING AND FITTING**

- A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### **3.13 CLEANING**

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.
- C. Use non-metallic tools in cleaning operations.

### **3.14 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 2000**



**SECTION 04 7200  
CAST STONE MASONRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Architectural cast stone.
- B. Units required are:
  - 1. Exterior wall units, including sills and water tables.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 0511 - Masonry Mortaring and Grouting: Mortar for setting cast stone.
- B. Section 04 2000 - Unit Masonry: Installation of cast stone in conjunction with masonry.
- C. Section 07 9200 - Joint Sealants: Sealing joints indicated to be left open for sealant.

**1.03 REFERENCE STANDARDS**

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- C. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement; 2019.
- D. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- F. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- G. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- H. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
- I. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- J. ASTM C1364 - Standard Specification for Architectural Cast Stone; 2023.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Test results of cast stone components made previously by the manufacturer.
- C. Shop Drawings: Include elevations, dimensions, layouts, profiles, cross sections, reinforcement, exposed faces, arrangement of joints, anchoring methods, anchors, and piece numbers.
- D. Mortar Color Selection Samples.
- E. Verification Samples: Pieces of actual cast stone components not less than 6 inches (152 mm) square, illustrating range of color and texture to be anticipated in components furnished for the project.
- F. Manufacturer's Qualification Data: Documentation showing compliance with specified requirements.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. A firm with a minimum of 5 years experience producing cast stone of types required for project.

2. Adequate plant capacity to furnish quality, sizes, and quantity of cast stone required without delaying progress of the work.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver cast stone components secured to shipping pallets and protected from damage and discoloration. Protect corners from damage.
- B. Number each piece individually to match shop drawings and schedule.
- C. Store cast stone components and installation materials in accordance with manufacturer's instructions.
- D. Store cast stone components on pallets with nonstaining, waterproof covers. Ventilate under covers to prevent condensation. Prevent contact with dirt.
- E. Protect cast stone components during handling and installation to prevent chipping, cracking, or other damage.
- F. Store mortar materials where contamination can be avoided.
- G. Schedule and coordinate production and delivery of cast stone components with unit masonry work to optimize on-site inventory and to avoid delaying the work.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Architectural Cast Stone:

#### **2.02 ARCHITECTURAL CAST STONE**

- A. Cast Stone: Architectural concrete product manufactured to simulate appearance of natural granite, complying with ASTM C1364.
  1. Compressive Strength: As specified in ASTM C1364; calculate strength of pieces to be field cut at 80 percent of uncut piece.
  2. Freeze-Thaw Resistance: Demonstrated by laboratory testing in accordance with ASTM C1364.
  3. Surface Texture: Fine grained texture, with no bugholes, air voids, or other surface blemishes visible from distance of 20 feet (6 meters).
  4. Color: Selected by Architect from manufacturer's full range.
  5. Remove cement film from exposed surfaces before packaging for shipment.
- B. Shapes: Provide shapes indicated on drawings.
  1. Variation from Any Dimension, Including Bow, Camber, and Twist: Maximum of plus/minus 1/8 inch (3 mm) or length divided by 360, whichever is greater, but not more than 1/4 inch (6 mm).
  2. Unless otherwise indicated on drawings, provide:
    - a. Wash or slope of 1:12 on exterior horizontal surfaces.
    - b. Drips on projecting components, wherever possible.
    - c. Raised fillets at back of sills and at ends to be built in.
- C. Reinforcement: Provide reinforcement as required to withstand handling and structural stresses; comply with ACI CODE-318.

#### **2.03 MATERIALS**

- A. Portland Cement: ASTM C150/C150M.
  1. For Units: Type I, white or gray as required to match Architect's sample.
  2. For Mortar: Type I or II, except Type III may be used in cold weather.
- B. Coarse Aggregate: ASTM C33/C33M, except for gradation; granite, quartz, or limestone.
- C. Fine Aggregate: ASTM C33/C33M, except for gradation; natural or manufactured sands.

- D. Admixtures: ASTM C494/C494M.
- E. Water: Potable.
- F. Reinforcing Bars: ASTM A615/A615M, Grade 40 (40,000 psi) (280 MPa), deformed bars, galvanized.
  - 1. Galvanized in accordance with ASTM A767/A767M, Class I.
- G. Steel Welded Wire Reinforcement: ASTM A1064/A1064M, galvanized or ASTM A884/A884M, epoxy coated.
- H. Embedded Anchors, Dowels, and Inserts: Type 304 stainless steel, of type and size as required for conditions.
- I. Mortar: Portland cement-lime, as specified in Section 04 0511 ; do not use masonry cement.
- J. Cleaner: General-purpose cleaner designed for removing mortar and grout stains, efflorescence, and other construction stains from new masonry surfaces without discoloring or damaging masonry surfaces; approved for intended use by cast stone manufacturer and by cleaner manufacturer for use on cast stone and adjacent masonry materials.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine construction to receive cast stone components. Notify Architect if construction is not acceptable.
- B. Do not begin installation until unacceptable conditions have been corrected.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install cast stone components in conjunction with masonry, complying with requirements of Section 04 2000.
- C. Mechanically anchor cast stone units indicated; set remainder in mortar.
- D. Setting:
  - 1. Drench cast stone components with clear, running water immediately before installation.
  - 2. Set units in a full bed of mortar unless otherwise indicated.
  - 3. Fill vertical joints with mortar.
  - 4. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

#### **3.03 TOLERANCES**

- A. Joints: Make all joints 3/8 inch (9.5 mm), except as otherwise detailed.
  - 1. Rake mortar joints 3/4 inch (19 mm) for pointing.
  - 2. Remove excess mortar from face of stone before pointing joints.
  - 3. Point joints with mortar in layers 3/8 inch (9.5 mm) thick and tool to a slight concave profile.
  - 4. Leave the following joints open for sealant:
    - a. Head joints in top courses, including copings, parapets, cornices, sills, and steps.
    - b. Joints in projecting units.
    - c. Joints between rigidly anchored units, including soffits, panels, and column covers.
    - d. Joints below lugged sills and stair treads.
    - e. Joints below ledge and relieving angles.
    - f. Joints labeled "expansion joint".
- B. Installation Tolerances:
  - 1. Variation from Plumb: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m) or more.
  - 2. Variation from Level: Not more than 1/8 inch in 10 feet (3 mm in 3 m) or 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (9 mm) maximum.

3. Variation in Joint Width: Not more than 1/8 inch in 36 inches (3 mm in 900 mm) or 1/4 of nominal joint width, whichever is less.
4. Variation in Plane Between Adjacent Surfaces (Lipping): Not more than 1/16 inch (1.5 mm) difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

**3.04 REPAIR**

- A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet (6 m).
- B. Repair with matching touch-up material provided by the manufacturer and in accordance with manufacturer's instructions.
- C. Repair methods and results subject to Architect 's approval.

**3.05 CLEANING**

- A. Keep cast stone components clean as work progresses.

**3.06 PROTECTION**

- A. Protect completed work from damage.
- B. Clean, repair, or restore damaged or mortar-splashed work to condition of new work.

**END OF SECTION 04 7200**

**SECTION 05 2000**  
**STEEL JOISTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes the manufacture and erection of steel joists shown on the Drawings.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.
- C. Section 051000 - Structural Steel.
- D. Section 053000 - Metal Decking.

**1.03 REFERENCES**

- A. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- B. AWS D1.1 - Structural Welding Code.
- C. SJI - Standard Specifications for Open Web Steel Joists, K-Series.
- D. SJI - Standard Specifications for Longspan Steel Joists, LH-Series, and Deep Longspan Steel Joists, DLH-Series.

**1.04 DESIGN REQUIREMENTS**

- A. Steel joists and bridging shall be designed by an engineer licensed in the project state.
- B. Design joists and bridging in accordance with the Steel Joist Institute (SJI) Standard Specifications.
- C. Refer to Drawings for special design requirements, if any.
- D. Steel joist deflections shall be designed for L/240 under total load (dead + live) and L/360 under live load.

**1.05 SUBMITTALS**

- A. Submit certification letter stating compliance with SJI specifications.
- B. Submit detailed shop drawings showing layout of joist units, special connections, and accessories. Include the mark, number, type, location, and spacing of joists and bridging.
- C. Submit signed and sealed calculations by the design engineer for review.
- D. Upon request, submit mill test certificates.
- E. Upon request, submit written welding procedures for each type of welded joint used. Use prequalified joints.
- F. Upon request, submit the erection sequence and procedures to be used by the steel erector.

**1.06 QUALITY ASSURANCE**

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Visual inspection of bolted and welded connections.
  - 2. Verify installation of bridging or braces.
  - 3. Verify connections for top and bottom chords.
  - 4. Verify reinforcement of members for concentrated loads.
  - 5. Verify proper bearing.
- B. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required by Specification 01 4525.

**1.07 QUALIFICATIONS**

- A. Manufacturer shall verify that design and manufacture of joists conform with SJI Standard Specifications.

**1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Store and handle joists as recommended in SJI Standard Specifications.

## **PART 2 PRODUCTS**

### **2.01 ROLLED STEEL PLATES, SHAPES, AND BARS**

- A. Steel shall conform to SJI Standard Specifications.

### **2.02 UNFINISHED BOLTS, WASHERS, AND NUTS**

- A. Unfinished bolts shall conform to ASTM A307, Grade A, 60 ksi minimum tensile strength. Provide compatible hexagonal nuts and plain washers.

### **2.03 WELD ELECTRODES**

- A. E-70 series low hydrogen electrodes conforming to AWS A5.1 or A5.5, A5.17 or A5.20.
- B. Provide proper storage for electrodes to maintain flux quality.

### **2.04 PAINT**

- A. Primer shall conform to AISC Specifications and Code of Standard Practice and SSPC Steel Structures Painting Manual.

## **PART 3 EXECUTION**

### **3.01 MANUFACTURE AND ERECTION**

- A. Manufacture and erect joists in accordance with SJI Standard Specifications.
- B. Members shall have parallel top and bottom chords unless otherwise indicated.
- C. Fabricate bearings which rest on sloped surfaces with a slope which conforms to that of the support unless otherwise approved.
- D. Provide for connections of kickers and hangers to members.
- E. Provide bottom chord extensions at columns and as indicated by the Contract Drawings. Weld bottom chords to members after dead loads have been applied.
- F. Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord (not suspended ceilings). Extend ends to within 1/2 inch of the finished wall surface unless otherwise indicated.
- G. Camber joists according to SJI Standard Specifications. Negative camber and bent joists are unacceptable.
- H. Do not erect joists until supporting work is secured.
- I. Provide bridging complying with SJI Standard Specifications. Provide for connections where bridging terminates.

### **3.02 CONCENTRATED LOADS ON JOISTS**

- A. Concentrated loads not shown on Drawings must be verified by joist manufacturer for adequacy of joist design. The necessity of any reinforcement required for concentrated loads applied to either the top or bottom chord shall be designed by joist manufacturer.

### **3.03 HEADER UNITS**

- A. Provide header units to support openings in floor or roof system not framed with steel shapes.

### **3.04 SHOP PAINTING**

- A. Remove loose scale, heavy rust, and other foreign materials from joists and accessories before application of shop paint.
- B. Apply one shop coat of steel joist primer paint to joists and accessories, by spray, dipping, or other method to provide a continuous dry paint film thickness of not less than 1.50 mil.

### **3.05 BEARING**

- A. Extend ends of steel joists not less than 4 inches over masonry and concrete supports. Extend ends of joists not less than 2-1/2 inches over steel supports. Positive attachment to support shall be made by welding or bolting. In such cases where a shorter end bearing length must be used, such condition must be designed.
- B. "U" type anchors are not acceptable unless authorized in writing.

### **3.06 WELDING**

- A. Perform welding in accordance with AWS D1.1 "Structural Welding Code". Use AWS Certified Welders.
- B. Weld ends of joists resting on steel supports with the minimum weld specified by the SJI standard specifications, unless otherwise indicated on Contract Drawings.
- C. Remove all slag and weld splatter from deposited weld material.

### **3.07 BRIDGING INSTALLATION**

- A. Permanently fasten bridging before the application of loads.
- B. In areas where joists will be exposed to view, align bridging in straight rows to create uniform appearance.

### **3.08 PROTECTION**

- A. Provide means for adequate distribution of concentrated loads so that carrying capacity of joists is not exceeded during construction.
- B. Provide temporary bridging, bracing, connections, and anchors to ensure lateral stability during construction.
- C. Joists damaged during construction shall be replaced or repaired with procedures submitted by the joist manufacturer.

### **3.09 REPAIRS**

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Touchup Painting:
  - 1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
    - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
    - b. Apply a compatible primer of same type as primer used on adjacent surfaces.

### **3.10 CUTTING**

- A. Do not field cut or apply heat to joists unless authorized in writing.

### **3.11 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner shall engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds according to AWS D1.1.
  - 1. In addition to visual inspection, test field welds according to AWS D1.1 and the following procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E165.
    - b. Magnetic Particle Inspection: ASTM E709.
    - c. Ultrasonic Testing: ASTM E164.
    - d. Radiographic Testing: ASTM E94.
- C. Visually inspect bolted connections.
- D. Prepare test and inspection reports.

**END OF SECTION 05 2000**

**SECTION 05 3000**  
**METAL DECKING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes metal decking as indicated on Drawings, specified herein, and needed for a complete and proper installation.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.
- C. Section 051000 - Structural Steel.
- D. Section 052000 - Steel Joists.

**1.03 REFERENCES**

- A. AISI - Specifications for the Design of Cold-Formed Steel Structural Members.
- B. AWS D1.1 - Structural Welding Code.
- C. AWS A5.5 - Specifications For Low Alloy Steel Covered Arc-Welding.
- D. SDI - Basic Design Specifications.
- E. SDI - Steel Roof Deck Design Manual.
- F. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
- G. AWS D1.3 – Specification for Welding Sheet Steel in Structures.

**1.04 SUBMITTALS**

- A. Notify the Design Professional prior to detailing shop drawings.
- B. Submit detailed shop drawings showing layout and types of deck panels, weld sizes, weld patterns and conditions requiring closure panels, finishes, supplementary framing, sump pans, cant strips, cut openings, special jointing or other accessories. Include calculations and required information if not completely covered by load tables and products data.
- C. Submit mill certification that the steel supplied meets the required specifications.
- D. Submit written welding procedures.
- E. Submit manufacturer's specifications, section properties, load tables, diaphragm shear tables, noise reduction coefficients (if applicable) and installation instructions for each type of decking and accessories. Include manufacturer's certifications to show compliance with supplementary framing, sump pans, cant strips, curb openings, special jointing and other accessories.

**1.05 QUALITY ASSURANCE**

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Verify placement of deck for alignment and proper lap.
  - 2. Verify welds for size and pattern.

**1.06 DELIVERY, STORAGE AND HANDLING**

- A. Protect steel deck from corrosion, deformation and other damage during delivery, storage and handling. Store materials off ground to permit easy access for inspection and identification. Store steel members and packaged items in a manner that provides protection against contact with deleterious materials. Protect with a waterproof covering and ventilate to avoid condensation.

**1.07 DEFINITIONS**

- A. Dovetail Deck – Roof deck panels shall have a continuous dovetail shaped ribs spaced 8 inches on center and formed with the following nominal dimensions: 3-1/2 inches in depth, 3/4 inch rib opening at the bottom, 3-inch rib width at top.
- B. Aggressive Environment for Metal Deck – Any interior space where a deck is directly exposed to a pool and any exterior space where a deck is exposed to weather.

**PART 2 PRODUCTS**



## 2.01 GENERAL

- A. Provide metal deck sheets of three spans minimum wherever possible.
- B. AISI Specifications Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- C. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- D. Composite deck formed from steel sheets having a minimum yield strength of 50,000 pounds per square inch shall conform to ASTM A653 or A1008. Provide roof deck types and gauges as indicated on Drawings.
- E. Provide phosphatized/painted finish on the exposed side of the deck. The side to be in contact with the concrete may be uncoated unless galvanized deck is indicated on the Drawings.
- F. Provide galvanized closures for columns, girders, where panels change direction, and end closures for panels not closed by bent plates or other means.

## 2.02 ROOF DECK

- A. Metal roof deck formed from steel sheets shall conform to ASTM A653 structural quality (SQ). Provide roof deck types, minimum grades and gauges as indicated on Drawings.
- B. Before forming, the steel sheets shall receive a hot-dip protective coating of zinc conforming to ASTM A924 with the following minimum coating class, as defined in ASTM A653:
  - 1. Aggressive Environment                      G90
  - 2. All other locations                              G60

Provide accessories, clips, and other items as required.
- C. Roof deck that will be painted in the field (coordinate with Design Professional), shall comply with these additional requirements:
  - 1. Before fabrication of the panel, all surfaces of the galvanized sheet steel shall be processed through a continuous coil coating line, designed to degrease and clean the metal, followed by a chemical conversion coating to etch the surface for proper bond characteristics. The roof deck shall then be coated with a 0.2 mil epoxy primer, oven baked and recoated with a 0.5 mil polyester primer and rebaked. This coil coated prime finish shall be applied to both sides of the material.
  - 2. For deck within aggressive environments, after fabrication or assembly of the panel, the exposed surface and the inside periphery of the perforations shall receive the factory applied epoxy primer. The primer shall be oven cured to enhance adhesion and durability characteristics.
  - 3. Compatibility of all field applied finish paint with the factory applied primer shall be the responsibility of the painting contractor.
- D. Provide roof deck units with flush, nested 2-inch end laps and nested side laps, unless otherwise indicated or specified. Provide deck configurations complying with SDI "Basic Design Specifications".

## 2.03 GALVANIZING REPAIR PAINT

- A. ASTM A780 – SSPC Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

## 2.04 REPAIR PAINT

- A. Manufacturer's standard rust-inhibitive primer of same color as primer. Coordinate with Architect.

## PART 3 EXECUTION

### 3.01 GENERAL

- A. Load conditions shall be in accordance with Steel Deck Institute sequential loading formulas.

- B. Installer must examine the areas and conditions under which metal decking is to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- C. Locate deck bundles to prevent overloading of supporting members.

### **3.02 PLACEMENT**

- A. Place steel deck units on supporting steel framework and adjust to final position before permanently fastening. Install deck units and accessories in accordance with manufacturer's recommendations and the Drawings, and as specified herein.

### **3.03 CUTTING**

- A. Cut holes in deck indicated by the Drawings. Other holes required shall be supplied by those requiring them. Obtain written authorization for additional holes and cutting not indicated on erection drawings.

### **3.04 WELDING**

- A. Perform welding in accordance with AWS Structural Welding Code.
- B. Provide weld washers for deck thinner than 22 gauge.

### **3.05 CONCENTRATED LOADS**

- A. Do not hang concentrated loads exceeding 50 pounds from the deck. Only one such load is allowed per span of the deck. Must be spaced minimum 4'-0" from next concentrated load.

### **3.06 DECK SUPPORTS**

- A. Fasten deck to steel framework at ends and at each intermediate support by welding according to manufacturer's specifications unless indicated otherwise on structural drawings or otherwise specified herein. Do not weld deck in place until all bolted and welded connections for the structural frame are complete. A minimum of one floor over the area to be decked is to be bolted and welded prior to welding deck in place.

### **3.07 ROOF DECK**

- A. Place roof deck in straight alignment. Lap ends of sheets two inches.
- B. Attach side laps of roof deck with as shown on the Drawings. Fasteners for side laps and overlying roofing material in dovetail deck shall be concealed within the depth of the dovetail shaped ribs. Within aggressive environments, fasteners shall be stainless steel.
- C. Fasten roof deck in place as shown on the Drawings.

### **3.08 REPAIR**

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780 and manufacturer's written instructions. Puddle welds to be painted only if deck is exposed in final condition.
- B. Repair Painting:
  - 1. Wire brush and clean rust spots, welds, and abraded areas on surface of prime-painted deck immediately after installation and apply repair paint. Coordinate with manufacturer's specifications.
  - 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

### **3.09 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner shall engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Prepare test and inspection reports.

**END OF SECTION 05 3000**

**SECTION 05 5000  
METAL FABRICATIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Shop fabricated steel items.
- B. Downspout boots.

**1.02 REFERENCE STANDARDS**

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- I. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- K. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- L. SSPC-SP 2 - Hand Tool Cleaning; 2024.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - 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.
  - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
    - a. Include the following, as applicable:
      - 1) Design criteria.
      - 2) Engineering analysis depicting stresses and deflections.
      - 3) Member sizes and gauges.
      - 4) Details of connections.
      - 5) Support reactions.
      - 6) Bracing requirements.
- 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.

**1.04 QUALITY ASSURANCE**

- A. Design work in this section under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Plates: ASTM A283/A283M.
- C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- D. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

### **2.02 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. Continuously seal joined members by intermittent welds and plastic filler.
- D. 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.
- E. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

### **2.03 FABRICATED ITEMS**

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- B. Shelf Angles Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- C. Lintels: As detailed; galvanized finish.
- D. Door Frames for Overhead Door Openings: Channel sections; prime paint finish.

### **2.04 DOWNSPOUT BOOTS**

- A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and integral cleanout, cleanout cover, and tamper proof fasteners.
  - 1. Configuration: Angular.
  - 2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
  - 3. Color: To be selected by Architect from manufacturer's standard range.
  - 4. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, rubber coupling, and integral neoprene gaskets.

### **2.05 FINISHES - STEEL**

- A. Prime paint steel items.
  - 1. Exceptions: Galvanize items to be embedded in concrete, items to be embedded in masonry, and items specified for galvanized finish.
  - 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.

## **2.06 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 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Furnish setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

### **3.02 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. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

### **3.03 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 5000**

**SECTION 05 5133  
METAL LADDERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Prefabricated ladders.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9113 - Exterior Painting: Paint finish.
- B. Section 11 8129 - Facility Fall Protection: Ladder safety systems.

**1.03 REFERENCE STANDARDS**

- A. 29 CFR 1910.23 - Ladders; Current Edition.
- B. 29 CFR 1926.1053 - Ladders; Current Edition.
- C. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- H. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- J. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- 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. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- P. SSPC-SP 2 - Hand Tool Cleaning; 2024.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 2. 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.

### **1.05 QUALITY ASSURANCE**

- A. Design of work in this section under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Plates: ASTM A283/A283M.
- C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- D. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

### **2.02 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. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

### **2.03 PREFABRICATED LADDERS**

- A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
  - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
  - 2. Materials: Carbon steel; ASTM A1011/A1011M Grade 36, minimum.
  - 3. Finish: Manufacturer's standard hot-dipped galvanizing; comply with ASTM A153/A153M.
  - 4. Manufacturers:
    - a. O'Keeffe's Inc; Model 500: [www.okeeffes.com](http://www.okeeffes.com)
    - b. Precision Ladders, LLC: [www.precisionladders.com](http://www.precisionladders.com)
    - c. Substitutions: See Section 01 6000 - Product Requirements.

### **2.04 FINISHES - STEEL**

- A. Prime paint steel items.
  - 1. Do not prime surfaces in direct contact with concrete.
  - 2. Do not prime surfaces where field welding is required.
- 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.

## **2.05 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 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.

### **3.02 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. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.

### **3.03 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 5133**



**SECTION 06 1000**  
**ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes wood framing and sheathing to form the superstructure of a wood framed building as indicated on the Drawings.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.

**1.03 REFERENCES**

- A. AFPA (American Forest and Paper Association) - National Design Specification for Wood Construction.
- B. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.
- C. ANSI A208.1 - Mat-Formed Wood Particleboard.
- D. ANSI/AHA A135.4 - Basic Hardboard.
- E. APA: American Plywood Association.
- F. AWWA (American Wood Preservers Association) C1 - All Timber Products Preservative Treatment by Pressure Process.
- G. AWWA C20 - Structural Lumber Fire Retardant Treatment by Pressure Process.
- H. RIS: Redwood Inspection Service.
- I. SPIB: Southern Pine Inspection Bureau.
- J. WCLIB: West Coast Lumber Inspection Bureau.
- K. WWP: Western Wood Products Association.

**1.04 DEFINITIONS**

- A. Structural Panel is a panel product composed primarily of wood and meeting the requirements of United States Voluntary Product Standard PS 2-92 "Performance Standard for Wood-Based Structural-Use Panels". Structural panels include all-veneer plywood, composite panels containing a combination of veneer and wood-based material, and malformed panels such as oriented strand board and waferboard.

**1.05 SUBMITTALS**

- A. For treated materials, submit certification by treating plant stating chemicals and process used, net amount of preservative retained and conformance with applicable standards.

**1.06 QUALITY ASSURANCE**

- A. The Structural Testing / Inspection Agency shall provide special inspections as required by Chapter 17 of the building code as required by Specification 01 4525.
- B. Comply with National Design Specification For Wood Construction.
- C. Perform work in accordance with the following agencies:
  - 1. Lumber Grading Agency: Certified by ALSC.
  - 2. Plywood Grading Agency: Certified by APA.
- D. Identify all structural panels by official grade mark.
  - 1. Lumber: Grade stamp to contain symbol of grading agency, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded, where applicable and condition of seasoning at time of manufacture.
  - 2. Structural Panel: Panel grade, span rating, exposure durability classification, product standard thickness, and mill number.

**1.07 REQUIREMENTS OF REGULATORY AGENCIES**

- A. Pressure treated material - American Wood Preservers Bureau Standards.

- B. Span tables - National Forest Products Association.
- C. Working stresses - Softwood Lumber, National Design Specification, National Forest Products Association.

#### **1.08 PROTECTION**

- A. Deliver, store, and handle all materials in such a manner to protect against damage and the weather.
- B. Use all means necessary to protect the installed work and materials of all other trades.

#### **1.09 REPLACEMENTS**

- A. In the advent of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

### **PART 2 PRODUCTS**

#### **2.01 LUMBER**

- A. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual size as required by PS 20, for moisture content specified for each use.
- B. Provide dressed lumber, S4S, unless otherwise indicated.
- C. Provide seasoned lumber No. 2, Southern Pine with 15% maximum moisture content at time of dressing unless noted otherwise on the Drawings.
- D. Lumber Grading Rules and Wood Species to be in conformance with Voluntary Product Standard PS 20: Grading rules of the following associations apply to materials furnished under this section:
  - 1. Northeastern Lumber Manufacturer's Association, Inc. (NELMA).
  - 2. Southern Pine Inspection Bureau (SPIB).
  - 3. West Coast Lumber Inspection Bureau (WCLIB).
  - 4. West Wood Products Association (WWPA).

#### **2.02 STRUCTURAL PANEL**

- A. Provide Roof, Wall and Floor Sheathing thickness as noted on the drawings.
- B. For backing panels for electrical or telephone equipment, provide fire-retardant treated structural panel with exterior glue.

#### **2.03 PARALLEL STRAND LUMBER**

- A. Provide Parallel Strand Lumber (PSL) as specified on Drawings as manufactured by Trus Joist MacMillan.

#### **2.04 FASTENERS AND ANCHORAGES**

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel unless noted otherwise in the drawings.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.
- E. Metal framing connector anchors:
  - 1. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical

data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

2. Provide connectors as noted in manufacturer's instructions.

## **2.05 WOOD-PRESERVATIVE-TREATED LUMBER**

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
  2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
  1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.
- D. Application: Treat items indicated on Drawings, and the following:
  1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
  3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
  4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
  5. Wood floor plates that are installed over concrete slabs-on-grade.
- E. Complete fabrication of treated items prior to treatment, wherever possible. If cut after treatment, apply one coat of same chemical used for treatment in accordance with manufacturer's instructions.

Allow preservative to dry prior to erecting members. Inspect each piece of lumber or structural panel after drying and discard damaged or defective pieces.

## **2.06 FIRE-RETARDANT-TREATED MATERIALS**

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  1. Treatment shall not promote corrosion of metal fasteners.
  2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841.
- C. Kiln-dry lumber after treatment to maximum moisture content of 15 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
  1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by testing agency.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
  1. Framing for raised platforms.
  2. Framing for stages.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. Set structural members level and plumb, in correct position.
- B. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Discard unit of material with defects which might impair quality of work, and units which are too small to fabricate work with minimum joints or optimum joint arrangement.
- D. Installer must examine the substrate structure and the conditions under which the carpentry work is to be installed and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- E. Coordinate carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

#### **3.02 JOIST FRAMING**

- A. Provide framing of sizes and spacings shown.
- B. Install with crown edge up and support ends of each member with not less than 1-7/8 inches of bearing on support.
- C. Attach to wood bearing members by toe nailing or galvanized metal connectors. Provide blocking of joist at ends of joists unless nailed to header or supported by metal joist hanger.
- D. Do not notch joists.
- E. Do not bore holes in PSL which violate manufacturer's recommendations.
- F. Provide bridging between joists as noted on drawings.

#### **3.03 STRUCTURAL PANELS**

- A. Secure roof sheathing perpendicular to framing member with ends staggered and sheet ends over firm bearing. Provide solid edge blocking between sheets. Secure to wood framing with nails of size and spacing shown on Drawings.
- B. Secure wall sheathing with long dimension parallel to wall studs, with ends over firm bearing. Provide solid blocking at ends of sheets. Secure to wood framing with nails of size and spacing shown on Drawings.
- C. Secure floor sheathing perpendicular to framing members with ends staggered and sheet ends over firm bearing. Attach to framing with subfloor glue and drywall screws.

- D. Oriented strand board with laminated face shall be attached to wood with laminated face against wood framing.
- E. Install sheets with 1/8" gap between panels.

#### **3.04 WOOD GROUND, NAILERS, BLOCKING AND SLEEPERS**

- A. Provide wherever shown and where required for screening or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- B. Attach to substrate as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- C. Provide permanent grounds of dressed, preservative treated, key-beveled lumber not less than 1-1/2" (38mm) wide and of thickness required to bring face of ground to exact thickness of finish material involved. Remove temporary grounds when no longer required.

#### **3.05 WOOD FURRING**

- A. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.

#### **3.06 MISCELLANEOUS FRAMING**

- A. Firestops:
  - 1. Stud walls: Two inches thick by depth of member blocking at each floor level, top story ceiling level, and soffits as required.
  - 2. Floor and ceiling framing: Two inches thick by depth of wood member blocking, fitted to fill openings from one space to another to prevent drafts.
- B. Framing for mechanical work:
  - 1. Frame members for passage of pipes and ducts to avoid cutting structural members.
  - 2. Reinforce framing members where damaged by cutting.
- C. Blocking: Locate blocking to facilitate installation of finish materials, casework, fixtures, specialty items and trim railings.

**END OF SECTION 06 1000**

**SECTION 06 2000  
FINISH CARPENTRY**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Finish carpentry items.
- B. Wood door frames, glazed frames.
- C. Wood casings and moldings.
- D. Hardware and attachment accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 4100 - Architectural Wood Casework: Shop fabricated custom cabinet work.
- C. Section 08 7100: Cabinet hardware.
- D. Section 08 8000 - Glazing: Glass and glazing of wood partitions and screens.
- E. Section 09 9123 - Interior Painting: Painting of finish carpentry items.

**1.03 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- D. BHMA A156.9 - Cabinet Hardware; 2020.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. PS 1 - Structural Plywood; 2019.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
  - 2. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
  - 3. Include certification program label.

**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. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.
  - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
  - 3. Single Source Responsibility: Provide and install this work from single fabricator.
- B. Quality Certification:
  - 1. Provide labels or certificates indicating that work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
  - 2. Provide designated labels on shop drawings as required by certification program.
  - 3. Provide designated labels on installed products as required by certification program.
  - 4. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

### **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. Interior Woodwork Items:
  - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Clear maple; prepare for paint/stain finish.
  - 2. Loose Shelving: Birch plywood; prepare for paint finish.

### **2.02 LUMBER MATERIALS**

- A. Softwood Lumber: White Pine species, rotary sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

### **2.03 SHEET MATERIALS**

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Particleboard: ANSI A208.1 Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.

### **2.04 PLASTIC LAMINATE MATERIALS**

- A. Plastic Laminate: NEMA LD 3; color as selected by Architect; textured, low gloss finish.

### **2.05 FASTENINGS**

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Fasteners: Of size and type to suit application; galvanized finish in concealed locations and stainless steel finish in exposed locations.
- C. Fasteners for Exterior Applications: Stainless steel; length required to penetrate wood substrate 1-1/2 inch (38 mm) minimum.
- D. Concealed Joint Fasteners: Threaded steel.

### **2.06 ACCESSORIES**

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Lumber for Shimming and Blocking: Softwood lumber of Southern Pine species.
- C. Primer: Alkyd primer sealer.
- D. Wood Filler: Solvent base, tinted to match surface finish color.

### **2.07 HARDWARE**

- A. Hardware: Comply with BHMA A156.9.

### **2.08 FABRICATION**

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Cap exposed plastic laminate finish edges with material of same finish and pattern.

- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs. (Locate counter butt joints minimum 600 mm from sink cut-outs.)

## **2.09 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:
    - a. System - 11, Polyurethane, Catalyzed.
    - b. Stain: As selected by Architect.
    - c. Sheen: Satin.
  - 2. Opaque:
    - a. System - 4, Latex Acrylic, Water-based.
    - b. Color: As selected by Architect.
    - c. Sheen: Satin.
- E. Back prime woodwork items to be field finished, prior to installation.

## **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. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. 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 PREPARATION FOR SITE FINISHING**

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.
- B. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

### **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 (0.79 mm).

**END OF SECTION 06 2000**



**SECTION 06 4100**  
**ARCHITECTURAL WOOD CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Specially fabricated cabinet units.
- B. Hardware.
- C. Preparation for installing utilities.

**1.02 RELATED REQUIREMENTS**

- A. Section 12 3600 - 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; 2021, with Errata.
- C. BHMA A156.9 - Cabinet Hardware; 2020.
- D. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
  - 1. Scale of Drawings: 1-1/2 inch to 1 foot (125 mm to 1 m), minimum.
- C. Product Data: Provide data for hardware accessories.

**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. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
  - 2. Single Source Responsibility: Provide and install this work from single fabricator.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from moisture damage.

**1.07 FIELD CONDITIONS**

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

**PART 2 PRODUCTS**

**2.01 CABINETS**

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
  - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
  - 2. Finish - Exposed Interior Surfaces: Decorative laminate.
  - 3. Finish - Semi-Exposed Surfaces: Decorative laminate
  - 4. Finish - Concealed Surfaces: Manufacturer's option.
  - 5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
  - 6. Casework Construction Type: Type A - Frameless.
  - 7. Adjustable Shelf Loading: 40 psf (19.5 gm/sq cm).

8. Cabinet Style: Flush inset.
  9. Cabinet Doors and Drawer Fronts: Stile and rail, flat panel style.
  10. Drawer Side Construction: Multiple-dovetailed.
- D. Hardware:
1. Basis of Design; Mockett: [www.mockett.com](http://www.mockett.com)
    - a. DP128 Series - Round Top Drawerpull in 4 9/32" Satin Nickel

## **2.02 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.

## **2.03 LAMINATE MATERIALS**

- A. Manufacturers:
1. Basis of Design; Arborite; [www.arborite.com](http://www.arborite.com)
    - a. PL-1 Black Satin V7003 VR
    - b. PL-2 Industrial Loft P1011 IM
    - c. PL-3 Natural Arcadian Oak W490

## **2.04 FABRICATION**

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

**END OF SECTION 06 4100**

**SECTION 07 2100  
THERMAL INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Board insulation \_\_\_\_\_ at cavity wall construction and over roof sheathing.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 2700 - Air Barriers: Separate air barrier materials.

**1.03 REFERENCE STANDARDS**

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

**PART 2 PRODUCTS**

**2.01 APPLICATIONS**

**2.02 FOAM BOARD INSULATION MATERIALS**

- A. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Comply with ASTM C578, and manufactured using carbon black technology.
  - 1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
  - 2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
  - 3. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.6 (0.98), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
  - 4. Board Size: 15-3/4 inch by 96 inch (400 mm by 2440 mm).
  - 5. Board Thickness: 1-3/4 inch (44.5 mm).
  - 6. Board Edges: Square.

**2.03 ACCESSORIES**

**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 honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

**END OF SECTION 07 2100**

**SECTION 07 2200  
ROOF AND DECK INSULATION**

**PART 1 - GENERAL**

**1.01 REFERENCES**

- A. Definitions:
  - 1. Conditioned R-value: Polyisocyanurate insulation; R-value established by RIC/TIMA Procedure 281-1 which is six-month conditioning procedure; this value is normally advertised in insulation manufacturer's literature. This is conditioning procedure, not aging procedure. Generally considered R-value at 180 days after manufacture.
  - 2. Design stabilized R-value: Polyisocyanurate insulation; R-value insulation meets during five years of manufacture (long term aged R-value) due to thermal drift to reach equilibrium; value not normally advertised in manufacturer's literature.
  - 3. ODP: Ozone Depletion Potential.
  - 4. LTTR:
    - a. Long Term Thermal Resistance; ASTM C1289- 13e1 incorporating CAN/ULC-S770-09 and ASTM C1303-11.
    - b. Polyisocyanurate insulation; R-value insulation meets five years after manufacture (long term aged R-value) due to thermal drift to reach equilibrium; value not normally advertised in some manufacturer's literature.
- B. Standards of the following as referenced:
  - 1. ASTM International (ASTM).
  - 2. FM Global (FM).
  - 3. Federal Specifications (FS).
  - 4. International Code Council, Inc. (ICC).
    - a. International Building Code (IBC).
    - b. International Energy Conservation Code (IECC).
  - 5. National Roofing Contractors Association (NRCA).
  - 6. Polyisocyanurate Insulation Manufacturers Association (PIMA).
- C. Industry standards:
  - 1. FM
    - a. 1-28R, Property Loss Prevention Data Sheets, Roof Systems,- January 2016.
    - b. 1-34, Property Loss Prevention Data Sheets, Hail Damage,' October 2014.
  - 2. ICC:
    - a. IBC: International Building Code, IBC edition and Supplements adopted in State or Commonwealth where Project is located or municipality where Project is located with that municipality's respective adopted Amendments.
    - b. IECC: International Energy Conservation Code, edition and Supplements adopted in State or Commonwealth where Project is located or municipality where Project is located with that municipality's respective adopted Amendments.
  - 3. NRCA: The NRCA Roofing Manual: Membrane Roof Systems-2015.

**1.02 SYSTEM DESCRIPTION**

- A. Design requirements; meets LTTR:
  - 1. Utilize LTTR-value as follows:
    - a. Polyisocyanurate insulation: 5.7 per inch thickness, nominal.
    - b. Gypsum board insulation system protection: 0.28.
    - c. High density insulation cover board: 2.5.
  - 2. Crickets: Design to provide actual valley slope of 1/8" per foot, minimum, at cricket intersection with main roof insulation.
- B. Performance requirements: roof system total insulation R value for base layer, intermediate layer(s), and insulation system protection layer, not including air films, deck, crickets, or roof membrane: LTTR-25.

### 1.03 SUBMITTALS

- A. General: Coordinate submittals; verify use of insulation manufacturer acceptable to roofing system manufacturer to receive warranty specified.
- B. Product data: Manufacturer's dated product description and complete installation instructions for insulation materials. Indicate specific systems and procedures proposed for use.
- C. Quality control submittals:
  - 1. Certificates: indicate materials supplied or installed are:
    - a. Asbestos free.
    - b. CFC-12 and HCFC free; zero ODP.
  - 1) DELIVERY, STORAGE, AND HANDLING

### 1.04 WARRANTY

- A. Special warranty:
  - 1. Warrant insulation work to be free of defects in materials and workmanship.
  - 2. Combine warranty with roofing warranty.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Acceptable manufacturers:
  - 1. Products specified as standard of quality are indicated in MANUFACTURED UNITS Article.
  - 2. Products of manufacturers listed below meeting indicated standards and specified manufacturer's product data characteristics, except as modified below, are acceptable for use, subject to approval of product list and acceptance by related Sections.
- B. Polyisocyanurate roof insulation, system base and intermediate layer(s):
  - 1. Atlas Roofing Corp.: [www.atlasroofing.com](http://www.atlasroofing.com)
  - 2. Firestone Building Products Company: [www.holcimelevate.com](http://www.holcimelevate.com)
  - 3. GAF Corp.: [www.gaf.com](http://www.gaf.com)
  - 4. Hunter Panel: [www.hunterpanels.com](http://www.hunterpanels.com)
  - 5. Johns Manville Corp.: [www.jm.com](http://www.jm.com)
  - 6. Rmax Operating, LLC.: [www.rmax.com](http://www.rmax.com)
- C. Insulation system protection:
  - 1. Gypsum board overlayment:
    - a. Firestone Building Products Company: [www.holcimelevate.com](http://www.holcimelevate.com)
    - b. G-P Gypsum Products: [www.buildgp.com](http://www.buildgp.com)
    - c. Johns Manville Corp.: [www.jm.com](http://www.jm.com)
    - d. U.S. Gypsum Company (referred to as USG): [www.usg.com](http://www.usg.com)
  - 2. High density insulation cover board:
    - a. Firestone Building Products Company: [www.holcimelevate.com](http://www.holcimelevate.com)
    - b. GAF Corp.: [www.gaf.com](http://www.gaf.com)
    - c. Johns Manville Corp.: [www.jm.com](http://www.jm.com)

### 2.02 MANUFACTURED UNITS

- A. Polyisocyanurate roof insulation, system base and intermediate layer(s):
  - 1. Product quality standard: Johns Manville Corp.; ENERGY 3 ISO.
  - 2. Characteristics:
    - a. Type: Isocyanurate foam core, glass fiber reinforced boards with non-asphaltic fiber glass mat laminated to core.
    - b. Size: 4'-0" by 4'-0" and 4'-0" by 8'-0".
    - c. Thickness:
      - 1) Base layer: 2.1".

- 2) Intermediate layer(s): Thickness(es) required to meet requirements specified in SYSTEM DESCRIPTION Article above.
  - d. Design stabilized LTTR-value: Meet requirements specified in SYSTEM DESCRIPTION Article above.
  - e. ASTM E84-16 surface burning characteristics:
    - 1) Flame spread: <25.
    - 2) Smoke developed: <450, maximum.
  - f. UL listed.
  - g. Mark each board indicating code compliance and ODP free.
  - h. Furnish  $\frac{1}{4}$ " per foot, minimum, positive tapered system at indicated roof areas.
  - i. Furnish  $\frac{1}{4}$ " per foot, minimum, tapered crickets; design requirements indicated in SYSTEM DESCRIPTION Article in PART 1.
  - j. Fill insulation: Polyisocyanurate board insulation material; thicknesses required for slope.
- B. Insulation system protection:
- 1. High density insulation cover board:
    - a. Product quality standard: Johns Manville Corp.; ProtectoR HD.
    - b. Characteristics:
      - 1) Type: High density isocyanurate foam core (HCFC-free blowing agent), glass fiber reinforced boards with non-asphaltic fiber glass mat laminated to core.
      - 2) Size: 4'-0" by 4'-0" and 4'-0" by 8'-0".
      - 3) Design stabilized LTTR-value: 2.5.
      - 4) ASTM E84-16 surface burning characteristics:
        - (a) Flame spread:  $\leq$ 25.
        - (b) Smoke developed: <450, maximum.
      - 5) UL listed.
      - 6) Mark each board indicating code compliance and ODP free.
    - c. Fasteners: Cover board manufacturer's approved types with metal plate.

## 2.03 ACCESSORIES

- A. Blocking, nailers, and fasteners for blocking and nailers:
  - 1. Blocking and nailers: Preservative-treated lumber, specified in Rough Carpentry Section.
  - 2. Fasteners: Non-corroding; types recommended in reviewed product data, lengths required for indicated conditions.
- B. Insulation adhesive to insulation; voluntary option to fasteners if permitted by local code:
  - 1. Product standard of quality: Johns Manville Corp.; Two-Part Urethane Insulation Adhesive (UIA).
  - 2. Characteristics: Two-component polyurethane froth adhesive designed to attach a variety of insulation board stock to various substrates as well as to additional boards where multiple layers are required.
- C. Fire retardant tapered edge strips: Perlite; 12" wide by 4'-0" long; tapered from 1-5/8" to featheredge across width.
- D. Insulation and insulation system protection board fasteners with galvanized steel discs:
  - 1. Type: Acceptable to insulation system protection board and roof insulation manufacturer and roofing system manufacturer for achieving wind classification required by local code requirements.
  - 2. FM 4470-2012 for corrosion resistance.
  - 3. SO Corrosion Test Cabinet (Kesternich Cabinet, DIN 50018) test for 30 cycles with less than 10% red rust.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verification of conditions:

1. Verify locations of roof openings and penetrations are in accord with reviewed shop drawings.
2. Verify nailers and blocking locations and anchorages are in accord with reviewed shop drawings.

### 3.02 PREPARATION

- A. Protection:
  1. Mask and otherwise protect adjacent surfaces to prevent marring of adjacent finishes.
  2. Protect building and site from damage and defacing by operations. Use tarps at hoisting points.
  3. Restore or replace adjacent work or materials damaged during handling of bitumen's and insulation materials.
- B. Surface preparation: Immediately prior to application of insulation materials, sweep roof deck; remove debris and foreign material.

### 3.03 INSTALLATION

- A. General: Install roof insulation and accessories in quantity capable of being covered by roofing materials by end of same work period.
- B. Insulation:
  1. Base layer installation:
    - a. Metal deck:
      - 1) Stagger end joints in adjacent boards,  $\frac{1}{2}$ " board width; butt edges for moderate contact. Insulation joints at steel beams, girders, or joints below are prohibited.
      - 2) Bear ends of boards on deck ribs.
      - 3) Mechanically fasten insulation at corners, changes in deck direction, and field with specified fasteners in accord with insulation manufacturer's requirements to meet or exceed local code requirements for wind uplift.
      - 4) Firmly set insulation units with long joints continuous; staggered end joints in adjacent boards,  $\frac{1}{4}$  board width in adhesive at rate recommended by insulation manufacturer's requirements to meet or exceed local code requirements for wind uplift.
  2. Insulation system protection, general:
    - a. Follow selected manufacturer's product data requirements if more stringent.
    - b. Use maximum lengths to minimize joints over insulation.
    - c. Stagger end joints in adjacent lengths of board decking with insulation layer below.
    - d. Mechanically fasten at corners, changes in deck direction, and field with specified fasteners to receive insulation manufacturer's requirements to meet or exceed local code requirements for wind uplift.
    - e. Fasten through insulation to metal deck with fasteners in accord with manufacturer's requirements to meet or exceed local code requirements for wind uplift.

**END OF SECTION 07 2200**

**SECTION 07 2500  
WEATHER BARRIERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Water-Resistive Barrier: Under exterior wall cladding, over sheathing or other substrate; not air tight or vapor retardant.
- B. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

**1.02 DEFINITIONS**

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

**1.03 REFERENCE STANDARDS**

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).
- B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection 2021.
- C. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials 2021.
- D. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials 2021a.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.

**1.05 FIELD CONDITIONS**

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

**PART 2 PRODUCTS**

**2.01 WEATHER BARRIER ASSEMBLIES**

- A. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.
- B. Air Barrier:
  - 1. On outside surface of single wythe masonry and concrete exterior walls use air barrier coating.
  - 2. On outside surface of sheathing of exterior walls use air barrier coating.

**2.02 AIR BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)**

- A. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
  - 1. Air Barrier Coating:
    - a. Material: Acrylic.
    - b. Dry Film Thickness (DFT): 40 mils, 0.040 inch, minimum.
    - c. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
    - d. Water Vapor Permeance: 18 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure B (Water Method) at 73.4 degrees F.



- e. Elongation: 250 percent, minimum, when tested in accordance with ASTM D412.
- f. Nail Sealability: Pass, when tested in accordance with ASTM D1970/D1970M.
- g. Sealants, Tapes and Accessories: As recommended by coating manufacturer.
- h. Manufacturers:
  - 1) Carlisle Coatings and Waterproofing, Inc: [www.carlisleccw.com](http://www.carlisleccw.com)
  - 2) Dow Chemical Company: [www.consumer.dow.com/en-us/industry/ind-building-construction.html](http://www.consumer.dow.com/en-us/industry/ind-building-construction.html)
  - 3) Henry Company; Air-Bloc 17MR: [www.henry.com](http://www.henry.com)
  - 4) Substitutions: See Section 01 6000 - Product Requirements.

### 2.03 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
  - 1. Composition: Modified bituminous sheet laminated to polyethylene sheet.
  - 2. Thickness: 40 mil, 0.040 inch, nominal; exception from ASTM D1970/D1970M.
  - 3. Manufacturers:
    - a. Basis of Design: GCP Applied Technologies; Perm-A-Barrier Wall Flashing: [www.gcpat.com](http://www.gcpat.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

### 3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

### 3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.
- D. Coatings:
  - 1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
  - 2. Use flashing to seal to adjacent construction and to bridge joints.
- E. Openings and Penetrations in Exterior Weather Barriers:
  - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
  - 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
  - 3. At openings to be filled with non-flanged frames, seal weather barrier to each side of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
  - 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
  - 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.

6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

**3.04 PROTECTION**

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

**END OF SECTION 07 2500**

**SECTION 07 6200**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, downspouts, and exterior penetrations.
- B. Sealants for joints within sheet metal fabrications.

**1.02 REFERENCE STANDARDS**

- A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- G. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products; 2020.
- H. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- J. CDA A4050 - Copper in Architecture - Handbook; current edition.
- K. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Samples: Submit two samples, 2 by 4 inches 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.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

**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 SHEET MATERIALS**

- A. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.

1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
2. Color: As selected by Architect from manufacturer's standard colors.
- B. Anodized Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 20 gauge, 0.032 inch (0.81 mm) thick; clear anodized finish.
  1. Clear Anodized Finish: AAMA 611, AA-M12C22A41, Class I, clear anodic coating not less than 0.7 mil, 0.0007 inch (0.018 mm) thick.
- C. Pre-Finished Aluminum: ASTM B209/B209M, 3005 alloy, H12 or H14 temper; 18 gauge, 0.040 inch (1.02 mm) thick; plain finish shop pre-coated with silicone modified polyester coating.
  1. Fluoropolymer Coating: High performance organic powder coating, AAMA 2604; multiple coat, thermally cured fluoropolymer finish system.
  2. Color: As selected by Architect from manufacturer's standard colors.
- D. Lead Sheet: ASTM B749, 0.047-inch (1.19 mm) minimum thickness; UNS Number L51121.
- E. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 28 gauge, 0.0156 inch (0.40 mm) thick; smooth No. 4 - Brushed finish.

## **2.02 SOLDERING MATERIALS**

- A. Solder: ASTM B32-00, alloy grade 50A, 50% pig lead and 50% block tin.
- B. Solder flux for lead: Non-corrosive rosin.

## **2.03 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 material. Return and brake edges.

## **2.04 GUTTERS AND DOWNSPOUTS**

- A. Gutters: SMACNA (ASMM) Rectangular profile.
- B. Downspouts: Rectangular profile.
- C. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM).
- D. Accessories: Profiled to suit gutters and downspouts.
  1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
  2. Gutter Supports: Brackets.
  3. Downspout Supports: Brackets.
- E. Downspout Boots: Steel.
- F. Downspout Extenders: Same material and finish as downspouts.
- G. Seal metal joints.

## **2.05 MANUFACTURED UNITS**

- A. Downspout boots:
  1. Acceptable Manufacturers:
    - a. Barry Pattern & Foundry: [www.barrycraft.com](http://www.barrycraft.com)
    - b. McKinley Iron Works, Inc.: [www.mckinleyironworks.com](http://www.mckinleyironworks.com)
    - c. Neenah Foundry Company: [www.groupnei.com](http://www.groupnei.com)

- B. Copings:
  - 1. Acceptable Manufacturers:
    - a. Metal Era, Inc.: [www.metalera.com](http://www.metalera.com)
    - b. MM Systems Corp.: [www.mmsystemscorp.com](http://www.mmsystemscorp.com)
    - c. OMG Roofing Products: [www.omgroofing.com](http://www.omgroofing.com)
    - d. Petersen Aluminum Company: [www.pac-clad.com](http://www.pac-clad.com)
    - e. Other roof system manufacturer's OEM proprietary or "private label" required edge metal to effect "total roof system warranty".
  - 2. Product basis standard of quality: Metal Era, Inc.; Perma-Tite® Coping System; snap-on design.
- C. Flashing reglet system:
  - 1. Acceptable Manufacturers:
    - a. Fry Reglet Corp.: [www.fryreglet.com](http://www.fryreglet.com)
    - b. MM Systems Corp.: [www.mmsystemscorp.com](http://www.mmsystemscorp.com)
    - c. OMG Roofing Products: [www.omgroofing.com](http://www.omgroofing.com)
  - 2. Type: Fry Reglet Corp.; Springlok™ Flashing System, Type SM - Surface mounting.
  - 3. Reglet and flashing material: 0.020" thickness, SSINA Alloy 304 Stainless Steel.
  - 4. Finish: Specified manufacturer's standard uncoated finish for material indicated.
  - 5. Accessories:
    - a. Factory fabricated mitered and sealed interior and exterior corners, splice plates.
    - b. Windlock clips at 2 1/2" O.C.
    - c. Vinylok Flashing Retainer, continuous.

## 2.06 ACCESSORIES

- A. Fasteners: Same material or compatible with sheet metal being fastened.
- B. Expansion shields: Lead or bronze sleeves.
- C. Screws: Self-tapping stainless steel type with round heads and soft, neoprene washers.
- D. Blind clips and cleats: Same gauge as sheet metal.
- E. Nails: Flathead, needle pint, no less than 12 gauge; sufficient length to penetrate substrate 1" minimum.
- F. Neoprene washers for nails.
- G. Primer Type: Zinc chromate.
- H. Concealed Sealants: Non-curing butyl sealant.
- I. Caulk: ADCO Products, Inc.; BP-300, non-skinning, non-drying butyl caulk.
- J. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- K. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- L. Reglets: Surface-mounted type, galvanized steel; face and ends covered with plastic tape.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

### 3.02 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).

### 3.03 INSTALLATION

- A. Secure flashings in place using concealed fasteners.
- 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. Seams: Orient as watershed for direction of water flow.
- E. Seal metal joints watertight.
- F. Solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
  - 1. Soldered lap seams: Finish not less than 1" wide.
- G. Secure gutters and downspouts in place with concealed fasteners at 6'-0 O.C. maximum
- H. Slope gutters 1/4 inch per 10 feet (2.1 mm per m), minimum.
- I. Connect downspouts to downspout boots, and grout connection watertight.
- J. Install prefabricated copings in accord with manufacturer's product data, true to line, and in accord with ANSI/SPRI windload requirements.
  - 1. Install back-up plates at joints between sections, set in full beds of sealant 1/2" from plate edges; make weathertight fit; allow for free expansion and contraction recommended by manufacturer's product data.
  - 2. Attach material using stainless steel fasteners and hold-down clips; match metal finish for exposed fasteners.
- K. Install reglet system in accord with manufacturer's installation instructions, true to line; lap joint 1", top of reglet 7", minimum, above cant strip high point.
  - 1. Fill top groove with sealant specified and in accord with Joint Sealants Section.
  - 2. Install factory fabricated corners at changes in direction.
  - 3. Following roofing installation, install flashing by snapping into reglet in accord with manufacturer's product data. Overlap adjacent lengths 3" minimum to allow for expansion and contraction.
- L. Install sheet flashing at junctures of roof areas to sidewalls, parapets, curbs, and other indicated areas.
  - 1. Install sheet flashing at juncture of roof area to fire walls and high walls using stepped flashing details; continuous sheet not permitted. Coordinate flashing at fire walls with reglet installation.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

**END OF SECTION 07 6200**

**SECTION 07 7123  
MANUFACTURED GUTTERS AND DOWNSPOUTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pre-finished galvanized steel gutters and downspouts.

**1.02 RELATED REQUIREMENTS**

- A. Section 05 5000 - Metal Fabrications: Downspout boots.
- B. Section 07 6200 - Sheet Metal Flashing and Trim.

**1.03 REFERENCE STANDARDS**

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- 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 D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Comply with SMACNA (ASMM) for sizing components for rainfall intensity determined by a storm occurrence of 1 in 5 years.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on prefabricated components.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- B. Prevent contact with materials that could cause discoloration, staining, or damage.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Gutters and Downspouts:
  - 1. ATAS International, Inc: [www.atas.com](http://www.atas.com)
  - 2. Cheney Flashing Company: [www.cheneyflashing.com](http://www.cheneyflashing.com)
  - 3. Drexel Metals Inc: [www.drexmet.com](http://www.drexmet.com)
  - 4. OMG Roofing Products: [www.omgroofing.com](http://www.omgroofing.com)
- B. Scupper and Collectors:
  - 1. Same manufacturer as Gutters and Downspouts.

**2.02 MATERIALS**

- A. Polyvinyl Chloride (PVC): ASTM D2665, virgin vinyl, SDR 35 pipe and fittings, high impact type, colorfast; \_\_\_\_\_ color.

**2.03 COMPONENTS**

- A. Gutters: SMACNA square style profile.
- B. Downspouts: SMACNA rectangular profile.
- C. Connectors: Furnish required connector pieces for polyvinyl chloride (PVC) components.

- D. Anchors and Supports: Profiled to suit gutters and downspouts.
  - 1. Anchoring Devices: In accordance with SMACNA requirements.
  - 2. Gutter Supports: Brackets.
  - 3. Downspout Supports: Brackets.
- E. Fasteners: Galvanized steel, with soft neoprene washers.

#### **2.04 FABRICATION**

- A. Form gutters and downspouts of profiles and size indicated.
- B. Fabricate with required connection pieces.
- C. Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- D. Hem exposed edges of metal.
- E. Fabricate gutter and downspout accessories; seal watertight.

#### **2.05 FINISHES**

- A. Acrylic polyester coating: Baked enamel system, comply with AAMA 2603.
- B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.

#### **2.06 ACCESSORIES**

- A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots and on-body cleanout and cover with neoprene gaskets.
  - 1. Configuration: Angular.
  - 2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
  - 3. Finish: Manufacturer's standard factory applied powder coat finish.
  - 4. Color: To be selected by Architect from manufacturer's standard range.
  - 5. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, and rubber coupling.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that surfaces are ready to receive work.

#### **3.02 PREPARATION**

- A. Paint concealed sheet metal surfaces and surfaces in contact with dissimilar metals with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch (0.381 mm).

#### **3.03 INSTALLATION**

- A. Install gutters, downspouts, and accessories in accordance with manufacturer's instructions.
- B. Slope gutters 1/8 inch per foot .
- C. Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- D. Connect downspouts to downspout boots at 8 inches above grade. Grout connection watertight.
- E. Connect downspouts to storm sewer system. Grout connection watertight.

**END OF SECTION 07 7123**



**SECTION 07 7200  
ROOF ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof curbs.
- B. Roof penetrations mounting curbs.
- C. Roof hatches, manual and automatic operation, including smoke vents.
- D. Roof hatches with access ladders.

**1.02 REFERENCE STANDARDS**

- A. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process; 2022.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
  - 1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.
- D. Warranty Documentation:
  - 1. Submit manufacturer warranty.
  - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
  - 3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.

**1.05 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for installed work. Complete forms in Owner's name and register with manufacturer.
- C. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- D. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 ROOF CURBS**

- A. Roof Curbs Manufacturers:
  - 1. AES Industries Inc: [www.aescurb.com](http://www.aescurb.com)
  - 2. Air Balance; a division of MESTEK, Inc.: [www.airbalance.com](http://www.airbalance.com)
  - 3. Curbs Plus, Inc.: [www.curbs-plus.com](http://www.curbs-plus.com)
  - 4. Custom Solution Roof and Metal Products: [www.csroofmetalproducts.com](http://www.csroofmetalproducts.com)
  - 5. Greenheck Fan Corporation: [www.greenheck.com](http://www.greenheck.com)
  - 6. Kingspan Light + Air, North America: [www.kingspan.com](http://www.kingspan.com)
- B. Roof Curbs Mounting Assemblies: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
  - 1. Roof Curb Mounting Substrate: Curb substrate consists of flat roof deck sheathing with insulation.
  - 2. Sheet Metal Material:
    - a. Galvalume Steel: Hot-dip aluminum zinc alloy coated steel sheet complying with ASTM A792/A792M; AZ55 (AZM165) coating designation; 18 gauge, 0.048 inch (1.2 mm) thick.
      - 1) Finish: Factory primed.
      - 2) Color: As selected by Architect from manufacturer's standard line of colors.
  - 3. Provide layouts and configurations indicated on drawings.
- C. Curbs Adjacent to Roof Openings: Provide curb on each side of opening, with top of curb horizontal for equipment mounting.
  - 1. Provide preservative treated wood nailers along top of curb.
  - 2. Insulate inside curbs with 1-1/2 inch (38 mm) thick fiberglass insulation.
  - 3. Height Above Roof Deck: 14 inches (356 mm), minimum.

### **2.02 ROOF HATCHES**

- A. Roof Hatch Manufacturers:
  - 1. Architectural Specialties, Inc.: [www.archsp.com](http://www.archsp.com)
  - 2. Babcock-Davis: [www.babcockdavis.com](http://www.babcockdavis.com)
  - 3. Bilco Company: [www.bilco.com](http://www.bilco.com)
  - 4. LMCurbs; Roof Hatch: [www.lmcurbs.com](http://www.lmcurbs.com)
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
- C. Type and Size: Single-leaf lid, 36 by 36 inches.
- D. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.
- E. Hatch Material: Zinc-coated (galvanized) steel sheet.
  - 1. Thickness: Manufacturer's standard thickness for hatch size indicated.
  - 2. Finish: Factory prime coating.
  - 3. Color: As indicated by manufacturer's designations.
- F. Hardware: Spring operators, hold-open arm, galvanized steel spring latch with turn handles, galvanized steel butt- or pintle-type hinge system, and padlock hasps inside and outside.
- G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.
  2. Posts and Rails: Galvanized-steel pipe, 1 1/4 inches in diameter or galvanized-steel tube, 1 5/8 inches in diameter.
  3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inches thick.
  4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
  5. Self-Latching Gate: Fabricated of same materials and rail specing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
  6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
  7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
  8. Fabricate joints exposed to weather to be watertight.
  9. Fasteners: Manufacturer's standard, finished to match railing system.
  10. Finish: Manufacturer's standard.
    - a. Color: As selected by Architect from manufacturer's full range.
- H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
  2. Height: 42 inches above finished roof deck.
  3. Material: Steel tube.
  4. Post: 1 5/8-inch-diameter pipe.
  5. Finish: Manufacturer's standard baked enamel or powder coat.
    - a. Color: As selected by Architect from manufacturer's full range.

### **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.

#### **3.02 PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

#### **3.04 CLEANING**

- A. Clean installed work to like-new condition.

#### **3.05 PROTECTION**

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

**END OF SECTION 07 7200**

**SECTION 07 4113  
METAL ROOF PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal roof panel system of preformed steel panels.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 4213 - Metal Wall Panels: Preformed wall panels.
- B. Section 07 9200 - Joint Sealants: Sealing joints between metal roof panel system and adjacent construction.

**1.03 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing 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 D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- D. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2005 (Reapproved 2017).

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Storage and handling requirements and recommendations.
  - 2. Installation methods.
  - 3. Specimen warranty.
- C. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
  - 1. Show work to be field-fabricated or field-assembled.
- D. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches (305 mm) square, representing actual roofing metal, thickness, profile, color, and texture.
- E. Test Reports: Indicate compliance of metal roofing system to specified requirements.
- F. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Architectural Metal Roof Panel Manufacturers:
  - 1. ATAS International, Inc; \_\_\_\_: [www.atas.com](http://www.atas.com)

2. Elevate; Warranted Una-Clad UC- \_\_\_\_ Standing Seam Metal Roofing Panel: [www.holcimelevate.com](http://www.holcimelevate.com)
  3. Fabral; Stand N Seam: [www.fabral.com](http://www.fabral.com)
  4. Metal Roofing Systems, Inc; System 1000 - Metal Roof Panels: [www.metalroofingsystems.biz](http://www.metalroofingsystems.biz)
  5. Petersen Aluminum Corporation; PAC T-250 Panel: [www.pac-clad.com](http://www.pac-clad.com)
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Metal Soffit Panels Manufacturers:
1. ATAS International, Inc; \_\_\_\_: [www.atas.com](http://www.atas.com)
  2. Elevate; UNA-CLAD UC-750 V-Groove Soffit Panel: [www.holcimelevate.com](http://www.holcimelevate.com)
  3. Fabral; \_\_\_\_: [www.fabral.com](http://www.fabral.com)
  4. Metal Roofing Systems, Inc; \_\_\_\_: [www.metalroofingsystems.biz](http://www.metalroofingsystems.biz)
  5. Petersen Aluminum Corporation; PAC-850 Soffit: [www.pac-clad.com](http://www.pac-clad.com)

## **2.02 PERFORMANCE REQUIREMENTS**

- A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
  2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
  3. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F (56 degrees C).

## **2.03 METAL ROOF PANELS**

- A. Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
- B. Metal Panels: Factory-formed panels with factory-applied finish.
1. Steel Panels:
    - a. Steel Thickness: Minimum 24 gauge, 0.024 inch (0.61 mm).
  2. Texture: Smooth.
  3. Width: Maximum panel coverage of 18 inches (457 mm).

## **2.04 ATTACHMENT SYSTEM**

- A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

## **2.05 FABRICATION**

- A. Panels: Provide factory or field fabricated panels with applied finish and accessory items, using manufacturer's standard processes as required to achieve specified appearance and performance requirements.

## **2.06 FINISHES**

- A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat metal coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss to match sample.

## **2.07 ACCESSORIES**

- A. Miscellaneous Sheet Metal Items: Provide flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may

optionally be made of stainless steel.

- B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.
- C. Sealants:
  - 1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
  - 2. Concealed Sealant: Non-curing butyl sealant or tape sealant.
- D. Underlayment: Synthetic non-asphaltic sheet, intended by manufacturer for mechanically fastened roofing underlayment without sealed seams.
  - 1. Self Sealability: Nail sealability in accordance with ASTM D1970/D1970M.
  - 2. Low Temperature Flexibility: Comply with ASTM D1970/D1970M.
  - 3. Fasteners: As specified by manufacturer and building code qualification report or approval.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

#### **3.02 INSTALLATION**

- A. Overall: Install roofing system in accordance with approved shop drawings and metal roof panel manufacturer's instructions and recommendations, as applicable to specific project conditions; securely anchor components of roofing system in place allowing for thermal and structural movement.
  - 1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
  - 2. Minimize field cutting of panels. Where field cutting is required, use methods that will not distort panel profiles. Use of torches for field cutting is prohibited.
- B. Accessories: Install necessary components that are required for complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.
- C. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

#### **3.03 CLEANING**

- A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

#### **3.04 PROTECTION**

- A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.
- B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

**END OF SECTION 07 4113**

**SECTION 07 4213  
METAL WALL PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Manufactured metal panels for exterior wall panels, soffit panels, and subgirt framing assembly, with insulation, related flashings, and accessory components.

**1.02 RELATED REQUIREMENTS**

- A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.
- B. Section 07 2100 - Thermal Insulation.
- C. Section 07 2500 - Weather Barriers: Weather barrier under wall panels.
- D. Section 07 2700 - Air Barriers: Air barrier under wall panels.
- E. Section 07 9200 - Joint Sealants: Sealing joints between metal wall panel system and adjacent construction.

**1.03 REFERENCE STANDARDS**

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- 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. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
  - 1. Physical characteristics of components shown on shop drawings.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation instructions and recommendations.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, \_\_\_\_\_, and methods of anchorage.
- D. Samples: Submit two samples of each wall panel and soffit panel, 12 inches by 12 inches (305 mm by 305 mm) in size illustrating finish color, sheen, and texture.
- E. Test Reports: Submit test report verifying compliance with NFPA 285 for previously-tested exterior wall assembly.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing products specified in this section with minimum three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.

- B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

### 1.07 FIELD CONDITIONS

- A. Do not install wall panels when air temperature or relative humidity are outside manufacturer's limits.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Metal Wall Panels - Concealed Fasteners:
- B. Basis of Design: PAC-CLAD; [www.pac-clad.com](http://www.pac-clad.com)
  - 1. Substitutions: See Section 01 6000 - Product Requirements.
- C. Metal Soffit Panels:
  - 1. Basis of Design: PAC-CLAD; [www.pac-clad.com](http://www.pac-clad.com)

### 2.02 METAL WALL PANEL SYSTEM

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
  - 1. Provide exterior wall panels.
  - 2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
  - 3. Maximum Allowable Deflection of Panel:  $L/180$  for length(L) of span.
  - 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
  - 5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
  - 6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
  - 7. Corners: Factory-fabricated in one continuous piece with minimum 2-inch (51 mm) returns.
- B. Exterior Wall Panels:
  - 1. Profile: Vertical and horizontal, as indicated; style as indicated.
  - 2. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
  - 3. Panel Width: \_\_\_\_ inches (\_\_\_\_ mm).
  - 4. Color: As indicated on drawings.
- C. Soffit Panels:
  - 1. Profile: Style as indicated, with venting provided.
  - 2. Material: Precoated steel sheet, 22 gauge, 0.0299 inch (0.76 mm) minimum thickness.
- D. Subgirt Framing Assembly:
- E. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- F. Expansion Joints: Same material, thickness and finish as exterior sheets; \_\_\_\_ gauge, \_\_\_\_ inch (\_\_\_\_ mm) thick; manufacturer's standard brake formed type, of profile to suit system.
- G. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- H. Anchors: Galvanized steel.

### 2.03 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed



surfaces with specified finish coating and on panel back with specified panel back coating.

#### **2.04 FINISHES**

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.
- B. Fluoropolymer Coil Coating System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of coil coated metal surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch (0.023 mm); color and gloss as selected by Architect from manufacturer's standard line.
  - 1. Products:
    - a. Arkema, Inc; Kynar 500: [www.arkema.com/#sle](http://www.arkema.com/#sle).
    - b. PPG; Duranar: [www.ppgmetalcoatings.com/#sle](http://www.ppgmetalcoatings.com/#sle).
    - c. Sherwin-Williams Company; Fluropon: [www.coil.sherwin.com/#sle](http://www.coil.sherwin.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.05 ACCESSORIES**

- A. Support for Cladding and Continuous Insulation: Thermal clips.
  - 1. Thermally-broken clips that provide attachment support for girts, angles, channels, and other cladding support framing.
  - 2. Fasteners: As recommended by clip manufacturer.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that building framing members are ready to receive panels.

#### **3.02 PREPARATION**

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane, and spaced at intervals indicated.

#### **3.03 INSTALLATION**

- A. Install panels on walls in accordance with manufacturer's instructions.

#### **3.04 CLEANING**

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.

#### **3.05 PROTECTION**

- A. Protect metal wall panels until completion of project.
- B. Touch-up, repair, or replace damaged wall panels or accessories before Date of Substantial Completion.

**END OF SECTION 07 4213**

**SECTION 07 8400  
FIRESTOPPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Firestopping systems.

**1.02 REFERENCE STANDARDS**

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- E. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- F. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023a.
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- H. ITS (DIR) - Directory of Listed Products; Current Edition.
- I. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- J. FM (AG) - FM Approval Guide; Current Edition.
- K. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- L. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- M. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- N. UL (DIR) - Online Certifications Directory; Current Edition.
- O. UL (FRD) - Fire Resistance Directory; Current Edition.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Sustainable Design Submittal: Submit VOC content documentation for nonpreformed materials.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.

**1.04 QUALITY ASSURANCE**

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
  - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
  - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at [www.icc-es.org](http://www.icc-es.org) will be considered as constituting an acceptable test report.

3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
  1. Trained by manufacturer.
  2. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:
  3. Verification of minimum three years documented experience installing work of this type.
  4. Verification of at least five satisfactorily completed projects of comparable size and type.
  5. Licensed by local authorities having jurisdiction (AHJ).

#### **1.05 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.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Firestopping Manufacturers:
  1. 3M Fire Protection Products: [www.3m.com/firestop](http://www.3m.com/firestop)
  2. A/D Fire Protection Systems Inc: [www.adfire.com](http://www.adfire.com)
  3. Hilti, Inc: [www.hilti.com](http://www.hilti.com)
  4. Nelson FireStop Products: [www.nelsonfirestop.com](http://www.nelsonfirestop.com)
  5. Specified Technologies Inc: [www.stifirestop.com](http://www.stifirestop.com)
  6. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 MATERIALS**

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

#### **2.03 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. 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.
- C. 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.
  1. Temperature Rise: Provide systems that have been tested to show T Rating as indicated.
  2. Air Leakage: Provide systems that have been tested to show L Rating as indicated.
  3. Watertightness: Provide systems that have been tested to show W Rating as indicated.
  4. Listing by FM (AG), ITS (DIR), UL (DIR), or UL (FRD) in their certification directories will be considered evidence of successful testing.

## **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.

## **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.
- C. Install backing materials to prevent liquid material from leakage.

### **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 8400**

**SECTION 07 9200  
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.
- D. Owner-provided field quality control.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 07 8400 - Firestopping: Firestopping sealants.
- C. Section 09 3000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

**1.03 REFERENCE STANDARDS**

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- J. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include 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. Substrates for which laboratory adhesion and/or compatibility testing is required.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- D. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

- E. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- F. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- H. 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.
- I. Executed warranty.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
  - 1. Adhesion Testing: In accordance with ASTM C794.
  - 2. Compatibility Testing: In accordance with ASTM C1087.
  - 3. Allow sufficient time for testing to avoid delaying the work.
  - 4. Deliver sufficient samples to manufacturer for testing.
  - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
  - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- D. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
  - 1. Identification of testing agency.
  - 2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
    - a. Test date.
    - b. Location on project.
    - c. Sealant used.
    - d. Stated movement capability of sealant.
    - e. Test method used.
    - f. Date of installation of field sample to be tested.
    - g. Date of test.
    - h. Copy of test method documents.
    - i. Age of sealant upon date of testing.
    - j. Test results, modeled after the sample form in the test method document.
    - k. Indicate use of photographic record of test.
- E. Owner will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
  - 1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.
- F. Field Quality Control Plan:
  - 1. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per

sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.

- G. 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. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
  - 6. 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.
- H. 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 before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.

## **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in Owner's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 3-year period commencing on Date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Nonsag Sealants:
  - 1. Dow: [www.dow.com](http://www.dow.com)
  - 2. Master Builders Solutions: [www.master-builders-solutions.com/en-us](http://www.master-builders-solutions.com/en-us)
  - 3. Momentive Performance Materials, Inc (formerly GE Silicones): [www.momentive.com](http://www.momentive.com)
  - 4. Pecora Corporation: [www.pecora.com](http://www.pecora.com)
  - 5. Tremco Commercial Sealants & Waterproofing: [www.tremcosealants.com](http://www.tremcosealants.com)
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 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.
    - a. Seal the following joints:
      - 1) Wall expansion and control joints.
      - 2) Joints between doors, windows, and other frames or adjacent construction.
      - 3) Joints between different exposed materials.
      - 4) Openings below ledge angles in masonry.
      - 5) Other joints indicated below.
  - 2. Interior Joints:

- a. Do not seal interior joints indicated on drawings as not sealed.
- b. Seal the following joints:
  - 1) Joints between door frames and window frames and adjacent construction.
  - 2) Other joints indicated below.
3. Do Not Seal:
  - a. Intentional weep holes in masonry.
  - b. Joints indicated to be covered with expansion joint cover assemblies.
  - c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
  - d. Joints where sealant installation is specified in other sections.
  - e. Joints between suspended ceilings and walls.
- B. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- C. Joints between exterior sheathing panels: Use multi-part, non-sag polyurethane sealant, unless otherwise indicated.
- D. Exterior joints in masonry, including expansion/control joints: Use low modulus silicone sealant, unless otherwise indicated.
- E. Exterior and interior joints at perimeter of windows/storefront: Medium modulus silicone sealant, unless otherwise indicated.
- F. Joints at perimeter of hollow metal framing: Medium modulus silicone sealant, unless otherwise indicated.
- G. Exterior joints between wall finish and conduit and pipe penetrations, base plates of light fixtures, signage supports and other items applied to exterior wall surface: Medium modulus silicone sealant, unless otherwise indicated.
- H. Interior concealed bedding joints and thresholds: Acrylic sealant, unless otherwise indicated.
- I. Exterior and interior horizontal traffic-bearing joints, excluding tile floor joints: Two-part polyurethane sealant, unless otherwise indicated.
- J. Tile expansion and control joint sealant: Refer to Tiling section.
- K. Firestopped joints: Firestop sealant as specified in Firestopping section.

### **2.03 JOINT SEALANTS - GENERAL**

- A. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content; see Section 01 6116.

### **2.04 NONSAG JOINT SEALANTS**

- A. Nonstaining 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. Nonstaining to Porous Stone: Nonstaining 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. Hardness Range: 15 to 40, Shore A, when tested in accordance with ASTM C661.
  5. Color: Match adjacent finished surfaces.
  6. Products:
    - a. Dow; DOWSIL 756 SMS Building Sealant: [www.dow.com](http://www.dow.com)
    - b. Dow; DOWSIL 790 Silicone Building Sealant: [www.dow.com](http://www.dow.com)
    - c. Dow; DOWSIL 795 Silicone Building Sealant: [www.dow.com](http://www.dow.com)
    - d. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): [www.pecora.com](http://www.pecora.com)
    - e. Pecora Corporation; Pecora 895 NST (Non-Staining Technology): [www.pecora.com](http://www.pecora.com)
    - f. Tremco Commercial Sealants & Waterproofing; Spectrem 1: [www.tremcosealants.com](http://www.tremcosealants.com)



- g. Tremco Commercial Sealants & Waterproofing; Spectrem 2:  
[www.tremcosealants.com](http://www.tremcosealants.com)
  - h. Tremco Commercial Sealants & Waterproofing; Spectrem 3:  
[www.tremcosealants.com](http://www.tremcosealants.com)
  - i. Substitutions: See Section 01 6000 - Product Requirements.
- 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: To be selected by Architect from manufacturer's standard range.
  - 2. Products:
    - a. Dow Chemical Company; DOWSIL 786 Silicone Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html](http://consumer.dow.com/en-us/industry/ind-building-construction.html)
    - b. Momentive Performance Materials, Inc.; GE Construction Sealants; GE SCS1700 Sanitary: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com)
    - c. Pecora Corporation; Pecora 898 NST (Non-Staining Technology):  
[www.pecora.com/#sle](http://www.pecora.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- 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. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
  - 3. Color: To be selected by Architect from manufacturer's standard range.
  - 4. Service Temperature Range: Minus 40 to 180 degrees F (Minus 40 to 82 degrees C).
  - 5. Products:
    - a. Master Builders Solutions by BASF; MasterSeal NP-2: [www.master-builders-solutions.com/en-us](http://www.master-builders-solutions.com/en-us)
    - b. Pecora Corporation; DynaTrol II: [www.pecora.com](http://www.pecora.com)
    - c. Tremco Commercial Sealants & Waterproofing; Dymeric 240 FC:  
[www.tremcosealants.com](http://www.tremcosealants.com)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
  - 1. Color: To be selected by Architect from manufacturer's standard range.
  - 2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
  - 3. Products:
    - a. Master Builders Solutions by BASF; MasterSeal NP 520: [www.master-builders-solutions.com/en-us](http://www.master-builders-solutions.com/en-us)
    - b. Pecora Corporation; AC-20 +Silicone: [www.pecora.com](http://www.pecora.com)
    - c. Pecora Corporation; AVW-920: [www.pecora.com](http://www.pecora.com)
    - d. Tremco Commercial Sealants & Waterproofing; Tremflex 834:  
[www.tremcosealants.com](http://www.tremcosealants.com)
    - e. Substitutions: See Section 01 6000 - Product Requirements.

## **2.05 SELF-LEVELING JOINT SEALANTS**

- A. Self-Leveling Polyurethane Sealant for Horizontal Expansion Joints: ASTM C920, Grade P, Uses T, M, and O; multicomponent; explicitly approved by manufacturer for horizontal expansion joints.
  - 1. Movement Capability: Plus and minus 25 percent, minimum.
  - 2. Hardness Range: 30 to 35, Shore A, when tested in accordance with ASTM C661.
  - 3. Color: To be selected by Architect from manufacturer's standard range.
  - 4. Products:
    - a. Master Builders Solutions by BASF; MasterSeal SL2: [www.master-builders-solutions.basf.us/en-us](http://www.master-builders-solutions.basf.us/en-us)
    - b. Pecora Corporation; Urexpan NR-200: [www.pecora.com](http://www.pecora.com)

- c. Tremco Commercial Sealants & Waterproofing; THC-901: [www.tremcosealants.com](http://www.tremcosealants.com)
- d. Substitutions: See Section 01 6000 - Product Requirements.

## **2.06 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. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

## **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.
- D. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
  - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
  - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
  - 3. Record each test on Preinstallation Adhesion Test Log as indicated.
  - 4. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
  - 5. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

### **3.03 INSTALLATION**

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific

dimensions are indicated.

- 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.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Owner will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

**END OF SECTION 07 9200**

**SECTION 08 1113  
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.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 9113 - Exterior Painting: Field painting.
- D. Section 09 9123 - Interior Painting: Field painting.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. ANSI: American National Standards Institute.
- B. NFPA: National Fire Protection Association.
- C. SDI: Steel Door Institute.
- D. 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; 2022.
- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- 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 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; 2021a.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- M. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- N. ITS (DIR) - Directory of Listed Products; Current Edition.

- O. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- P. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- Q. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.
- R. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- S. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- T. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- U. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- V. UL (DIR) - Online Certifications Directory; Current Edition.
- W. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - 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; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. 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](http://www.assaabloydss.com)
  - 2. Mesker, dormakaba Group: [www.meskeropeningsgroup.com](http://www.meskeropeningsgroup.com)
  - 3. Steelcraft, an Allegion brand: [www.allegion.com](http://www.allegion.com)
  - 4. Substitutions: See Section 01 6000 - 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; galvanized 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.
  - 3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.

4. Door Edge Profile: Manufacturers standard for application indicated.
  5. Typical Door Face Sheets: Flush.
  6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
  7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
  8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.
    - a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. 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. Exterior Doors: Thermally insulated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 1 - Full Flush.
    - d. Door Face Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
    - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
  2. Door Core Material: Polyisocyanurate, 2 lbs/cu ft minimum density.
    - a. Foam Plastic Insulation: Manufacturer's standard board insulation with maximum flame spread index (FSI) of 75, and maximum smoke developed index (SDI) of 450 in accordance with ASTM E84, and completely enclosed within interior of door.
  3. Door Thermal Resistance: R-Value of 9.9, minimum, for installed thickness of polyisocyanurate.
  4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
  5. Weatherstripping: Refer to Section 08 7100.
  6. 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. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
  3. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
  4. Door Finish: Factory primed and field finished.
- C. Fire-Rated Doors:
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: 18 gauge, 0.042 inch (1.0 mm), minimum.
- 2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
- 3. Provide units listed and labeled by UL (DIR) or ITS (DIR).
  - a. Attach fire rating label to each fire rated unit.
- 4. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
- 5. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
- 6. Door Finish: Factory primed and field finished.

#### **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. Exterior Door Frames: Full profile/continuously welded type.
  - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
  - 2. Frame Metal Thickness: 14 gauge, 0.067 inch (1.7 mm), minimum.
  - 3. Frame Finish: Factory primed and field finished.
  - 4. Weatherstripping: Separate, see Section 08 7100.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  - 1. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
  - 2. Frame Finish: Factory primed and field finished.
- D. Door Frames, Fire-Rated: Full profile/continuously welded type.
  - 1. Fire Rating: Same as door, labeled.
  - 2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
  - 3. Frame Finish: Factory primed and field finished.
- E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- F. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- G. Transom Bars: Fixed, of profile same as jamb and head.
- H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.
- I. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

#### **2.05 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

#### **2.06 ACCESSORIES**

- A. Glazing: As specified in Section 08 8000, factory installed.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. 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.
- D. 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.
- E. 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. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
- D. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- E. Install door hardware as specified in Section 08 7100.
  - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- F. Comply with glazing installation requirements of Section 08 8000.
- G. Coordinate installation of electrical connections to electrical hardware items.
- H. Touch up damaged factory finishes.

#### **3.04 TOLERANCES**

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. 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.

**END OF SECTION 08 1113**



**SECTION 08 1416  
FLUSH WOOD DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.
- B. Transom panels.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 2000 - Finish Carpentry: Wood door frames.
- B. Section 08 1113 - Hollow Metal Doors and Frames.
- C. Section 08 7100 - Door Hardware.
- D. Section 09 9123 - Interior Painting: Field finishing of doors.
- E. Section 09 9300 - Staining and Transparent Finishing: 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; 2021, with Errata.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
- D. Samples: Submit two samples of door veneer, 8 1/2 by 11 inches in size illustrating wood grain, stain color, and sheen.
- E. Specimen warranty.
- F. Warranty, executed in Owner's name.

**1.05 QUALITY ASSURANCE**

**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.
  - 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; and break seal on site to permit ventilation.
    - 1. Store doors in space having controlled humidity between 30% and 50%; temperature between 50° F. and 90° F.; stack doors flat, off floor; protect from artificial and natural light.
    - 2. Seal edges of doors immediately after delivery, unless factory sealed.
    - 3. Provide protection for door faces in contact with other surfaces.
    - 4. Walking on or stacking other materials on top of doors is prohibited. Do not drag doors across one another.
- Follow WDMA I.S. 1-A, *Job Site Information* Section.

## **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in Owner's name and register with manufacturer.
  - 1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
  - 2. Provide for finished replacement; include Project site refinishing, labor, and materials.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
  - 1. Eggers Industries: [www.eggersindustries.com](http://www.eggersindustries.com)
  - 2. Haley Brothers: [www.haleybros.com](http://www.haleybros.com)
  - 3. Marshfield Door Systems, Inc.: [www.marshfielddoors.com](http://www.marshfielddoors.com)
  - 4. Masonite Architectural; Aspiro Select Wood Veneer Doors: [www.architectural.masonite.com](http://www.architectural.masonite.com)
  - 5. VT Industries, Inc: [www.vtindustries.com](http://www.vtindustries.com)
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 DOORS AND PANELS**

- A. Doors: See drawings for locations and additional requirements.
  - 1. 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. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
  - 3. Wood veneer facing for field transparent finish as indicated on drawings.

### **2.03 DOOR AND PANEL CORES**

- A. Assembly, General:
  - 1. Doors, solid core: Stiles and rails securely bonded to cores and entire unit abrasive planed flat prior to face application.
  - 2. Wood veneer face: AWI/AWMAC/WI, Section 9, PC-5, bonded; five ply construction; two stiles, two rails.
- B. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- C. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
  - 1. Assembly, general: WDMA I.S. 1-A, AWI/AWMAC/WI, Section 9, FD-5-90PP 90 MIN; FD-5-60PP 90 MIN; or FD-5-45PP 45 MIN; five ply construction; label requirements indicated on Drawings.
  - 2. Core and edges: Asbestos free and salt-free mineral composition core; non-combustible mineral composite materials and intumescent materials that are necessary for 45 minute, 60 minute, and 90 minute ratings per manufacturer's approval(s).
  - 3. Vertical and horizontal edges: Bonded to core; AWI/AWMAC/WI, Section 9, Type II gluelines.
  - 4. Adhesive: Commercial Standard CS-171, Type II.
  - 5. Blocking, rails, and reinforcement; salt free:
    - a. Provide lock blocks for scheduled locks. Provide blocking for other scheduled surface hardware attachment directly into blocking. Top blocking 5" minimum for closers.

- b. Top and bottom rails: Manufacturer's standard; Georgia-Pacific Firestop® II high density mineral with 1130 lb. screw holding power minimum.
- 6. Stiles; salt free:
  - a. 1 1/4" minimum before fitting, Georgia-Pacific Firestop® II high density mineral with 920 lb. screw holding power minimum with 3/16" minimum exposed Type C hardwood and veneer to match face veneer.
  - b. Bonded to core. Drill 5/32" pilot holes for hinge screws.
  - c. Meet following performance criteria:
    - 1) Split resistance; tested in accord with "*Test Method to Determine Split Resistance of Hinge Edges of Composite Type Fire Doors*": Average of ten test samples shall be not less than 900 load pounds.
    - 2) Direct screw withdrawal; ASTM D1037-12: Average of ten test samples shall be not less than 650 load pounds when tested for direct screw withdrawal using No. 12 x 1 1/4" steel thread-to-the-head wood screw of cadmium plated or rust-resistant type.
- D. Vertical and horizontal edges: Bonded to solid core; WDMA T.M.6, Type II gluelines, minimum.
- E. Adhesive: Commercial Standard CS-171, Type I for exterior and high moisture doors; Type II for other interior doors.
- F. Blocking and reinforcement: No blocking required for TimberStrand® LSL or stave core doors. Provide particle board core doors with solid wood blocking such as wide top rails and lock blocks for surface hardware such as closers and exit devices.
- G. Stiles; bonded to core:
  - 1. Type B veneered to match face veneer over manufacturer's standard construction hardwood lumber; 1" hinge stile and 15/16" lock stile after trimming.
  - 2. Type A Hardwood lumber; 1 3/8" thickness before trim.
  - 3. Outer stile when two ply stile is used:
    - a. Match face veneer or Architect acceptable compatible species.
    - b. Matching hardwood: 1/4" minimum thickness after trim to assure good results if field fitting is required.
- H. Rails: AWI/AWMAC/WI, Section 9: Lumber species to match face veneer where exposed.
- I. Moldings and trim: AWI/AWMAC/WI, Section 9: Lumber species to match face veneer where exposed.
- J. Crossbands (AWI/AWMAC/WI):
  - 1. Hardwood veneer with 1/16" minimum thickness. Composite crossbands of either MDF or particleboard are not permitted unless they meet minimum requirements described below.
  - 2. Crossbands must extend the full width of the door and have grain direction at 90° to door face.
  - 3. Minimum properties for composite crossband (ANSI 208.2 and AWI/AWMAC/WI): Meet Physical and Mechanical Properties of Thin MDF-Grade 240.
  - 4. Internal Bond: 200 psi, minimum strength.
  - 5. Linear expansion: minimum of <0.2% measured between 50% and 80% Relative Humidity.

## 2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Natural birch, 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.

## 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.
- E. Provide edge clearances in accordance with the quality standard specified.

## **2.06 FINISHES - WOOD VENEER DOORS**

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
  - 1. Transparent:
    - a. System - 11, Polyurethane, Catalyzed.
    - b. Sheen: Satin.
  - 2. Opaque:
    - a. System - 4, Latex Acrylic, Water-based.
    - b. Color: As selected by Architect.
    - c. Sheen: Satin.
- B. Factory finish doors in accordance with approved sample.
  - 1. Fabricate doors to AWI/AWMAC/WI, Section 9, as applicable for Grade specified and specified criteria. Abrasively plane and bond stiles, rails, and faces to core material.
  - 2. Fabrication details; use below unless otherwise indicated:
    - a. Meeting edge for door pairs:
      - 1) Non-rated and 20 minute doors: Tee Astragal
      - 2) Rated doors: Metal Edge Guard Astragal.
    - b. Vision Panel trimming:
      - 1) Non-rated and 20 minute doors: Lip Moulding for glazing, same rating as door.
      - 2) Rated doors: Metal Vision Frame.
  - 3. Cut and fit to sizes and supplied hardware templates prior to finishing.
  - 4. Fabricate openings in non-rated doors in accord with manufacturer's standards; seal and finish immediately after cutting or machining.
  - 5. Fabricate openings in labeled doors in accord with manufacturer's inspection service procedure and under label service; seal and finish immediately after cutting or machining in accord with door manufacturer's standards.
- C. Seal door top edge with color sealer to match door facing.
- D. Tolerances:
  - 1. Not prefit doors; width, height, and thickness: +/- 1/16"
  - 2. Machined for hardware:
    - a. Width: +/- 1/32"
    - b. Height and thickness: +/- 1/16"
    - c. Hardware location: +/- 1/32"
    - d. Locks and hinges: + 1/32" -0
  - 3. Prefit clearances:
    - a. Top and hinge edge: 1/8"
    - b. Single door lock edge: 1/8"
    - c. Pair meeting edge, per leaf: 1/16"
  - 4. Squareness: Maximum 1/8" difference in diagonal measurements

## **2.07 ACCESSORIES**

- A. Hollow Metal Door Frames: See Section 08 1113.
- B. Door Hardware: See Section 08 7100.

### **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.
  - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- 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. Variation from specified clearances: + 1/32", -0
- B. Variation in edge alignment, pairs of doors, each leaf: 1/16" maximum
- C. Clearances around door perimeter:
  - 1. Hinge side: 1/16"
  - 2. Latch edge: 1/8" (+0", -1/16")
  - 3. Meeting edges, pairs of doors: 1/8" total
  - 4. Bottoms: 1/4" above threshold or floor finish except where undercutting is indicated.
- D. 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.

**END OF SECTION 08 1416**

**SECTION 08 1613  
FIBERGLASS DOORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fiberglass doors.
- B. Fiberglass door frames.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware.
- B. Section 09 9123 - Interior Painting: Factory Finished.

**1.03 REFERENCE STANDARDS**

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022.
- B. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.
- C. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- D. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
- E. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- F. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard details, installation instructions, hardware and anchor recommendations.
- C. Shop Drawings: Indicate layout and profiles; include assembly methods.
  - 1. Indicate product components, including hardware reinforcement locations and preparations, accessories, finish colors, patterns, and textures.
  - 2. Indicate wall conditions, door and frame elevations, sections, materials, gauges, finishes, location of door hardware by dimension, and details of openings; use same reference numbers indicated on drawings to identify details and openings.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials in original packaging, under cover, protected from exposure to harmful weather conditions and from direct contact with water.

1. Store at temperature and humidity conditions recommended by manufacturer.
  2. Do not use non-vented plastic or canvas shelters.
  3. Immediately remove wet wrappers.
- C. Store in position recommended by manufacturer, elevated minimum 4 inches (100 mm) above grade, with minimum 1/4 inch (6 mm) space between doors.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Fiberglass Composite Doors:
1. FRP.Architectural Doors Inc.:[www.frparch.com](http://www.frparch.com)
  2. Weiland: [www.weilanddoors.com](http://www.weilanddoors.com)
  3. Corrim: [www.corrim.com](http://www.corrim.com)
  4. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 DOOR AND FRAME ASSEMBLIES**

- A. Door and Frame Assemblies: Factory-fabricated, prepared and machined for hardware.
1. Operation: Manual.
  2. Screw-Holding Capacity: Tested to 890 pounds (404 kg), minimum.
  3. Surface Burning Characteristics: Flame spread index (FSI) of 0 to 25, Class A, and smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84.
  4. Flammability: Self-extinguishing when tested in accordance with ASTM D635.
  5. Clearance Between Door and Frame: 1/8 inch (3 mm), maximum.
  6. Clearance Between Bottom of Door and Finished Floor: 3/4 inch (19 mm), maximum; not less than 1/4 inch (6 mm) clearance to threshold.

### **2.03 COMPONENTS**

- A. Doors: Fiberglass construction with reinforced core.
1. Type: As indicated on drawings, including swinging doors.
  2. Thickness: 1-3/4 inch (44 mm), nominal.
  3. Core Material: Manufacturer's standard core material for application indicated.
  4. Construction:
  5. Face Sheet Texture: Smooth.
  6. Door Panel Configuration: As indicated on drawings.
  7. Subframe and Reinforcements: Manufacturer's standard materials.
  8. Waterproof Integrity: Provide factory fabricated edges, cut-outs, and hardware preparations of fiberglass reinforced plastic (FRP); provide cut-outs with joints sealed independently of glazing, louver inserts, or trim.
  9. Hardware Preparations: Factory reinforce, machine, and prepare for door hardware including field installed items; provide solid blocking for each item; field cutting, drilling or tapping is not permitted; obtain manufacturer's hardware templates for preparation as necessary.
- B. Door Frames: Provide type in compliance with performance requirements specified for doors.
1. Type: Factory assembled with chemically welded joints.
  2. Profiles: As indicated on drawings.
  3. Door Stop: 5/8 inch (16 mm) wide, by 1-7/8 inches (48 mm) deep.

### **2.04 PERFORMANCE REQUIREMENTS**

- A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
- B. Fiberglass Doors: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific door type:
1. Performance Class (PC): R.

### **2.05 FINISHES**

- A. Gel Coating: Ultraviolet (UV) stabilized polyester finish.

1. Thickness: Minimum 15 mils, 0.015 inch (0.38 mm) wet thickness, plus/minus 3 mils, 0.003 inch (0.07 mm).

## **2.06 HARDWARE**

- A. Door Hardware: See Section 08 7100.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify actual dimensions of openings by field measurements before door fabrication; show recorded measurements on shop drawings.
- B. Do not begin installation until substrates have been properly prepared.

### **3.02 PREPARATION**

- A. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- B. Clean and prepare substrate in accordance with manufacturer's directions.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions; do not penetrate frames with anchors.
- B. Set units plumb, level, and true-to-line, without warping or racking doors, and with specified clearances; anchor in place.
- C. Separate aluminum and other metal surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

### **3.04 ADJUSTING**

- A. Lubricate, test, and adjust doors to operate easily, free from warp, twist or distortion, and to fit watertight for entire perimeter.
- B. Adjust hardware for smooth and quiet operation.
- C. Adjust doors to fit snugly and close without sticking or binding.

### **3.05 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.

**END OF SECTION 08 1613**



**SECTION 08 3100  
ACCESS DOORS AND PANELS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wall- and ceiling-mounted access units.

**1.02 REFERENCE STANDARDS**

- A. ITS (DIR) - Directory of Listed Products; Current Edition.
- B. UL (FRD) - Fire Resistance Directory; Current Edition.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

**PART 2 PRODUCTS**

**2.01 ACCESS DOORS AND PANELS ASSEMBLIES**

- A. Wall-Mounted Units with Return Air Grille:
  - 1. Size: 12 by 12 inches (305 by 305 mm).
- B. Ceiling-Mounted Units with Return Air Grille:
  - 1. Location: As indicated on drawings.
  - 2. Panel Material: Aluminum extrusion with gypsum board inlay.
  - 3. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
  - 4. Size - Other Ceilings: 12 by 12 inches (305 by 305 mm).
  - 5. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

**2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS**

- A. Manufacturers:
  - 1. ACUDOR Products Inc: [www.acudor.com](http://www.acudor.com)
  - 2. Babcock-Davis: [www.babcockdavis.com](http://www.babcockdavis.com)
  - 3. Milcor, Inc.: [www.milcorinc.com](http://www.milcorinc.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Wall- and Ceiling-Mounted Units: 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. Style: Exposed frame with door surface flush with frame surface.
  - 2. Door Style: Single thickness with rolled or turned in edges.
  - 3. Heavy-Duty Frames: 14-gauge, 0.0747-inch (1.89 mm) minimum thickness.
  - 4. Hardware:
    - a. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
    - b. Latch/Lock: Tamperproof tool-operated cam latch.

**2.03 WALL- AND CEILING-MOUNTED ACCESS UNITS WITH RETURN AIR GRILLES**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that rough openings are correctly sized and located.

**3.02 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 3100**

**SECTION 08 4313  
ALUMINUM-FRAMED STOREFRONTS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront, with vision glass.
- B. Aluminum doors and frames.
- C. Weatherstripping.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- B. Section 08 8000 - 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 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. 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.
- H. 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).
- I. 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).

**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 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, 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.
  - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- E. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

### **1.06 QUALITY ASSURANCE**

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- C. 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. 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 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- C. 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 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING**

- A. Center-Set Style, Thermally-Broken:
  - 1. Basis of Design: Kawneer North America; Trifab VG 451T: [www.kawneer.com](http://www.kawneer.com)
  - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (51 mm wide by 114 mm deep).
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
  - 1. C.R. Laurence Company, Inc.; U.S. Aluminum: [www.crl-arch.com](http://www.crl-arch.com)
  - 2. Oldcastle BuildingEnvelope: [www.oldcastlebe.com](http://www.oldcastlebe.com)
  - 3. YKK AP America, Inc.: [www.ykkap.com](http://www.ykkap.com)
- C. Substitutions: See Section 01 6000 - Product Requirements.
  - 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### **2.02 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING**

- A. Center-Set Style:
  - 1. Basis of Design: Kawneer North America; Trifab VG 450: [www.kawneer.com](http://www.kawneer.com)
  - 2. Vertical Mullion Dimensions: 2 inches wide by 4 1/2 inches deep.
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
  - 1. C.R. Laurence Company, Inc.; U.S. Aluminum: [www.crl-arch.com](http://www.crl-arch.com)
  - 2. Oldcastle BuildingEnvelope: [www.oldcastlebe.com](http://www.oldcastlebe.com)
  - 3. YKK AP America, Inc.: [www.ykkap.com](http://www.ykkap.com)
- C. Substitutions: See Section 01 6000 - Product Requirements.
  - 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### 2.03 BASIS OF DESIGN -- SWINGING DOORS

- A. Medium Stile, Insulating Glazing, Thermally-Broken:
  - 1. Basis of Design: Kawneer North America; Trifab VG 450: [www.kawneer.com](http://www.kawneer.com)
  - 2. Thickness: 2-1/4 inches (57.1 mm).
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
  - 1. C.R. Laurence Company, Inc.; U.S. Aluminum: [www.crl-arch.com](http://www.crl-arch.com)
  - 2. Oldcastle BuildingEnvelope: [www.oldcastlebe.com](http://www.oldcastlebe.com)
  - 3. YKK AP America, Inc.: [www.ykkap.com](http://www.ykkap.com)
- C. Substitutions: See Section 01 6000 - Product Requirements.
  - 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

### 2.04 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  - 1. Glazing Rabbet: For 1 inch (25 mm) insulating glazing.
  - 2. Glazing Rabbet: For 1/4 inch (6 mm) monolithic glazing.
  - 3. Finish: Class I natural anodized.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
  - 4. 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.
  - 5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
  - 6. 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.
  - 7. 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.
  - 8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  - 9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
  - 10. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and heel bead of glazing compound.
  - 11. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- 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 applicable code.
    - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
  - 2. 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).
  - 3. 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.

## 2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, 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 8000.
- C. Swing Doors: Glazed aluminum.
  - 1. Thickness: 2 1/4 inches (\_\_\_\_ mm).
  - 2. Top Rail: 4 1/4 inches (\_\_\_\_ mm) wide.
  - 3. Bottom Rail: 6 1/2 inches (\_\_\_\_ mm) wide.
  - 4. Glazing Stops: Square.
  - 5. Finish: Same as storefront.

## 2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- D. Concealed Flashings: Sheet aluminum, 26 gauge, 0.017 inch (0.43 mm) minimum thickness.
- E. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- F. Sealant for Setting Thresholds: Non-curing butyl type.
- G. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- H. Glazing Accessories: See Section 08 8000.

## 2.07 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils (0.018 mm) thick.

## 2.08 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: See Section 08 7100.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

## PART 3 EXECUTION

### 3.01 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. Install glass using glazing method required to achieve performance criteria; see Section 08 8000.
- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.02 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).

### **3.03 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 indicated on drawings.
  - 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.

### **3.04 ADJUSTING**

- A. Adjust operating hardware and sash for smooth operation.

### **3.05 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.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

### **3.06 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.

**END OF SECTION 08 4313**

**SECTION 08 5113  
ALUMINUM WINDOWS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Extruded aluminum windows with fixed sash.
- B. Factory glazing.

**PART 2 PRODUCTS**

**2.01 ALUMINUM WINDOWS**

- A. Aluminum Windows: Extruded aluminum frame and sash, factory fabricated, factory finished, with operating hardware, related flashings, and anchorage and attachment devices.
  - 1. Frame Depth: 3-1/2 inch (89 mm).
  - 2. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for operating hardware and imposed loads.
  - 3. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
  - 4. Movement: Accommodate movement between window and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
  - 5. 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.

**END OF SECTION 08 5113**



## **SECTION 087100 - DOOR HARDWARE**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### **1.2 SUMMARY**

- A. This Section includes commercial door hardware for the following:
  - 1. Swinging doors.
  - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
  - 1. Mechanical door hardware.
  - 2. Electromechanical door hardware.
  - 3. Cylinders specified for doors in other sections.
- C. Related Sections:
  - 1. Division 01 Section "Closeout Procedures"
  - 2. Division 06 Section "Finish Carpentry".
  - 3. Division 08 Section "Operations and Maintenance".
  - 4. Division 08 Section "Door Schedule".
  - 5. Division 08 Section "Hollow Metal Doors and Frames".
  - 6. Division 08 Section "Fiberglass Doors",
  - 7. Division 08 Section "Aluminum-Framed Entrances and Storefronts".
- D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.
  - 1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
  - 2. ICC/IBC - International Building Code.
  - 3. NFPA 70 - National Electrical Code.
  - 4. NFPA 80 - Fire Doors and Windows.
  - 5. NFPA 101 - Life Safety Code.
  - 6. NFPA 105 - Installation of Smoke Door Assemblies.
  - 7. State Building Codes, Local Amendments.
- E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:
  - 1. ANSI/BHMA Certified Product Standards - A156 Series.
  - 2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
  - 3. ANSI/UL 294 - Access Control System Units.
  - 4. UL 305 - Panic Hardware.
  - 5. ANSI/UL 437- Key Locks.

#### **1.3 SUBMITTALS**

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
  2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
  3. Content: Include the following information:
    - a. Type, style, function, size, label, hand, and finish of each door hardware item.
    - b. Manufacturer of each item.
    - c. Fastenings and other pertinent information.
    - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    - e. Explanation of abbreviations, symbols, and codes contained in schedule.
    - f. Mounting locations for door hardware.
    - g. Door and frame sizes and materials.
    - h. Warranty information for each product.
  4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
    - a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    - b. Complete (risers, point-to-point) access control system block wiring diagrams.
    - c. Wiring instructions for each electronic component scheduled herein.
  2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.
- E. Informational Submittals:
1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.
- F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).
- C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
- E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
  - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
  - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.
- G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
  - 1. Function of building, purpose of each area and degree of security required.
  - 2. Plans for existing and future key system expansion.
  - 3. Requirements for key control storage and software.
  - 4. Installation of permanent keys, cylinder cores and software.
  - 5. Address and requirements for delivery of keys.
- H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
  - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
  - 2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
  - 3. Review sequence of operation narratives for each unique access controlled opening.
  - 4. Review and finalize construction schedule and verify availability of materials.
  - 5. Review the required inspecting, testing, commissioning, and demonstration procedures

- I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

#### **1.6 COORDINATION**

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

#### **1.7 WARRANTY**

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
  1. Structural failures including excessive deflection, cracking, or breakage.
  2. Faulty operation of the hardware.
  3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  4. Electrical component defects and failures within the systems operation.
- C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 SCHEDULED DOOR HARDWARE**

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

- B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
  - 1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.
- C. Please note that ASSA ABLOY is transitioning the Yale Commercial brand to ASSA ABLOY ACCENTRA. This affects only the brand name; the products and product numbers will remain unchanged. The brand transition is expected to be complete in or about May of 2024, and products shipping after that time will be branded ASSA ABLOY ACCENTRA.
- D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

## **2.2 BUTT HINGES**

- A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
  - 1. Quantity: Provide the following hinge quantity:
    - a. Two Hinges: For doors with heights up to 60 inches.
    - b. Three Hinges: For doors with heights 61 to 90 inches.
    - c. Four Hinges: For doors with heights 91 to 120 inches.
    - d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
  - 2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
    - a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
    - b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
  - 3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
    - a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    - b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
  - 4. Hinge Options: Comply with the following:
    - a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
  - 5. Manufacturers:
    - a. McKinney (MK) - TA/T4A Series, 5-knuckle.

## **2.3 CONTINUOUS HINGES**

- A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.
  - 1. Manufacturers:
    - a. Pemko (PE).

## **2.4 POWER TRANSFER DEVICES**

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.
1. Manufacturers:
    - a. Pemko (PE) - EL-CEPT Series.
    - b. Securitron (SU) - EL-CEPT Series.
- B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.
1. Provide one each of the following tools as part of the base bid contract:
    - a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    - b. McKinney (MK) - Connector Hand Tool: QC-R003.
  2. Manufacturers:
    - a. McKinney (MK) - QC-C Series.

## **2.5 DOOR OPERATING TRIM**

- A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.
1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
  2. Furnish dust proof strikes for bottom bolts.
  3. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
  4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
  5. Manufacturers:
    - a. Rockwood (RO).
- B. Coordinators: ANSI/BHMA A156.3 door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Model as indicated in hardware sets.
1. Manufacturers:
    - a. Rockwood (RO).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
  2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls, where applicable, shall be provided with a 10" clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
6. Manufacturers:
  - a. Rockwood (RO).

## 2.6 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
- B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:
  1. Threaded mortise cylinders with rings and cams to suit hardware application.
  2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
  3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
  4. Tubular deadlocks and other auxiliary locks.
  5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
  6. Keyway: Manufacturer's Standard.
- C. Large Format Interchangeable Cores: Provide removable cores (LFIC) as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.
- D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed cylinders employing a utility patented and restricted keyway requiring the use of a patented key. Cylinders are to be protected from unauthorized manufacture and distribution by manufacturer's United States patents. Cylinders are to be factory keyed with owner having the ability for on-site original key cutting.
  1. Patented key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
  2. Manufacturers:
    - a. Corbin Russwin (RU) - Access 3 AP.
    - b. Sargent (SA) - Degree DG1.
- E. Keying System: Each type of lock and cylinders to be factory keyed.
  1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
  2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
  3. New System: Key locks to a new key system as directed by the Owner.
- F. Key Quantity: Provide the following minimum number of keys:
  1. Change Keys per Cylinder: Two (2)
  2. Master Keys (per Master Key Level/Group): Five (5).
  3. Construction Keys (where required): Ten (10).
  4. Construction Control Keys (where required): Two (2).
  5. Permanent Control Keys (where required): Two (2).
- G. Construction Keying: Provide temporary keyed construction cores.
- H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

## **2.7 KEY CONTROL**

- A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
  1. Manufacturers:
    - a. Lund Equipment (LU).
    - b. MMF Industries (MM).
    - c. Telkee (TK).

## **2.8 MORTISE LOCKS AND LATCHING DEVICES**

- A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.
  1. Provide locksets with functions and features as follows:
    - a. Heavy duty 12-gauge wrought steel case.
    - b. Stainless steel 3/4" one-piece anti-friction reversible latchbolt with a one-piece hardened stainless steel 1" projection deadbolt.
    - c. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    - d. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    - e. Meets UL Certification Directory ZHLL.R21744 for products used in windstorm rated assemblies.
    - f. Status indicators inside, outside, or on both sides of doors as specified; available with wording for "locked/unlocked", "vacant/occupied" or custom wording options. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status.
    - g. Ten-year limited warranty for mechanical functions.
  2. Electromechanical locksets shall have the following functions and features:
    - a. Universal Molex plug-in connectors that have standardized color-coded wiring and are available in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
    - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
    - c. Options to be available for request-to-exit or enter signaling, latchbolt and deadbolt monitoring.
    - d. Optional high security monitoring with internal end-of-line monitoring alongside deadbolt privacy and integrated door position monitoring.
    - e. Two-year limited warranty on electrified functions.
  3. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - ML2000 Series.
    - b. Sargent Manufacturing (SA) - 8200 Series.



## **2.9 CYLINDRICAL LOCKS AND LATCHING DEVICES**

- A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide locksets with functions and features as follows:
    - a. Meets ANSI/BHMA A156.41 for single motion egress.
    - b. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    - c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    - d. Exceeds ANSI/BHMA A156.2 requirements by 2.6 times for 3,100 in-lb. abusive locked lever torque with no entry while maintaining egress.
    - e. Exceeds ANSI/BHMA A156.2 requirements by 8 times for 1,600 lbs. offset lever pull with no entry for protection against attacks.
    - f. Exceeds ANSI/BHMA A156.3 requirements by 2 times for latch retraction with 100 lb. preload while maintaining operation in warped doors.
    - g. Exceeds ANSI/BHMA A156.3 requirements by 20 times for no access with minimum 100 vertical impacts for protection against vandalism attempts.
    - h. Independent return springs allow lock to exceed ANSI/BHMA A156.2 Grade 1 cycle requirements without lever sag.
    - i. Ten-year limited warranty for mechanical functions.
  2. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - CLX3300 Series.
    - b. Sargent Manufacturing (SA) - 10X Line.
- B. Cylindrical Indicator Locksets, Grade 1 (Commercial Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide locksets with functions and features as follows:
    - a. Visual status indicators in rose, displaying bold visuals for vacant or occupied lock status.
    - b. Meets ANSI/BHMA A156.41 for single motion egress.
    - c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    - d. Three-year limited warranty.
  2. Manufacturers:
    - a. ASSA ABLOY ACCENTRA, formerly known as Yale (YA) - YPL Series.

## **2.10 LOCK AND LATCH STRIKES**

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
  2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
  3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
  4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
- B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

## **2.11 CONVENTIONAL EXIT DEVICES**

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. Exit devices shall have a five-year warranty.
  2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
  3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
  4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
  5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
  6. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
  7. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
    - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
  8. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
  9. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
  10. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
  11. Rail Sizing: Provide exit device rails factory sized for proper door width application.
  12. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.
1. Provide exit devices with functions and features as follows:
    - a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    - b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
    - c. Five-year limited warranty for mechanical features.
  2. Electromechanical exit devices shall have the following functions and features:

- a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
  - b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
  - c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
  - d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
  - e. Five-year limited warranty for electromechanical features.
3. Manufacturers:
- a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
  - b. Sargent Manufacturing (SA) - 80 Series.

## 2.12 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
  2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
  3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
  4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
  5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
  6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.
- B. Door Closers, Surface Mounted (Unitrol): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted closers with door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.
1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - Unitrol Series.
    - b. Norton Rixson (NO) - Unitrol Series.
- C. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.
1. Manufacturers:
    - a. Corbin Russwin Hardware (RU) - DC6000 Series.
    - b. Norton Rixson (NO) - 8500 Series.
    - c. Sargent Manufacturing (SA) - 1431 Series.

- D. Door Closers, Overhead Concealed Double Acting (Heavy Duty): Center pivot, double acting ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) overhead door closers. UL Listed and ADA-compliant for interior or exterior doors up to 250 lbs. Closers are non-handed, with adjustable spring strength, hydraulic back check, and two closing speed adjustments for sweep and latch. Latch speed can be independently adjustable per door direction. Cast iron body construction with 1-1/4" dual pistons and an optional hold open feature. Closer bodies shall fit in a 1-3/4" x 4" metal or aluminum transom and 2-1/2" x 4-1/2" wood frame.
1. Manufacturers:
    - a. Norton Rixson (RF) - 73 Series.

## **2.13 ARCHITECTURAL TRIM**

- A. Door Protective Trim
1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
  2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
  3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer's catalog and template book for specific requirements for size and applications.
  4. Protection Plates: ANSI/BHMA A156.6 protection plates (kick, armor, or mop), fabricated from the following:
    - a. Stainless Steel: 300 grade, 050-inch thick.
  5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.
  6. Manufacturers:
    - a. Rockwood (RO).

## **2.14 DOOR STOPS AND HOLDERS**

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
1. Manufacturers:
    - a. Rockwood (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
1. Manufacturers:
    - a. Norton Rixson (RF).
    - b. Rockwood (RO).
    - c. Sargent Manufacturing (SA).

## **2.15 ARCHITECTURAL SEALS**

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
  - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
  - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Manufacturers:
  - 1. Pemko (PE).

## **2.16 ELECTRONIC ACCESSORIES**

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
  - 1. Manufacturers:
    - a. Securitron (SU) - DPS Series.
- B. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.
  - 1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
  - 2. Manufacturers:
    - a. Securitron (SU) - AQL Series.

## **2.17 FABRICATION**

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

## **2.18 FINISHES**

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### **3.2 PREPARATION**

- A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.
- B. Wood Doors: Comply with ANSI/DHI A115-W series.

### **3.3 INSTALLATION**

- A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
  - 1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.
- B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
  - 2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
  - 3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
  - 4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.
- C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9

Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

- D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."
- E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

### **3.4 FIELD QUALITY CONTROL**

- A. Field Inspection (Punch Report): Reference Division 01 Sections "Closeout Procedures". Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

### **3.5 ADJUSTING**

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### **3.6 CLEANING AND PROTECTION**

- A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.
- B. Clean adjacent surfaces soiled by door hardware installation.
- C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

### **3.7 DEMONSTRATION**

- A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

### **3.8 DOOR HARDWARE SETS**

- A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.
  - 1. Quantities listed are for each pair of doors, or for each single door.
  - 2. The supplier is responsible for handling and sizing all products.
  - 3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
- B. Manufacturer's Abbreviations:

- 1. MK - McKinney

2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. SA - SARGENT
6. YA - ASSA ABLOY ACCENTRA
7. RF - Rixson
8. NO - Norton
9. HG - HID Global

### **Hardware Sets**

#### **Set: 1.0**

Doors: 101, 142A

Description: EXTERIOR - ALUM - PAIR - INTAKE LOBBY, VEST.

|                                       |                                 |        |    |
|---------------------------------------|---------------------------------|--------|----|
| 2 Continuous Hinge                    | K10BEFM__HD1 x Length Required  |        | PE |
| 1 Concealed Vert Rod Exit, Nightlatch | DG164 43 AD8410 106 x Less Pull | US10BE | SA |
| 1 Concealed Vert Rod Exit, Exit Only  | 43 AD8410 EO                    | US10BE | SA |
| 1 Core                                | DG1 6300                        | US4    | SA |
| 2 Door Pull                           | BF158                           | 10BE   | RO |
| 2 Conc Overhead Stop                  | 6ADJ-_36                        | 613E   | RF |
| 2 Surface Closer                      | J8501                           | 613E   | NO |

#### Notes:

- Balance of hardware: Threshold, door sweeps, perimeter and meeting stile gasket furnished by aluminum storefront door/frame manufacturer.
- Coordinate all hardware with the aluminum storefront door/frame manufacturer/supplier.
- Provide necessary drop plates and fillers for proper installation of door closers.
- Exit devices can be dogged down for push / pull operation.
- Verify finish of hardware.



**Set: 2.0**

Doors: 110, 118C, 121B, 147B, 135D

Description: EXTERIOR - ADOPTION, CORRIDOR, INTAKE DOG (CARD READER)

|                                 |                                      |           |    |   |
|---------------------------------|--------------------------------------|-----------|----|---|
| 1 Continuous Hinge              | CFM__SLF-HD1 PT x Length Required    |           | PE |   |
| 1 Electric Power Transfer       | EL-CEPT                              | 630       | SU | ⚡ |
| 1 Rim Exit Device, Nightlatch   | DG164 43 55 56 8804 862              | US32D     | SA | ⚡ |
| 1 Core                          | DG1 6300                             | US15      | SA |   |
| 1 Surface Closer                | UNI8501                              | 600 x 689 | NO |   |
| 1 Kick Plate                    | K1050 10" high CSK BEV               | US32D     | RO |   |
| 1 Rain Guard                    | 346C x Frame Width                   |           | PE |   |
| 1 Gasketing                     | 303CSTST (Head & Jambs)              |           | PE |   |
| 1 Sweep                         | 315CN x Door Width                   |           | PE |   |
| 1 Threshold                     | 2005AT x L.A.R. x MSES25SS           |           | PE |   |
| 1 ElectroLynx Harness [door]    | QC-C**** (length / type as required) |           | MK | ⚡ |
| 1 ElectroLynx Harness [frame]   | QC-C1500P                            |           | MK | ⚡ |
| 1 Door Position Switch          | DPS-M / W-BK                         |           | SU | ⚡ |
| 1 Signo Reader                  | 20 / 40 (as req'd per application)   | BLK       | HG | ⚡ |
| 1 Power Supply                  | AQL Series (Type & Size as Required) |           | SU | ⚡ |
| 1 Wiring/Point-to-Point Diagram |                                      |           |    |   |
| 1 Elevation Diagram             |                                      |           |    |   |
| 1 Riser Diagram                 |                                      |           |    |   |

Notes:

-Coordinate with electrical, alarm and security contractors.

-Access control panel, security management software and credentials by Security Contractor.

Operational Narrative (Local AHJ should always be consulted and sign off on the operation):

1. Door normally closed and secure.
2. Authorized access by card reader retracting exit device latch for predetermined time limit. Exit device latch can be electrically held retracted for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed status.
6. Exit device latch releases (fail secure) in event of power loss. Keyed cylinder override for emergency access.

**Set: 3.0**

Doors: 164B

Description: EXTERIOR - ELEC (CARD READER)

|                               |                                      |           |    |   |
|-------------------------------|--------------------------------------|-----------|----|---|
| 1 Continuous Hinge            | CFM__SLF-HD1 PT x Length Required    |           | PE |   |
| 1 Electric Power Transfer     | EL-CEPT                              | 630       | SU | ⚡ |
| 1 Rim Exit Device, Nightlatch | DG164 43 55 56 8804 ETL              | US32D     | SA | ⚡ |
| 1 Core                        | DG1 6300                             | US15      | SA |   |
| 1 Surface Closer              | UNI8501                              | 600 x 689 | NO |   |
| 1 Kick Plate                  | K1050 10" high CSK BEV               | US32D     | RO |   |
| 1 Rain Guard                  | 346C x Frame Width                   |           | PE |   |
| 1 Gasketing                   | 303CSTST (Head & Jambs)              |           | PE |   |
| 1 Sweep                       | 315CN x Door Width                   |           | PE |   |
| 1 Threshold                   | 2005AT x L.A.R. x MSES25SS           |           | PE |   |
| 1 ElectroLynx Harness [door]  | QC-C**** (length / type as required) |           | MK | ⚡ |

|                                 |                                      |     |    |   |
|---------------------------------|--------------------------------------|-----|----|---|
| 1 ElectroLynx Harness [frame]   | QC-C1500P                            |     | MK | ⚡ |
| 1 Door Position Switch          | DPS-M / W-BK                         |     | SU | ⚡ |
| 1 Signo Reader                  | 20 / 40 (as req'd per application)   | BLK | HG | ⚡ |
| 1 Power Supply                  | AQL Series (Type & Size as Required) |     | SU | ⚡ |
| 1 Wiring/Point-to-Point Diagram |                                      |     |    |   |
| 1 Elevation Diagram             |                                      |     |    |   |
| 1 Riser Diagram                 |                                      |     |    |   |

Notes:

-Knurling: Where required by local code provide knurling or abrasive coating to all levers on doors leading to hazardous areas such as electrical rooms, mechanical rooms, boiler and furnace rooms, janitor closets, and as otherwise required.

-Coordinate with electrical, alarm and security contractors.

-Access control panel, security management software and credentials by Security Contractor.

Operational Narrative (Local AHJ should always be consulted and sign off on the operation):

1. Door normally closed and secure.
2. Authorized access by card reader retracting exit device latch for predetermined time limit. Exit device latch can be electrically held retracted for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switch monitors open/closed status.
6. Exit device latch releases (fail secure) in event of power loss. Keyed cylinder override for emergency access.

**Set: 4.0**

Doors: 118B, 120C, 136

Description: EXTERIOR - ADOPTION, CORRIDOR

|                               |                                |           |    |
|-------------------------------|--------------------------------|-----------|----|
| 1 Continuous Hinge            | CFM__SLF-HD1 x Length Required |           | PE |
| 1 Rim Exit Device, Nightlatch | DG164 43 8804 862              | US32D     | SA |
| 1 Core                        | DG1 6300                       | US15      | SA |
| 1 Surface Closer              | UNI8501                        | 600 x 689 | NO |
| 1 Kick Plate                  | K1050 10" high CSK BEV         | US32D     | RO |
| 1 Rain Guard                  | 346C x Frame Width             |           | PE |
| 1 Gasketing                   | 303CSTST (Head & Jambs)        |           | PE |
| 1 Sweep                       | 315CN x Door Width             |           | PE |
| 1 Threshold                   | 2005AT x L.A.R. x MSES25SS     |           | PE |

**Set: 5.0**

Doors: 163

Description: EXTERIOR - PAIR - MED GAS (CARD READER)

|                            |                                   |       |      |
|----------------------------|-----------------------------------|-------|------|
| 1 Continuous Hinge         | CFM__SLF-HD1 x Length Required    |       | PE   |
| 1 Continuous Hinge         | CFM__SLF-HD1 PT x Length Required |       | PE   |
| 1 Electric Power Transfer  | EL-CEPT                           | 630   | SU ⚡ |
| 2 Flush Bolt               | 555 [12" / 72" AFF]               | US26D | RO   |
| 1 Dust Proof Strike        | 570                               | US26D | RO   |
| 1 Electrified Mortise Lock | DG164 IDP NAC-82281 LNL           | US32D | SA ⚡ |
| 1 Core                     | DG1 6300                          | US15  | SA   |
| 1 Coordinator              | 1700                              | Black | RO   |

|   |                               |                                              |           |    |   |
|---|-------------------------------|----------------------------------------------|-----------|----|---|
| 2 | Surface Closer                | UNI8501                                      | 600 x 689 | NO |   |
| 2 | Kick Plate                    | K1050 10" high CSK BEV                       | US32D     | RO |   |
| 1 | Astragal                      | 357SP x Door Height                          |           | PE |   |
| 1 | Rain Guard                    | 346C x Frame Width                           |           | PE |   |
| 1 | Gasketing                     | 303CSTST (Head & Jambs)                      |           | PE |   |
| 2 | Sweep                         | 315CN x Door Width                           |           | PE |   |
| 1 | Threshold                     | 2005AT x L.A.R. x MSES25SS                   |           | PE |   |
| 1 | ElectroLynx Harness [door]    | QC-C**** (length / type as required)         |           | MK | ⚡ |
| 1 | ElectroLynx Harness [frame]   | QC-C1500P                                    |           | MK | ⚡ |
| 1 | Signo Reader                  | 20 / 40 (as req'd per application)           | BLK       | HG | ⚡ |
| 1 | Door Position Switch          | Integrated into the electrified mortise lock |           | SA | ⚡ |
| 1 | Power Supply                  | AQL Series (Type & Size as Required)         |           | SU | ⚡ |
| 1 | Wiring/Point-to-Point Diagram |                                              |           |    |   |
| 1 | Elevation Diagram             |                                              |           |    |   |
| 1 | Riser Diagram                 |                                              |           |    |   |

Notes:

- Coordinate with electrical, alarm and security contractors.
- Access control panel, security management software and credentials by Security Contractor.

Operational Narrative (Local AHJ should always be consulted and sign off on the operation):

1. Doors normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. Mortise lock REX switch allows authorized exit without alarm condition.
5. Integral door position switch monitors open/closed status.
6. Lever remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

**Set: 6.0**

Doors: 158B

Description: EXTERIOR - BULK STORAGE, INCINERATOR (CARD READER)

|   |                               |                                              |           |    |   |
|---|-------------------------------|----------------------------------------------|-----------|----|---|
| 1 | Continuous Hinge              | CFM__SLF-HD1 PT x Length Required            |           | PE |   |
| 1 | Electric Power Transfer       | EL-CEPT                                      | 630       | SU | ⚡ |
| 1 | Electrified Mortise Lock      | DG164 IDP NAC-82281 LNL                      | US32D     | SA | ⚡ |
| 1 | Core                          | DG1 6300                                     | US15      | SA |   |
| 1 | Surface Closer                | UNI8501                                      | 600 x 689 | NO |   |
| 1 | Kick Plate                    | K1050 10" high CSK BEV                       | US32D     | RO |   |
| 1 | Rain Guard                    | 346C x Frame Width                           |           | PE |   |
| 1 | Gasketing                     | 303CSTST (Head & Jambs)                      |           | PE |   |
| 1 | Sweep                         | 315CN x Door Width                           |           | PE |   |
| 1 | Threshold                     | 2005AT x L.A.R. x MSES25SS                   |           | PE |   |
| 1 | ElectroLynx Harness [door]    | QC-C**** (length / type as required)         |           | MK | ⚡ |
| 1 | ElectroLynx Harness [frame]   | QC-C1500P                                    |           | MK | ⚡ |
| 1 | Signo Reader                  | 20 / 40 (as req'd per application)           | BLK       | HG | ⚡ |
| 1 | Door Position Switch          | Integrated into the electrified mortise lock |           | SA | ⚡ |
| 1 | Power Supply                  | AQL Series (Type & Size as Required)         |           | SU | ⚡ |
| 1 | Wiring/Point-to-Point Diagram |                                              |           |    |   |
| 1 | Elevation Diagram             |                                              |           |    |   |

## 1 Riser Diagram

### Notes:

- Coordinate with electrical, alarm and security contractors.
- Access control panel, security management software and credentials by Security Contractor.

Operational Narrative (Local AHJ should always be consulted and sign off on the operation):

1. Door normally closed and secure.
2. Authorized access by card reader unlocking lever trim for a predetermined time limit. Trim can remain unlocked for open access.
3. Egress free for immediate exit.
4. Mortise lock REX switch allows authorized exit without alarm condition.
5. Integral door position switch monitors open/closed status.
6. Lever remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.

## **Set: 7.0 – NOT USED**

### **Set: 8.0**

Doors: 102

Description: ALUM - PAIR - ADOPTION LOBBY

|                    |                                |      |    |
|--------------------|--------------------------------|------|----|
| 2 Continuous Hinge | K10BEFM__HD1 x Length Required |      | PE |
| 2 Push Bar & Pull  | BF15847                        | 10BE | RO |
| 2 Surface Closer   | 8501                           | 613E | NO |

### Notes:

- Coordinate all hardware with the aluminum storefront door/frame manufacturer/supplier.
- Provide necessary drop plates and fillers for proper installation of door closers.
- Where possible install closers on door for optimum aesthetics.
- Verify finish of hardware.

### **Set: 9.0**

Doors: 103, 109A, 109B, 109C, 117

Description: ALUM - CORRIDOR, MEETING, VEST.

|                    |                              |       |    |
|--------------------|------------------------------|-------|----|
| 1 Continuous Hinge | KCFM__-HD1 x Length Required |       | PE |
| 1 Push Bar & Pull  | BF15847                      | US28  | RO |
| 1 Surface Closer   | 8501 Reg / PA                | 689   | NO |
| 1 Door Stop        | 409 / 446 as required        | US32D | RO |

### Notes:

- Coordinate all hardware with the aluminum storefront door/frame manufacturer/supplier.
- Provide necessary drop plates and fillers for proper installation of door closers.
- Where possible install closers on door for optimum aesthetics.
- Verify finish of hardware.

**Set: 10.0**

Doors: 158A, 159A

Description: PAIR - STORAGE

|                         |                                     |       |    |
|-------------------------|-------------------------------------|-------|----|
| 6 Hinge, Full Mortise   | TA2714                              | US26D | MK |
| 1 Auto Flush Bolt Set   | 2842 / 2962 (As Required)           | US26D | RO |
| 1 Dust Proof Strike     | 570                                 | US26D | RO |
| 1 Storeroom/Closet Lock | DG164 41 10XG04 LL                  | US26D | SA |
| 1 Core                  | DG1 6300                            | US15  | SA |
| 1 Coordinator           | 1700                                | Black | RO |
| 2 Surface Closer        | 8501 Reg / PA                       | 689   | NO |
| 2 Kick Plate            | K1050 10" high CSK BEV              | US32D | RO |
| 2 Door Stop             | 409 / 446 as required               | US32D | RO |
| 1 Astragal              | 357SP with S88BL x TB x Door Height |       | PE |
| 1 Gasketing             | S88BL (Head & Jambs)                |       | PE |

**Notes:**

-Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.

**Set: 11.0**

Doors: 151

Description: EUTH

|                         |                       |       |    |
|-------------------------|-----------------------|-------|----|
| 3 Hinge, Full Mortise   | TA2714                | US26D | MK |
| 1 Storeroom/Closet Lock | DG164 10XG04 LL       | US26D | SA |
| 1 Core                  | DG1 6300              | US15  | SA |
| 1 Door Stop             | 409 / 446 as required | US32D | RO |
| 3 Silencer              | 608-RKW               |       | RO |

**Set: 12.0**

Doors: 120B, 135B, 141B

|                         |                       |       |    |
|-------------------------|-----------------------|-------|----|
| 3 Hinge, Full Mortise   | TA2314                | US32D | MK |
| 1 Storeroom/Closet Lock | DG164 10XG04 LL       | US26D | SA |
| 1 Core                  | DG1 6300              | US15  | SA |
| 1 Door Stop             | 409 / 446 as required | US32D | RO |
| 3 Silencer              | 608-RKW               |       | RO |

**Set: 13.0**

Doors: 108, 157, 164A

Description: ELEC, IT, MECH

|                         |                        |       |    |
|-------------------------|------------------------|-------|----|
| 3 Hinge, Full Mortise   | TA2714                 | US26D | MK |
| 1 Storeroom/Closet Lock | DG164 10XG04 LL        | US26D | SA |
| 1 Core                  | DG1 6300               | US15  | SA |
| 1 Surface Closer        | 8501 Reg / PA          | 689   | NO |
| 1 Kick Plate            | K1050 10" high CSK BEV | US32D | RO |
| 1 Door Stop             | 409 / 446 as required  | US32D | RO |
| 1 Gasketing             | S88BL (Head & Jambs)   |       | PE |

Notes:

- Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.
- Knurling: Where required by local code provide knurling or abrasive coating to all levers on doors leading to hazardous areas such as electrical rooms, mechanical rooms, boiler and furnace rooms, janitor closets, and as otherwise required.

**Set: 14.0**

Doors: 116, 125

Description: JAN.

|                         |                        |       |    |
|-------------------------|------------------------|-------|----|
| 3 Hinge, Full Mortise   | TA2714                 | US26D | MK |
| 1 Storeroom/Closet Lock | DG164 10XG04 LL        | US26D | SA |
| 1 Core                  | DG1 6300               | US15  | SA |
| 1 Surface Closer        | 8501 Reg / PA          | 689   | NO |
| 1 Mop Plate             | K1050 4" high CSK BEV  | US32D | RO |
| 1 Kick Plate            | K1050 10" high CSK BEV | US32D | RO |
| 1 Door Stop             | 409 / 446 as required  | US32D | RO |
| 1 Gasketing             | S88BL (Head & Jambs)   |       | PE |

Notes:

- Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.
- Knurling: Where required by local code provide knurling or abrasive coating to all levers on doors leading to hazardous areas such as electrical rooms, mechanical rooms, boiler and furnace rooms, janitor closets, and as otherwise required.

**Set: 15.0**

Doors: 119

Description: JAN.

|                         |                        |           |    |
|-------------------------|------------------------|-----------|----|
| 3 Hinge, Full Mortise   | TA2314                 | US32D     | MK |
| 1 Storeroom/Closet Lock | DG164 10XG04 LL        | US26D     | SA |
| 1 Core                  | DG1 6300               | US15      | SA |
| 1 Surface Closer        | 8501 Reg / PA          | 600 x 689 | NO |
| 1 Mop Plate             | K1050 4" high CSK BEV  | US32D     | RO |
| 1 Kick Plate            | K1050 10" high CSK BEV | US32D     | RO |
| 1 Door Stop             | 409 / 446 as required  | US32D     | RO |
| 1 Gasketing             | S88BL (Head & Jambs)   |           | PE |

Notes:

- Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.
- Knurling: Where required by local code provide knurling or abrasive coating to all levers on doors leading to hazardous areas such as electrical rooms, mechanical rooms, boiler and furnace rooms, janitor closets, and as otherwise required.

**Set: 16.0**

Doors: 128, 129, 130, 131, 132  
Description: OFFICE

|                       |                       |       |    |
|-----------------------|-----------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714                | US26D | MK |
| 1 Entry/Office Lock   | DG164 10XG05 LL       | US26D | SA |
| 1 Core                | DG1 6300              | US15  | SA |
| 1 Door Stop           | 409 / 446 as required | US32D | RO |
| 3 Silencer            | 608-RKW               |       | RO |

**Set: 17.0**

Doors: 161B, 162A  
Description: SALLYPORT

|                     |                                |           |    |
|---------------------|--------------------------------|-----------|----|
| 1 Continuous Hinge  | CFM__SLF-HD1 x Length Required |           | PE |
| 1 Entry/Office Lock | DG164 10XG05 LL                | US26D     | SA |
| 1 Core              | DG1 6300                       | US15      | SA |
| 1 Surface Closer    | UNI8501                        | 600 x 689 | NO |
| 1 Kick Plate        | K1050 10" high CSK BEV         | US32D     | RO |
| 1 Gasketing         | S88BL (Head & Jambs)           |           | PE |
| 1 Sweep             | 315CN x Door Width             |           | PE |
| 1 Threshold         | 171A x L.A.R. x MSES25SS       |           | PE |

**Set: 18.0**

Doors: 107, 138, 139  
Description: RAD., SUPPLY / MAIL RM, VET

|                       |                       |       |    |
|-----------------------|-----------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714                | US26D | MK |
| 1 Classroom Lock      | DG164 10XG37 LL       | US26D | SA |
| 1 Core                | DG1 6300              | US15  | SA |
| 1 Door Stop           | 409 / 446 as required | US32D | RO |
| 3 Silencer            | 608-RKW               |       | RO |

**Set: 19.0**

Doors: 127  
Description: CLERKS

|                       |                        |       |    |
|-----------------------|------------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714                 | US26D | MK |
| 1 Classroom Lock      | DG164 10XG37 LL        | US26D | SA |
| 1 Core                | DG1 6300               | US15  | SA |
| 1 Surface Closer      | 8501 Reg / PA          | 689   | NO |
| 1 Kick Plate          | K1050 10" high CSK BEV | US32D | RO |
| 1 Door Stop           | 409 / 446 as required  | US32D | RO |
| 3 Silencer            | 608-RKW                |       | RO |

**Notes:**

-Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.

**Set: 20.0**

Doors: 123B, 124B

Description: TOILET/SHOWER

|                       |                       |       |    |
|-----------------------|-----------------------|-------|----|
| 3 Hinge, Full Mortise | TA2314                | US32D | MK |
| 1 Privacy - Indicator | AU YPL02              | 626   | YA |
| 1 Surf Overhead Stop  | 10-_36                | 630   | RF |
| 2 Mop Plate           | K1050 4" high CSK BEV | US32D | RO |
| 3 Silencer            | 608-RKW               |       | RO |

**Set: 21.0**

Doors: 105, 106

Description: TOILET

|                       |                        |       |    |
|-----------------------|------------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714                 | US26D | MK |
| 1 Privacy - Indicator | AU YPL02               | 626   | YA |
| 1 Surface Closer      | 8501 Reg / PA          | 689   | NO |
| 1 Mop Plate           | K1050 4" high CSK BEV  | US32D | RO |
| 1 Kick Plate          | K1050 10" high CSK BEV | US32D | RO |
| 1 Door Stop           | 409 / 446 as required  | US32D | RO |
| 1 Gasketing           | S88BL (Head & Jambs)   |       | PE |

**Notes:**

-Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.

**Set: 22.0**

Doors: 104, 111, 114, 134, 137, 143, 156B

Description: CAT BOND, CAT EVAL., CLOSET, DOG BONDING, DOG EVAL., TREATMENT

|                       |                       |       |    |
|-----------------------|-----------------------|-------|----|
| 3 Hinge, Full Mortise | TA2714                | US26D | MK |
| 1 Passage Latch       | 10XU15 LL             | US26D | SA |
| 1 Door Stop           | 409 / 446 as required | US32D | RO |
| 3 Silencer            | 608-RKW               |       | RO |

**Set: 23.0**

Doors: 141A

Description: PAIR - LAUNDRY & LINEN

|                               |                          |       |    |
|-------------------------------|--------------------------|-------|----|
| 6 Hinge, Full Mortise, Hvy Wt | T4A3786                  | US26D | MK |
| 2 Pull Plate                  | BF 110 x 70C             | US32D | RO |
| 2 Push Plate                  | 70C-RKW                  | US32D | RO |
| 2 Surface Closer              | 8501H                    | 689   | NO |
| 2 Armor Plate                 | K1050 36" high CSK BEV   | US32D | RO |
| 2 Door Stop                   | 409 / 446 as required    | US32D | RO |
| 1 Split Astragal Set          | 18041CNB x Door Height/2 |       | PE |
| 2 Silencer                    | 608-RKW                  |       | RO |

**Notes:**

-Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.



**Set: 24.0**

Doors: 112, 113A, 113B, 115, 118A, 118D, 120A, 121A, 135A, 135C, 145, 146, 148, 149, 150, 153, 154, 155, 156A, 160, 161A

Description: BITE HOLD, CAT ADOPT, DOG, DOG ADOPTION, FERAL, FUNGAL, INTAKE DOG, LITTER, MED DOG, PUPPY, TEMP HOLD, URI, VEST.

|                    |                                |           |    |
|--------------------|--------------------------------|-----------|----|
| 1 Continuous Hinge | CFM__SLF-HD1 x Length Required |           | PE |
| 1 Pull Plate       | BF 110 x 70C                   | US32D     | RO |
| 1 Push Plate       | 70C-RKW                        | US32D     | RO |
| 1 Surface Closer   | 8501 Reg / PA                  | 600 x 689 | NO |
| 1 Kick Plate       | K1050 10" high CSK BEV         | US32D     | RO |
| 1 Door Stop        | 409 / 446 as required          | US32D     | RO |
| 3 Silencer         | 608-RKW                        |           | RO |

Notes:

-Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.

**Set: 25.0**

Doors: 122A, 122B, 142B, 144, 147A

Description: INTAKE CORRIDOR, VEST.

|                               |                        |       |    |
|-------------------------------|------------------------|-------|----|
| 3 Hinge, Full Mortise, Hvy Wt | T4A3786                | US26D | MK |
| 1 Pull Plate                  | BF 110 x 70C           | US32D | RO |
| 1 Push Plate                  | 70C-RKW                | US32D | RO |
| 1 Surface Closer              | 8501 Reg / PA          | 689   | NO |
| 1 Kick Plate                  | K1050 10" high CSK BEV | US32D | RO |
| 1 Door Stop                   | 409 / 446 as required  | US32D | RO |
| 3 Silencer                    | 608-RKW                |       | RO |

Notes:

-Where possible install closers on door for optimum aesthetics.

**Set: 26.0**

Doors: 123A, 124A

Description: RESTROOM

|                               |                        |       |    |
|-------------------------------|------------------------|-------|----|
| 3 Hinge, Full Mortise, Hvy Wt | T4A3786                | US26D | MK |
| 1 Pull Plate                  | BF 110 x 70C           | US32D | RO |
| 1 Push Plate                  | 70C-RKW                | US32D | RO |
| 1 Surface Closer              | 8501 Reg / PA          | 689   | NO |
| 1 Mop Plate                   | K1050 4" high CSK BEV  | US32D | RO |
| 1 Kick Plate                  | K1050 10" high CSK BEV | US32D | RO |
| 1 Door Stop                   | 409 / 446 as required  | US32D | RO |
| 3 Silencer                    | 608-RKW                |       | RO |

Notes:

-Closers shall not be installed on corridor side of doors, where possible install closers on door for optimum aesthetics.

**Set: 27.0**

Doors: 140

Description: SURGERY/TREATMENT

|                    |                        |       |    |
|--------------------|------------------------|-------|----|
| 2 Push Plate       | 70C-RKW                | US32D | RO |
| 1 Concealed Closer | PH73N                  | 689   | RF |
| 2 Kick Plate       | K1050 10" high CSK BEV | US32D | RO |
| 2 Door Stop        | 409 / 446 as required  | US32D | RO |

**Set: 28.0**

Doors: 159B, 162B, 162C, 162D, 162E

Description: RUD

|            |                        |       |    |
|------------|------------------------|-------|----|
| 1 Core     | DG1 6300               | US15  | SA |
| 1 Cylinder | DG164 Type as Required | US32D | SA |

Notes:

- Balance of hardware furnished by roll up door manufacturer.
- Roll up door supplier to verify cylinder type, quantity & finish required.
- Provide necessary collars/rings, cams and tailpieces/spindles for all cylinders.

END OF SECTION 087100

**SECTION 08 8000  
GLAZING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds and accessories

**1.02 REFERENCE STANDARDS**

- A. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- B. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- D. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- E. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- F. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- G. GANA (GM) - GANA Glazing Manual; 2022.
- H. GANA (SM) - GANA Sealant Manual; 2008.
- I. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
- J. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- K. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
- L. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

**1.03 ADMINISTRATIVE REQUIREMENTS**

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

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples 12 by 12 inches in size of glass units.
- E. 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. Perform Work in accordance with GANA (GM), GANA (SM), and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.

- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

#### **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Float Glass Manufacturers:
  - 1. AGC Glass North America, Inc.: [www.agcglass.com](http://www.agcglass.com)
  - 2. Cardinal Glass Industries: [www.cardinalcorp.com](http://www.cardinalcorp.com)
  - 3. Guardian Glass, LLC: [www.guardianglass.com](http://www.guardianglass.com)
  - 4. Pilkington North America Inc: [www.pilkington.com/na](http://www.pilkington.com/na)
  - 5. Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com](http://www.vitroglazings.com)
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 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. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  - 2. 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.
  - 3. 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.

#### **2.03 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.

#### **2.04 INSULATING GLASS UNITS**

- A. Manufacturers:
  - 1. Glass: Any of the manufacturers specified for float glass.
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. 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: Aluminum.
  5. Edge Seal:
    - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
    - b. Color: Gray.
  6. Purge interpane space with dry air, hermetically sealed.
- C. Insulating Glass Units: Vision glass, double glazed.
1. Applications: Exterior glazing unless otherwise indicated.
  2. Space between lites filled with air.
  3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear.
  4. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear.
  5. Total Thickness: 1 inch (25.4 mm).
- D. Insulating Glass Units: Spandrel glazing.
1. Applications: Exterior spandrel glazing unless otherwise indicated.
  2. Space between lites filled with air.
  3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
    - a. Tint: Clear.
    - b. Coating: Same as on vision units, on #2 surface.
  4. Inboard Lite: Heat-strengthened float glass, 1/4 inch (6.4 mm) thick.
    - a. Tint: Clear.
    - b. Opacifier: Ceramic frit, on #4 surface.
    - c. Opacifier Color: To be selected by Architect from full range of colors.
  5. Total Thickness: 1 inch (25.4 mm).
  6. See basis of design information for technical requirements.

## **2.05 BASIS OF DESIGN - INSULATING GLASS UNITS**

- A. Basis of Design - Insulating Glass Units: Vision glazing, with low-e coating.
1. Applications: Exterior insulating glass glazing unless otherwise indicated.
  2. Space between lites filled with air.
  3. Total Thickness: 1 inch (25.4 mm).
  4. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.28, nominal.
  5. Visible Light Transmittance (VLT): 64 percent, nominal.
  6. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
  7. Visible Light Reflectance, Outside: 12 percent, nominal.
  8. Glazing Method: Dry glazing method, gasket glazing.
  9. 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.
  10. Metal Edge Spacers: Aluminum, bent and soldered corners.
  11. Spacer Color: Aluminum.
  12. Edge Seal:
    - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
  13. Color: Gray.
  14. Purge interpane space with dry air, hermetically sealed.

15. Basis of Design - Vitro Architectural Glass (formerly PPG Glass): [www.vitroglazings.com](http://www.vitroglazings.com)
  - a. Outboard Lite: Annealed float glass, except fully tempered float glass at locations noted on drawings or required by Code, 1/4 inch (6 mm) thick, minimum.
    - 1) Low-E Coating: Vitro Architectural Glass (formerly PPG Glass) Solarban 70XL on #2 surface.
    - 2) Glass: Clear.
  - b. Inboard Lite: Annealed float glass, except fully tempered float glass at locations noted on drawings or required by Code, 1/4 inch (6 mm) thick, minimum.
16. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of another acceptable manufacturer.
17. Substitution Procedures: See Section 01 6000 - Product Requirements.
  - a. For any product not identified as "Basis of Design", submit information as specified for substitutions.

## **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. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

## **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 the minimum required face and edge clearances are being provided.
- C. 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. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

### **3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

- B. Place setting blocks at 1/4 points with edge block no more than 6 inch (152 mm) from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### **3.05 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent 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.

### **3.06 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 8000**

**SECTION 09 0561  
COMMON WORK RESULTS FOR FLOORING PREPARATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
  - 1. Thin-set ceramic tile and stone tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
  - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- D. Patching compound.
- E. Remedial floor coatings.

**1.02 REFERENCE STANDARDS**

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50 mm] Cube Specimens); 2021.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

**1.04 SUBMITTALS**

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
  - 1. Moisture and alkalinity (pH) limits and test methods.
  - 2. Manufacturer's required bond/compatibility test procedure.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
  - 1. Certificate: Manufacturer's certification of compatibility with types of flooring applied over remedial product.
  - 2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
  - 3. Manufacturer's installation instructions.
- C. Testing Agency's Report:
  - 1. Description of areas tested; include floor plans and photographs if helpful.
  - 2. Summary of conditions encountered.
  - 3. Moisture and alkalinity (pH) test reports.
  - 4. Copies of specified test methods.
  - 5. Recommendations for remediation of unsatisfactory surfaces.
  - 6. Product data for recommended remedial coating.
  - 7. Submit report directly to Owner.
  - 8. Submit report not more than two business days after conclusion of testing.
- D. Adhesive Bond and Compatibility Test Report.



### **1.05 QUALITY ASSURANCE**

- A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by Owner.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
  - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
  - 1. Provide access for and cooperate with testing agency.
  - 2. Confirm date of start of testing at least 10 days prior to actual start.
  - 3. Allow at least 4 business days on site for testing agency activities.
  - 4. Achieve and maintain specified ambient conditions.
  - 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

### **1.07 FIELD CONDITIONS**

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F (18 degrees C) or more than 85 degrees F (30 degrees C).
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
  - 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
  - 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
  - 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- B. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
  - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
  - 2. Use product recommended by testing agency.

## **PART 3 EXECUTION**

### **3.01 CONCRETE SLAB PREPARATION**

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
  - 1. Preliminary cleaning.
  - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet (100 square meters) and one test in each additional 1000 square feet (100 square meters), unless otherwise indicated or required by flooring manufacturer.
  - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
  - 5. Specified remediation, if required.
  - 6. Patching, smoothing, and leveling, as required.
  - 7. Other preparation specified.
  - 8. Adhesive bond and compatibility test.
  - 9. Protection.
- C. Remediations:
  - 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
  - 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
  - 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

### **3.02 PRELIMINARY CLEANING**

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

### **3.03 MOISTURE VAPOR EMISSION TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet (1.4 kg per 93 square meters) per 24 hours.
- F. Report: Report the information required by the test method.

### **3.04 ALKALINITY TESTING**

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

- B. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

**3.05 PREPARATION**

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with requirements and recommendations of floor covering manufacturer.
- C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- D. Do not fill expansion joints, isolation joints, or other moving joints.

**3.06 ADHESIVE BOND AND COMPATIBILITY TESTING**

- A. Comply with requirements and recommendations of floor covering manufacturer.

**3.07 APPLICATION OF REMEDIAL FLOOR COATING**

- A. Comply with requirements and recommendations of coating manufacturer.

**3.08 PROTECTION**

- A. Cover prepared floors with building paper or other durable covering.

**END OF SECTION 09 0561**

**SECTION 09 2116  
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. Gypsum sheathing.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.

**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. 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 C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020.
- E. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- I. 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.
- J. 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.
- K. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- L. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- M. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
- N. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2018.
- O. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022.
- P. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.

- Q. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels; 2019, with Editorial Revision (2020).
- R. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- S. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- T. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
- U. UL (FRD) - Fire Resistance Directory; Current Edition.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
  - 1. Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- C. Test Reports: For stud framing products that do not comply with AISI S220 or ASTM C754, provide independent laboratory reports showing maximum stud heights at required spacings and deflections.

### **PART 2 PRODUCTS**

#### **2.01 GYPSUM BOARD ASSEMBLIES**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
  - 1. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

#### **2.02 METAL FRAMING MATERIALS**

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
  - 1. ClarkDietrich: [www.clarkdietrich.com](http://www.clarkdietrich.com)
  - 2. MarinoWARE: [www.marinoware.com](http://www.marinoware.com)
  - 3. Phillips Manufacturing Co: [www.phillipsmfg.com](http://www.phillipsmfg.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. 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: C-shaped.
  - 4. Furring Members: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
- C. 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.

#### **2.03 BOARD MATERIALS**

- A. Manufacturers - Gypsum-Based Board:
  - 1. American Gypsum Company: [www.americangypsum.com](http://www.americangypsum.com)
  - 2. Georgia-Pacific Gypsum: [www.gpgypsum.com](http://www.gpgypsum.com)

3. Gold Bond Building Products, LLC provided by National Gypsum Company:  
www.goldbondbuilding.com
4. USG Corporation: www.usg.com
5. Substitutions: See Section 01 6000 - 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. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
    - a. Mold resistant board is required in wet areas.
  3. 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. Backing Board For Wet Areas: One of the following products:
  1. Application: Surfaces behind tile in wet areas including tub and shower surrounds, shower ceilings, and kitchen walls.
- D. 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.
- E. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
  1. Application: Exterior sheathing, unless otherwise indicated.
  2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
  4. Type X Thickness: 5/8 inch (16 mm).
  5. Edges: Square.

## **2.04 GYPSUM BOARD ACCESSORIES**

- A. Water-Resistive Barrier: See Section 07 2500.
- B. Joint Materials: ASTM C475/C475M, and as recommended by gypsum board manufacturer for project conditions.
  1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners.
  2. Joint compound: Setting type, field-mixed.
  3. Corner Beads: Low profile, for 90 degree outside corners.
- C. 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.
- D. 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.
- E. 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 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C1007/AISI S220 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
  - 1. Level ceiling system to a tolerance of 1/1200.
  - 2. Laterally brace entire suspension system.
- 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: Horizontal.
  - 2. Spacing: As indicated.
- F. Blocking: Install wood blocking for support of:
  - 1. Wall-mounted cabinets.
  - 2. Toilet partitions.
  - 3. Toilet accessories.

### 3.03 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. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

### 3.04 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
  - 3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- B. 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).
- C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

### 3.05 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 2116**

**SECTION 09 3000  
TILING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Cementitious backer board as tile substrate.
- D. Stone thresholds.
- E. Non-ceramic trim.

**1.02 REFERENCE STANDARDS**

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2019.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).
- C. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.1c - Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- E. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship; 2019.
- F. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- G. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- H. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2024).
- J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- L. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2018.
- M. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- N. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2021).
- O. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar; 2020.



- P. ANSI A108.20 - American National Standard Specifications for Exterior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs; 2020.
- Q. 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.
- R. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
- S. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
- T. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2014 (Reaffirmed 2019).
- U. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).
- V. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- W. 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).
- X. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

### **1.03 ADMINISTRATIVE REQUIREMENTS**

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

### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Tile: 10 square feet (1 square meters) of each size, color, and surface finish combination.

### **1.05 QUALITY ASSURANCE**

- A. Maintain one copy of ANSI A108/A118/A136 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
  - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

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

## **PART 2 PRODUCTS**

### **2.01 TILE**

- A. Manufacturers: All products by the same manufacturer.
  - 1. Basis of Design: Trinity Tile: [www.trinitytile.com](http://www.trinitytile.com)

2. Dal-Tile Corporation: [www.daltile.com](http://www.daltile.com)
3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Porcelain 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. Color(s): As indicated on drawings.
  4. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.

## 2.02 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.
    - b. Open edges of floor tile.
    - c. Wall corners, outside and inside.
    - d. Transition between floor finishes of different heights.
    - e. Floor to wall joints.
    - f. Borders and other trim as indicated on drawings.
  2. Manufacturers:
    - a. Schluter-Systems: [www.schluter.com](http://www.schluter.com)
    - b. Genesis APS International: [www.genesis-aps.com](http://www.genesis-aps.com)
    - c. Substitutions: See Section 01 6000 - Product Requirements.

## 2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
  1. ARDEX Engineered Cements: [www.ardexamericas.com](http://www.ardexamericas.com)
  2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com)
  3. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com)
  4. LATICRETE International, Inc: [www.laticrete.com](http://www.laticrete.com)
  5. Merkrete, by Parex USA, Inc: [www.merkrete.com](http://www.merkrete.com)
  6. Substitutions: See Section 01 6000 - Product Requirements.

## 2.04 GROUTS

- A. Manufacturers:
  1. ARDEX Engineered Cements: [www.ardexamericas.com](http://www.ardexamericas.com)
  2. Bostik Inc: [www.bostik-us.com](http://www.bostik-us.com)
  3. Custom Building Products: [www.custombuildingproducts.com](http://www.custombuildingproducts.com)
  4. LATICRETE International, Inc: [www.laticrete.com](http://www.laticrete.com)
  5. Merkrete, by Parex USA, Inc: [www.merkrete.com](http://www.merkrete.com)
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
  1. Applications: Where indicated and where no other type of grout is indicated.
  2. Color(s): As selected by Architect from manufacturer's full line.

## 2.05 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
  1. Crack Resistance: No failure at 1/16 inch (1.6 mm) gap, minimum.
  2. Fluid or Trowel Applied Type:
    - a. Thickness: 20 mils (0.5 mm), maximum.

- B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 1/2 inch (12.7 mm) thick; 2 inch (51 mm) wide coated glass fiber tape for joints and corners.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- 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 tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
  - 1. Test in accordance with Section 09 0561.
  - 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

#### **3.02 PREPARATION**

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install 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 a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

#### **3.03 INSTALLATION - GENERAL**

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.20, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. 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.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- 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. Use standard grout unless otherwise indicated.
- 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 standard grout, unless otherwise indicated.

**3.05 INSTALLATION - SHOWERS AND BATHTUB WALLS**

- A. Grout with standard grout as specified above.

**3.06 INSTALLATION - WALL TILE**

- A. Over cementitious backer units installed in accordance with TCNA (HB) Method W223, organic adhesive.
- B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

**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.

**END OF SECTION 09 3000**

**SECTION 09 5100  
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 Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- 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; 2022.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
- F. CHPS (HPPD) - High Performance Products Database; Current Edition.

**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 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on suspension system components and acoustical units.
- C. Samples: Submit two samples 6 inch by 6 inch ( ) in size illustrating material and finish of acoustical units.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

**1.05 QUALITY ASSURANCE**

- A. Designer Qualifications for Seismic Design: Perform under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

**1.06 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](http://www.armstrongceilings.com)
  - 2. Certainteed Architectural; \_\_\_\_: [www.certainteed.com/ceilings-and-walls](http://www.certainteed.com/ceilings-and-walls)
  - 3. USG Corporation; \_\_\_\_: [www.usg.com/ceilings](http://www.usg.com/ceilings)

## 2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
- B. Acoustical Panels, Type \_\_\_\_: Painted mineral fiber, with the following characteristics:
  - 1. Classification: ASTM E1264 Type III.
    - a. Form: 2, water felted.
    - b. Pattern: "C" - perforated, small holes.
  - 2. Size: 24 by 24 inches (610 by 610 mm).
  - 3. Thickness: 3/4 inch (19 mm).
  - 4. Light Reflectance: 81 percent, determined in accordance with ASTM E1264.
  - 5. NRC Range: .50 to .70, determined in accordance with ASTM E1264.
  - 6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
  - 7. Panel Edge: Square.
  - 8. Tile Edge: Beveled.Tegular
    - a. Joint: Kerfed and rabbeted.
  - 9. Color: White.
  - 10. Suspension System: Exposed grid.
  - 11. Products:
    - a. Armstrong World Industries, Inc; Dune: [www.armstrongceilings.com](http://www.armstrongceilings.com)
- C. Acoustical Panels, Type \_\_\_\_: Mineral fiber with scrubbable finish, with the following characteristics:
  - 1. Classification: ASTM E1264 Type IX.
  - 2. Size: 24 by 24 inches (610 by 610 mm).
  - 3. Thickness: 3/4 inch (19 mm).
  - 4. Panel Edge: Square.
  - 5. Suspension System Type \_\_\_\_: Exposed grid.

## 2.03 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter mouldings, hold down clips, stabilizer bars, clips and splices.
  - 1. Materials:
    - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension System: Hot-dipped galvanized steel grid with steel cap.
  - 1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
  - 2. Profile: Tee; 9/16 inch (\_\_\_\_ mm) face width.
  - 3. Finish: Baked enamel.
  - 4. Color: White.
  - 5. Products:
    - a. Armstrong World Industries, Inc; Suprafine XL 9/16" Exposed Tee.
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## 2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, 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.

## 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 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. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Use longest practical lengths.
  - 2. Overlap and rivet corners.
- 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.

### **3.03 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. Cut to fit irregular grid and perimeter edge trim.
  - 2. Make field cut edges of same profile as factory edges.

### **3.04 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.

**END OF SECTION 09 5100**

**SECTION 09 6500  
RESILIENT FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Resilient sheet flooring with integral 4" cove base.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

**1.03 REFERENCE STANDARDS**

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- B. ASTM F970 - Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading; 2022.
- C. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2021).
- D. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing; 2021a.
- E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - 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. Verification Samples: Submit two samples, in size illustrating color and pattern for each resilient flooring product specified.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Flooring Material: 10 square feet of each type and color.
  - 3. Extra Wall Base: 100 linear feet of each type and color.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

**1.06 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).

**1.07 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 SHEET FLOORING**

- A. Vinyl Sheet Flooring - Type 1: Homogeneous without backing, with color and pattern throughout full thickness.
  - 1. Manufacturers:
    - a. Armstrong Flooring; Medintone: [www.armstrongflooring.com](http://www.armstrongflooring.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Minimum Requirements: Comply with ASTM F1913.
  - 3. Thickness: 0.080 inch (2.0 mm) nominal.
  - 4. Integral coved base.
  - 5. Color: Talisman H2012.
- B. Vinyl Sheet Flooring - Type 2: Heterogeneous
  - 1. Manufacturers:
    - a. AHF Contract; \_\_\_\_\_: [www.ahfcontract.com](http://www.ahfcontract.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Minimum Requirements: Comply with ASTM F1303, Type II, with Class A fibrous backing.
  - 3. Wear Layer Thickness: 0.050 inch (1.25 mm) minimum.
  - 4. Total Thickness: 0.080 inch (2.0 mm) minimum.
  - 5. Sheet Width: 72 inch (1830 mm) minimum.
  - 6. Static Load Resistance:  $\leq 0.005$ , when tested as specified in ASTM F970.
  - 7. Integral coved base.
  - 8. Color: As indicated on drawings.

## **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.

### **3.02 PREPARATION**

- A. Clean substrate.

### **3.03 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's written instructions.
- B. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.

### **3.04 INSTALLATION - SHEET FLOORING**

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

### **3.05 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

**END OF SECTION 09 6500**

**SECTION 09 6700  
FLUID-APPLIED FLOORING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fluid-applied flooring and base.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- B. Section 26 0539 - Underfloor Raceways for Electrical Systems: Recessed electrical access cover frames.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
- C. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store resin materials in a dry, secure area.

**1.06 FIELD CONDITIONS**

- A. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).
- B. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Fluid-Applied Flooring:

**2.02 FLUID-APPLIED FLOORING SYSTEMS**

**END OF SECTION 09 6700**

**SECTION 09 6723.13  
EPOXY AGGREGATE FLOORING AND WALL COATING****PART 1 - GENERAL****1.01 SUMMARY**

- A. Section includes: Providing epoxy aggregate seamless flooring, integral base, and wall coating to designated rooms.

**1.02 REFERENCES**

- A. Definitions:
1. Excess moisture content:
    - a. Industry standard hydrostatic pressure test for excess moisture content in slab, on grade or elevated using anhydrous calcium chloride. Moisture content for specified products are defined in adhesive manufacturer's product literature as pounds water per 1000 SF per 24 hours (indicated below as #/KSF).
    - b. Industry standard relative humidity test in slab, on grade or elevated, using RH probe (in situ). Relative humidity for specified products are defined in adhesive manufacturer's product literature as relative humidity percentage.
- B. Industry standards of the following as referenced:
1. ASTM:
    - a. F2170—16; Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes.

**1.03 SUBMITTALS**

- A. Product data: Manufacturer's product literature and application instructions. Include statement indicating flooring complies with non-slip properties specified.
- B. Samples: 6" by 6" samples for Architect's selection showing non-slip finish, cove base details, and transitions to wall; include manufacturer's standard colors.

**1.04 SITE CONDITIONS**

- A. Environmental requirements:
1. Temperature: Maintain temperature before, during, and after installation until flooring is cured, at temperature range recommended by flooring manufacturer's product data.
  2. Provide controlled ventilation of areas being floored. Maintain ventilation throughout curing period.

**PART 2 - PRODUCTS****2.01 MANUFACTURED UNITS**

- A. Acceptable manufacturers:
1. Basis of Design: DUR-A-FLEX: [www.dur-a-flex.com](http://www.dur-a-flex.com). Accelera broadcast floor system: self-leveling, decorative chip broadcast, cementitious urethane/blended polymer seamless flooring system.
  2. Stonhard, Inc.: [www.stonhard.com](http://www.stonhard.com)
  3. Sika Industrial Flooring: [usa.sika.com](http://usa.sika.com)
  4. Tnemec Company, Inc.: [www.tnemec.com](http://www.tnemec.com)
  5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Characteristics:
1. Manufacturer standard of quality: Sherwin-Williams
    - a. Floors: Sherwin Williams, Tile 141, RGB-28, 38, 40 and Tile 138, RGB-183, 159, 93
    - b. Base: Sherwin Williams, Precast Terrazzo Base, Black
  2. Accessories: Selected manufacturer's sealants, crack control materials, crack fillers, coving materials, and related items approved by system manufacturer required for correct installation.

3. Colors: Indicated on Drawings.
4. Finish: Textured finish with coefficient of friction of 0.75 or greater when tested in accord with ASTM D1894-08. Test on wet surface, against leather.

**PART 3 - EXECUTION****3.01 EXAMINATION**

- A. Verification of conditions:
  1. Verify concrete slabs are well cured, at least 45 days old, have no residual curing compound to inhibit adhesive and mortar bonding to concrete surface, and ready to receive floor covering materials.
  2. Additional requirements:
- B. Test results indicated below are obtained from Concrete Finishing Section requirements.
- C. Review test results for alkalinity/pH level on concrete floor slab.
- D. Review test results for acceptable excess moisture content in slab; excess moisture content range for specified products are defined in manufacturer's product literature.
- E. Review test results for acceptable relative humidity test in slab, on grade or elevated; relative humidity range for specified products are defined in adhesive and floor covering manufacturer's product literature as relative humidity percentage.
  1. Notify Architect and Contractor, in writing, of surfaces passing or not passing test results for successful material installation under this Section.
  2. Installing flooring materials over slabs not meeting material manufacturer's requirements indicated above is prohibited.

**3.02 INSTALLATION**

- A. Concrete surfaces to receive flooring: Smooth trowel finish, within tolerances specified in Concrete Finishing Section.
- B. Preparation:
  1. Remove dirt, oil, grease, or other foreign matter from surfaces to receive floor covering or accessories.
  2. Clean concrete surface in accord with ASTM D4259-88 (2012) for mechanical abrasive blast and ICRI No. 310.2R, surface profile CSP 5. These are typically accomplished through decontamination of concrete followed by medium shotblast.
- C. Apply system in accord with manufacturer's product data and USDA requirements at rate not less than recommended by manufacturer.
- D. Extend flooring material up wall surface to form integral coved base. Bond directly to wall surfaces.
- E. Cure systems for period recommended by manufacturer before allowing traffic on surface.

**END OF SECTION 09 6723.13**

**SECTION 09 7200  
WALL COVERINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wall covering and borders.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 9123 - Interior Painting: Preparation and priming of substrate surfaces.

**1.03 REFERENCE STANDARDS**

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate wall elevations with seaming layout.
- C. Samples: Submit two samples of wall covering, 8.5x11 inch (\_\_\_\_by\_\_\_\_ mm) in size illustrating color, finish, and texture.
- D. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing 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 of documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect roll materials at arrival on site, to verify acceptability.
- B. Protect packaged adhesive from temperature cycling and cold temperatures.
- C. Do not store roll goods on end.

**1.07 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
- B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

**PART 2 PRODUCTS**

**2.01 WALL COVERINGS**

- A. Manufacturers
  - 1. Chasing Paper: [www.chasingpaper.com](http://www.chasingpaper.com)

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

**3.02 PREPARATION**

- A. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

- B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

**3.03 INSTALLATION**

- A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
- B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
- C. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

**END OF SECTION 09 7200**

**SECTION 09 9113  
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:
- 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. Floors, unless specifically indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

**1.02 DEFINITIONS**

- A. Comply with ASTM D16 for interpretation of terms used in this section.

**1.03 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - 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.
  - 4. Manufacturer's installation instructions.
- C. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8 1/2 X 11 inch (\_\_\_\_x\_\_\_\_ mm) in size.
- D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - 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 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 3 years experience and approved by manufacturer.

#### **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 paint product manufacturer's temperature ranges.
- 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 ft candles (860 lx) measured mid-height at substrate surface.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  1. Benjamin Moore & Co.: [www.benjaminmoore.com](http://www.benjaminmoore.com)
  2. PPG Paints; \_\_\_\_\_: [www.ppgpaints.com](http://www.ppgpaints.com)
  3. Sherwin-Williams Company; \_\_\_\_\_: [www.sherwin-williams.com](http://www.sherwin-williams.com)

#### **2.02 PAINTS AND FINISHES - GENERAL**

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.
  1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI categories, except as otherwise indicated.
  2. 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.
  3. 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.
  4. 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.
  5. Supply each paint material in quantity required to complete entire project's work from a single production run.
  6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:



1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; [www.otcair.org](http://www.otcair.org); specifically:
      - 1) Opaque, Flat: 50 g/L, maximum.
      - 2) Opaque, Nonflat: 150 g/L, maximum.
      - 3) Opaque, High Gloss: 250 g/L, maximum.
  2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
  2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

### **2.03 PAINT SYSTEMS - EXTERIOR**

- A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, brick, fiber cement siding, primed wood, and primed metal.
1. Two top coats and one coat primer.
  2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
  3. Top Coat Sheen:
    - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

## **PART 3 EXECUTION**

### **3.01 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. Concrete:
- G. Masonry:
- H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
- I. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior caulking compound after prime coat has been applied. Back prime concealed surfaces before installation.

### **3.02 APPLICATION**

- A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- 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.

**3.03 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.04 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09 9113**

**SECTION 09 9123  
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. 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. Paint interior surfaces of air ducts and convectors and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- 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. Floors, unless specifically indicated.
  - 6. Glass.
  - 7. Concealed pipes, ducts, and conduits.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 9113 - Exterior Painting.
- C. Section 09 9600 - High-Performance Coatings.

**1.03 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.
- C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.
- D. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- G. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- H. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- I. SSPC-SP 2 - Hand Tool Cleaning; 2024.
- J. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

K. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - 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 products to be used in project; include description of each system.
- C. Samples: Submit two 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.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on tempered hardboard, 8 1/2 X 11 inch (\_\_\_\_x\_\_\_\_ mm) in size.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gal (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 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience and approved by manufacturer.

#### **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 used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
  - 1. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com)

- 2. Basis of Design: Benjamin Moore: [www.benjaminmoore.com](http://www.benjaminmoore.com)
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 6000 - 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.
- B. Volatile Organic Compound (VOC) Content:
  - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
    - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
    - b. SCAQMD 1113 Rule.
    - c. CARB (SCM).
    - d. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; [www.otcair.org](http://www.otcair.org); specifically:
      - 1) Opaque, Flat: 50 g/L, maximum.
      - 2) Opaque, Nonflat: 150 g/L, maximum.
      - 3) Opaque, High Gloss: 250 g/L, maximum.
  - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by designer of record from the manufacturer's full line.
- E. Colors: To be selected from manufacturer's full range of available colors.
  - 1. Selection to be made by Architect after award of contract.
  - 2. Allow for minimum of three colors for each system, unless otherwise indicated, without additional cost to Owner.
  - 3. Extend colors to surface edges; colors may change at any edge as directed by Architect.
  - 4. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

## **2.03 PAINT SYSTEMS - INTERIOR**

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, brick, wood, plaster, uncoated steel, shop primed steel, galvanized steel, and aluminum.
  - 1. Two top coats and one coat primer.
  - 2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
  - 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 all locations.
    - 4. Primer: As recommended by top coat manufacturer for specific substrate.
  - B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
    - 1. Medium duty applications include doors, door frames, railings, handrails, guardrails, and balustrades.
    - 2. Two top coats and one coat primer.
    - 3. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
    - 4. Top Coat Sheen:
      - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
    - 5. Primer: As recommended by top coat manufacturer for specific substrate.
  - C. Medium Duty Vertical and Overhead: Including gypsum board, plaster, concrete, concrete masonry units, uncoated steel, shop primed steel, galvanized steel, and aluminum.
    - 1. Two top coats and one coat primer.
    - 2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, or 141.
    - 3. Top Coat Sheen:
      - a. Eggshell: MPI gloss level 3; use this sheen at all locations.
    - 4. Primer: As recommended by top coat manufacturer for specific substrate.

#### **2.04 PRIMERS**

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
  - 1. Interior/Exterior Latex Block Filler; MPI #4.

#### **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. Do not begin application of paints and finishes until substrates have been adequately prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. 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.
  - 5. Concrete Floors and Traffic Surfaces: 8 percent.

#### **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.

- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Concrete:
  - 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  - 2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi (10,350 to 27,580 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
  - 3. Clean concrete according to ASTM D4258. Allow to dry.
  - 4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- F. Masonry:
  - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, 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.
- G. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- I. Galvanized Surfaces:
  - 1. Prepare surface according to SSPC-SP 2.
- J. 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 according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
- K. 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.
- L. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- M. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

### 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. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

**3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

**3.05 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.06 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09 9123**



**SECTION 09 9300  
STAINING AND TRANSPARENT FINISHING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of transparent finishes.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 9113 - Exterior Painting: Stains and transparent finishes for concrete substrates.
- C. Section 09 9123 - Interior Painting: Stains and transparent finishes for concrete substrates.

**1.03 DEFINITIONS**

- A. Comply with ASTM D16 for interpretation of terms used in this section.

**1.04 REFERENCE STANDARDS**

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2023.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - 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 catalog number, and general product category.
  - 2. Manufacturer's installation instructions.
- C. Samples: Two samples on actual wood substrate to be finished, 6 x 6 inch in size, indicating selected colors and sheens for each system, with specified coats cascaded.
- D. Certification: By manufacturer that stains and transparent finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements for additional provisions.
  - 2. Extra Stock Materials: Stain and transparent finish materials, 1 gal (4 L) of each color and type; store where directed.
    - a. Label each container with color and type in addition to the manufacturer's label.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least five years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

**1.07 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.

#### **1.08 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.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperature: 50 degrees F (10 degrees C) unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 fc (860 lux) measured mid-height at substrate surface.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Provide finishes used in any individual system from the same manufacturer; no exceptions.
- B. Transparent Finishes:
  - 1. Behr Process Corporation: [www.behr.com](http://www.behr.com)
  - 2. PPG Paints Deft Interior Clears/Polyurethanes: [www.ppgpaints.com](http://www.ppgpaints.com)
  - 3. PPG Paints Flood Exterior Transparent Finishes: [www.flood.com](http://www.flood.com)
  - 4. PPG Paints ProLuxe Transparent Finishes: [www.perfectwoodstains.com](http://www.perfectwoodstains.com)
  - 5. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com)
- C. Stains:
  - 1. Behr Process Corporation: [www.behr.com](http://www.behr.com)
  - 2. PPG Paints Deft Interior Stains: [www.ppgpaints.com](http://www.ppgpaints.com)
  - 3. PPG Paints ProLuxe Stains: [www.perfectwoodstains.com](http://www.perfectwoodstains.com)
  - 4. Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com)
- D. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 STAINS AND TRANSPARENT FINISHES - GENERAL**

- A. Finishes:
  - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at [www.paintinfo.com](http://www.paintinfo.com), for specified MPI categories, except as otherwise indicated.
  - 2. 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.
  - 3. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  - 4. Supply each finish material in quantity required to complete entire project's work from a single production run.
  - 5. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content: See Section 01 6116.

## **2.03 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS**

- A. Finish on Wood - Vertical Surfaces:
  - 1. Top-coat(s): Clear Water Based varnish; MPI #128, 129, or 130.

## **2.04 ACCESSORY MATERIALS**

- A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.

## **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.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. 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.
- F. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- G. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

### **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. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- G. Reinstall items removed prior to finishing.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for general requirements for field inspection.

**3.05 CLEANING**

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

**3.06 PROTECTION**

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION 09 9300**

**SECTION 09 9600  
HIGH-PERFORMANCE COATINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. High performance coatings.
- B. Surface preparation.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 9123 - Interior Painting: Requirements for mechanical and electrical equipment surfaces.

**1.03 REFERENCE STANDARDS**

- A. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- D. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - 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. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include cleaning procedures and repair and patching techniques.
- G. 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 QUALITY ASSURANCE**

- A. Maintain one copy of each referenced document that applies to application on site.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

**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 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.

#### **1.07 FIELD CONDITIONS**

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not install materials when temperature is below 55 degrees F (13 degrees C) or above 90 degrees F (32 degrees C).
- C. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- D. Restrict traffic from area where coating is being applied or is curing.

#### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Only materials (primers, coatings, etc.) listed in the latest edition of the MPI Approved Product List (APL) are acceptable for use on this project.
- B. Provide high performance coating products from the same manufacturer to the greatest extent possible.
- C. High-Performance Coatings:
  - 1. Basis of Design: Sherwin-Williams Company[<>]: [www.protective.sherwin-williams.com/industries](http://www.protective.sherwin-williams.com/industries)
  - 2. Dow Chemical Company: [www.dow.com/en-us/industry/ind-building-construction.html](http://www.dow.com/en-us/industry/ind-building-construction.html)
  - 3. PPG Paints: [www.ppgpaints.com](http://www.ppgpaints.com)
  - 4. Tnemec Company, Inc: [www.tnemec.com](http://www.tnemec.com)
  - 5. Substitutions: Section 01 6000 - Product Requirements.

#### **2.02 HIGH-PERFORMANCE COATINGS**

- A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in MPI Approved Products List.
- B. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
  - 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
  - 2. NFPA 101, Class A rated.
  - 3. Lead Content: None.
- C. Moderate Exposure: All minimum criteria.

#### **2.03 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.
- B. Epoxy Coating:
  - 1. Number of coats: Two.
  - 2. Top Coat(s): Polyamide Epoxy; MPI #77, #177.
    - a. Products:

- 1) Sherwin-Williams; Macropoxy 646-100 Epoxy, B58-600 Series:  
[www.protective.sherwin-williams.com](http://www.protective.sherwin-williams.com)
- 2) Substitutions: Section 01 6000 - Product Requirements.
3. Top Coat(s): High Performance Institutional, Two-Component, Water Based Epoxy Coating; MPI #252, #254, #255, #256.
  - a. Sheen: Eggshell.
  - b. Products:
    - 1) Sherwin-Williams; Pro Industrial Water Based Catalyzed Epoxy:  
[www.protective.sherwin-williams.com](http://www.protective.sherwin-williams.com) (MPI #254)
    - 2) Substitutions: Section 01 6000 - Product Requirements.
- C. Shellac: Pure, white type.

#### **2.04 PRIMERS**

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.
  1. Block Filler, Epoxy; MPI #116.
    - a. Products:
      - 1) PPG Paints; Amerlock 400 Epoxy Block Filler, 400BF: [www.ppgpaints.com](http://www.ppgpaints.com)
      - 2) Substitutions: Section 01 6000 - 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 coated surfaces.

### **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:
  1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
  2. Concrete Floors and Traffic Surfaces: 8 percent.
- F. Masonry: Verify masonry joints are struck flush.

#### **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. Concrete:
  1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi (10,350 to 27,580 kPa) at 6 to 12 inches (150 to 300 mm). Allow to dry.
  3. Clean concrete according to ASTM D4258. Allow to dry.

4. Prepare surface as recommended by coating manufacturer and according to SSPC-SP 13.
- E. 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 coating 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.
- F. 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.
- B. Concrete Masonry: Apply masonry filler to thickness required to fill holes and produce smooth surface; minimum thickness of 30 mils (0.8 mm).

### **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, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

### **3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for general requirements for field inspection.

### **3.06 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.

### **3.07 PROTECTION**

- A. Protect finished work from damage.

### **3.08 SCHEDULE**

- A. Color: As indicated on Finish Schedule.

**END OF SECTION 09 9600**



**SECTION 10 1400  
SIGNAGE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Emergency evacuation maps.
- D. Building identification signs.

**1.02 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- E. Verification Samples: Submit samples showing colors specified.

**1.04 QUALITY ASSURANCE**

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

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

**1.06 FIELD CONDITIONS**

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Flat Signs:
  - 1. Best Sign Systems, Inc: [www.bestsigns.com](http://www.bestsigns.com)
  - 2. Mohawk Sign Systems, Inc: [www.mohawksign.com](http://www.mohawksign.com)

3. APCO Graphics, Inc.: [www.apcosigns.com](http://www.apcosigns.com)
  4. ASI Sign Systems, Inc.: [www.asisignage.com](http://www.asisignage.com)
  5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Dimensional Letter Signs:
1. A.R.K. Ramos Architectural Signage Systems; Cast Aluminum Letters: [www.arkramos.com](http://www.arkramos.com)
  2. Cosco Industries; Cast Aluminum: [www.coscoarchitecturalsigns.com/](http://www.coscoarchitecturalsigns.com/)
  3. Inpro: [www.inprocorp.com](http://www.inprocorp.com)
  4. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 SIGNAGE APPLICATIONS**

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
1. Sign Type: Flat signs with engraved panel media as specified.
  2. Provide "tactile" signage, with letters raised minimum 1/32 inch ( 0.8 mm ) and Grade II braille.
  3. Character Height: 1 inch ( 25 mm ).
  4. Sign Height: 2 inches ( 50 mm ), unless otherwise indicated.
  5. Office Doors: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section for replaceable occupant name.
  6. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers indicated on drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
  7. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
  8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
- C. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
  2. Allow for 20 signs 4 inches high by 16 inches long.
- D. Emergency Evacuation Maps:
1. Map content to be provided by Owner.
  2. Use clear plastic panel silk-screened on reverse, in brushed aluminum frame, screw-mounted.
- E. Building Identification Signs:
1. Use individual metal letters.
  2. Mount on outside wall in location indicated on drawings.

## **2.03 SIGN TYPES**

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
  2. Corners: Square.
  3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
  2. Character Case: Upper case only.
  3. Background Color: Clear.
  4. Character Color: Contrasting color.

#### **2.04 TACTILE SIGNAGE MEDIA**

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
  - 1. Total Thickness: 1/16 inch ( 1.6 mm ).
- B. Injection Molded Panels: One-piece acrylic plastic, with raised letters and braille.
  - 1. Total Thickness: 1/8 inch ( 3 mm ).

#### **2.05 NON-TACTILE SIGNAGE MEDIA**

- A. Silk Screened Plastic Panels: Letters and graphics silk screened onto reverse side of plastic surface:
  - 1. Sign Color: Clear.
  - 2. Total Thickness: 1/8 inch ( 3 mm ).

#### **2.06 DIMENSIONAL LETTERS**

- A. Metal Letters:
  - 1. Metal: Aluminum casting.
  - 2. Metal Thickness: 1/8 inch minimum ( 3 mm ).
  - 3. Text and Typeface:
    - a. Character Font: Helvetica, Arial, or other sans serif font.
    - b. Character Case: Upper case only.
  - 4. Finish: Brushed, satin.
  - 5. Mounting: Concealed screws.

#### **2.07 ACCESSORIES**

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Protect from damage until Substantial Completion; repair or replace damaged items.

**END OF SECTION 10 1400**

**SECTION 10 2600  
WALL AND DOOR PROTECTION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Corner guards.
- B. Wall Protection.

**1.02 REFERENCE STANDARDS**

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- B. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2023.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
  - 1. Submit two sections of corner guards, bumper rails, and protective corridor handrails, 24 inches (610 mm) long.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
- C. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Basis of Design: Acrovyn Corner Guards c-sgroup.com

**2.02 PERFORMANCE CRITERIA**

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.

**2.03 PRODUCT TYPES**

- A. Corner Guards - Surface Mounted:
  - 1. Material: High impact vinyl with full height extruded aluminum retainer.
  - 2. Material: Type 304 stainless steel, No. 4 finish, \_\_\_\_\_ gauge, \_\_\_\_\_ inch (\_\_\_\_\_ mm) thick.
  - 3. Width of Wings: 3 inches (76 mm).
  - 4. Corner: Radiused.
  - 5. Color: As selected from manufacturer's standard colors.
  - 6. Length: One piece.

**2.04 FABRICATION**

- A. Fabricate components with tight joints, corners and seams.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

**3.02 INSTALLATION**

- A. Position corner guard 4 inches (102 mm) above finished floor to \_\_\_\_ inches high (\_\_\_\_ mm high).
- B. WP-1 Position wall protection above floor base up to 3'-2".
- C. WP-2 Position above WP-1.

**3.03 CLEANING**

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

**END OF SECTION 10 2600**

**SECTION 10 2800**  
**TOILET, BATH, AND LAUNDRY ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Under-lavatory pipe supply covers.
- D. Utility room accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 3000 - Tiling: Ceramic washroom accessories.
- B. Section 22 4000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- C. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.

**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 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Commercial Toilet, Shower, and Bath Accessories:
  - 1. Basis of Design: Bobrick Washroom Equipment, Inc.: [www.bobrick.com](http://www.bobrick.com)
  - 2. AJW Architectural Products: [www.ajw.com](http://www.ajw.com)
  - 3. American Specialties, Inc: [www.americanspecialties.com](http://www.americanspecialties.com)
  - 4. Bradley Corporation: [www.bradleycorp.com](http://www.bradleycorp.com)
  - 5. Substitutions: Section 01 6000 - Product Requirements.
- B. Under-Lavatory Pipe Supply Covers:
  - 1. Plumberex Specialty Products, Inc: [www.plumberex.com](http://www.plumberex.com)
  - 2. TRUEBRO; Lav Shield: [www.grainger.com](http://www.grainger.com)
  - 3. TRUEBRO; pipe and valve covers: [www.grainger.com](http://www.grainger.com)
  - 4. Substitutions: Section 01 6000 - Product Requirements.

**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.
  - 1. Grind welded joints smooth.
  - 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Keys: Provide minimum 2 keys for each accessory to Owner; master key lockable accessories.
- C. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

- D. Adhesive: Two component epoxy type, waterproof.
- E. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
- F. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

### **2.03 FINISHES**

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- C. Back paint components where contact is made with building finishes to prevent electrolysis.

### **2.04 COMMERCIAL TOILET ACCESSORIES**

- A. Toilet Paper Dispenser: Double roll, surface mounted bracket type, stainless steel, eccentric-shaped plastic spindle for 1/2 revolution delivery designed to prevent theft of tissue roll.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges, tumbler locks on upper and lower doors.
  - 1. Waste receptacle liner: Reusable, heavy-duty vinyl.
  - 2. Towel dispenser capacity: 600 C-fold..
- C. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
- D. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
  - 1. Size: As indicated on drawings.
  - 2. Frame: 0.05 inch (1.3 mm) angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
  - 3. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet and nonabsorptive filler material.
- E. 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: Satin.
    - d. Length and Configuration: As indicated on drawings.
- F. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

### **2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES**

- A. Shower Curtain Rod: Stainless steel tube, 1 inch (25 mm) outside diameter, 0.04 inch (1.0 mm) wall thickness, satin-finished, with 3 inch (75 mm) outside diameter, minimum 0.04 inch (1.0 mm) thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain:
  - 1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
  - 2. Material: Nylon, machine washable, and mildew-resistant.
  - 3. Size: 72 by 72 inches (1830 by 1830 mm), hemmed edges.
  - 4. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
  - 5. Color: White.
  - 6. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand seat.
  - 1. Seat: One-piece, pan-type, 0.05 inch (1.3 mm) stainless steel sheet, Type 304. Weld seams and grind smooth.
  - 2. Size: ADA Standards compliant.
- D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.
- E. Robe Hook: Heavy-duty stainless steel, double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

## **2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS**

- A. Specified in 22 4000 - Plumbing Fixtures.
- B. 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. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
  - 3. Color: To be chosen by Architect.

## **2.07 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: 36 inches (900 mm).

# **PART 3 EXECUTION**

## **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

## **3.02 PREPARATION**

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

## **3.03 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 required by accessibility regulations, unless otherwise indicated.

## **3.04 PROTECTION**

- A. Protect installed accessories from damage due to subsequent construction operations.

**END OF SECTION 10 2800**



**SECTION 10 4400  
FIRE PROTECTION SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

**1.02 REFERENCE STANDARDS**

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features.
- C. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

**1.04 FIELD CONDITIONS**

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Fire Extinguishers:
  - 1. Same as for Fire Extinguisher Cabinets and Accessories.
- B. Fire Extinguisher Cabinets and Accessories:
  - 1. Activar Construction Products Group, Inc. - JL Industries; Cosmopolitan Series:  
[www.activarcpg.com](http://www.activarcpg.com)
  - 2. Larsen's Manufacturing Co: [www.larsensmfg.com](http://www.larsensmfg.com)
  - 3. Oval Brand Fire Products; Cabinets for Low Profile Extinguishers:  
[www.ovalfireproducts.com](http://www.ovalfireproducts.com)
  - 4. Potter-Roemer: [www.potterroemer.com](http://www.potterroemer.com)
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

**2.02 FIRE EXTINGUISHERS**

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.

**2.03 FIRE EXTINGUISHER CABINETS**

- A. Cabinet Construction: Non-fire rated.
  - 1. Formed stainless steel sheet; 0.036 inch (0.9 mm) thick base metal.
- B. Cabinet Configuration: Semi-recessed type.
  - 1. Size to accommodate accessories.
- C. 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.
- D. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- E. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.

- F. Finish of Cabinet Interior: White colored enamel.

#### **2.04 ACCESSORIES**

- A. Extinguisher Brackets: Formed steel, chrome-plated.
- B. Lettering: FIRE EXTINGUISHER decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. 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 from finished floor to inside bottom of cabinet.
- C. Secure rigidly in place.
- D. Place extinguishers in cabinets.

#### **3.03 MAINTENANCE**

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

**END OF SECTION 10 4400**

**SECTION 10 5113  
METAL LOCKERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal lockers.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete base construction.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. 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; 2021a.
- C. ASTM F1267 - Standard Specification for Metal, Expanded, Steel; 2018 (Reapproved 2023).
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- C. Samples: Manufacturer's color chips for selection.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect locker finish and adjacent surfaces from damage.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Metal Lockers:
  - 1. ASI Storage Solutions: [www.asi-storage.com](http://www.asi-storage.com)
  - 2. DeBourgh Manufacturing Co: [www.debourgh.com](http://www.debourgh.com)
  - 3. Lyon Workspace Products: [www.lyonworkspace.com](http://www.lyonworkspace.com)
  - 4. Penco Products, Inc: [www.pencoproducts.com](http://www.pencoproducts.com)
  - 5. Tennsco Storage: [www.tennsco.com](http://www.tennsco.com)
  - 6. Substitutions: See Section 01 6000 - Product Requirements.

**2.02 LOCKER APPLICATIONS**

- A. Gear Lockers: Metal lockers, free-standing.
  - 1. Configuration: Single tier.
  - 2. Fittings: Size and configuration as indicated on drawings.
    - a. Upper shelf.
    - b. Hooks: Four single prong.
  - 3. Ventilation: Perforated side panels, doors, and back panels.
  - 4. Finish: Manufacturer's standard powder coated finish.
  - 5. Color: To be selected from manufacturer's full range by Architect.

**2.03 METAL LOCKERS**

- A. Accessibility: Design units indicated on drawings as 'accessible' to comply with ICC A117.1 and ADA Standards.
- B. Locker Case Construction:
  - 1. Heavy-Duty, Welded Construction: Made of formed and welded together sheet steel; metal edges finished smooth without burrs; baked enamel or powder coat finished inside and out.
    - a. Assembly: Do not use bolts, screws, or rivets to assemble locker bodies.

- b. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
  - 1) Expanded Steel Sheet: Made from ASTM A1008/A1008M carbon steel sheet and complying with ASTM F1267, Type II, expanded and flattened, style 3/4 - 16, with a minimum 70 percent open area.
    - (a) Class 2, hot-dip zinc-coated, galvanized or galvanized.
  - 2) Body and Shelves: Minimum 14 gauge.
  - 3) Backs: Minimum 14 gauge.
  - 4) Base: None.
- c. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
  - 1) Door Frame: 14 gauge, minimum.
- d. Provide filler strips where indicated or required, securely attached to lockers.
- C. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
  - 1. Door Thickness: 14 gauge, minimum.
- D. Latches and Door Handles: Manufacturer's standard.
  - 1. Latching: Manufacturer's standard for locking arrangement selected.
    - a. Spring Latch: Provide for box-size lockers and where indicated.
      - 1) 16 gauge, 0.0598 inch (1.52 mm) cold rolled steel, zinc plated with a 10 gauge, 0.1345 inch (3.42 mm) latch and 16 gauge, 0.0598 inch (1.52 mm) stainless steel lock hasp and completely enclosed stainless steel spring.
      - 2) Equip box locker doors with a padlock hasp and a stainless steel strike plate with an integral handle pull. Box locker doors may also be equipped with built-in locks.
      - 3) Rubber silencers: One silencer at each latch hook.
- E. Hinges: Heavy-duty, 5-knuckle type; two for doors under 42 inches (1050 mm) high; three for doors over 42 inches (1 050 mm) high.
- F. Coat Hooks: Stainless steel or zinc-plated steel.
- G. Built-In Lock Boxes: Same material as locker, manufacturer's standard size, with built-in key locks with spring bolt action. Positive automatic pre-locking type allowing locker to be locked while door is open, then closed without unlocking or damaging locking mechanism.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that prepared bases are in correct position and configuration.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds (445 N).
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels and filler panels.
- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

**3.03 CLEANING**

- A. Clean locker interiors and exterior surfaces.

**END OF SECTION 10 5113**

**SECTION 11 8129  
FACILITY FALL PROTECTION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Roof anchors.
- B. Ladder safety systems.
- C. Safety railings and gates.

**1.02 RELATED REQUIREMENTS**

- A. Section 05 5133 - Metal Ladders.

**1.03 DEFINITIONS**

- A. Anchorage Connector: A component or subsystem that functions as an interface between the anchorage and a fall protection, work positioning, rope access, or rescue system for the purpose of coupling the system to the anchorage.
- B. Fall Protection System: System can be either a fall arrest or a fall restraint system.

**1.04 REFERENCE STANDARDS**

- A. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- B. 29 CFR 1910.23 - Ladders; Current Edition.
- C. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- D. 29 CFR 1910.140 - Personal fall protection systems; Current Edition.
- E. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
- F. 29 CFR 1926.1053 - Ladders; Current Edition.
- G. ANSI/ASSP Z359.1 - The Fall Protection Code; 2024.
- H. ANSI/ASSP Z359.11 - Safety Requirements for Full Body Harnesses; 2021.
- I. ANSI/ASSP Z359.12 - Connecting Components for Personal Fall Arrest Systems; 2019.
- J. ANSI/IWCA I-14 - Window Cleaning Safety Standard; 2001.
- K. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
- L. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
- M. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications; 2021.
- N. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Material, equipment, and fixture lists. Manufacturer's catalog data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing in sufficient detail that product complies with contract requirements. Equipment and performance data including but not limited to lifeline anchors, safety tieback anchors, and lifeline cable.
- C. Shop Drawings: Installation details: plan showing locations and types of anchorage points for personal fall protection systems and building maintenance equipment.
- D. Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Delegated Design Documents: Drawings and calculations sealed by Designer for fall protection system, indicating compliance with performance requirements and design criteria.

- F. Manufacturer's qualification statement.
- G. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- H. Designer's qualification statement.
- I. Installer's qualification statement.
- J. Testing agency's qualification statement.

#### **1.06 QUALITY ASSURANCE**

- A. Designer Qualifications: Perform design under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
- C. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- D. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- E. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

### **PART 2 PRODUCTS**

#### **2.01 ROOF ANCHORS**

- A. Manufacturers:
  - 1. Substitutions: See Section 01 6000 - Product Requirements.
- B. Application:
- C. Structural Performance: Provide safety tieback anchors capable of withstanding design loads as required by governing regulations and codes.
- D. Anchors:
  - 1. Type: Steel anchorage plate with cast steel loop top.
- E. Anchor Installation:
  - 1. Roofing Material: As indicated on drawings.

#### **2.02 LADDER SAFETY SYSTEMS**

- A. Ladder Safety System:
  - 1. Manufacturers:
    - a. Guardian Fall Protection; \_\_\_\_\_: [www.guardianfall.com](http://www.guardianfall.com)
    - b. Honeywell International, Inc; \_\_\_\_\_: [www.honeywell.com](http://www.honeywell.com)
    - c. Sellstrom Manufacturing Company; \_\_\_\_\_: [www.fallprotection.com](http://www.fallprotection.com)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Description: Ladder safety system allows the worker to climb up and down using both hands; does not require the employee continuously, hold, push, or pull any part of the system while climbing.
- B. Personal Fall Arrest System Components; 29 CFR 1910.140:
  - 1. Body Support: Full body harness meeting requirements of ANSI/ASSP Z359.11; equipped with front or hip D-rings for attachment to climbing ladder fall arrest system.
  - 2. Connecting Means: Connecting hardware, such as a locking carabiner, meeting requirements of ANSI/ASSP Z359.12; compatible with fall arrester and body support harness.

### **2.03 MATERIALS - ALUMINUM**

- A. Aluminum Tube: Minimum wall thickness of 0.127 inch (3.2 mm); ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.

### **2.04 FABRICATION**

- A. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to appearance and performance.
- B. Grind off surplus welding material and ensure exposed internal corners have smooth lines.
- C. Fabricate system components of the same material unless otherwise indicated.
- D. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.
- E. Fabricate joints in a manner to discourage water accumulation. Provide weep holes to drain all water that could accumulate in the exposed joints.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine area for compliance with requirements for installation tolerances and other conditions related to this work.

### **3.02 PREPARATION**

- A. Coordinate location of fall protection equipment indicated to be attached to structural substrate or surface of roofing system and provide anchoring devices with templates, diagrams, and installation instructions.

### **3.03 INSTALLATION**

- A. Install anchorage and fasteners in accordance with shop drawings and manufacturer's recommendations to obtain allowable working loads published in product literature and in accordance with this specification.

### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for additional requirements.

### **3.05 ADJUSTING**

- A. Adjust fall protection components to function smoothly and safely.

### **3.06 CLEANING**

- A. Clean exposed surfaces in accordance with fall protection system manufacturer's written instructions.

### **3.07 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals for closeout submittals.
- B. Training: Train Owner's personnel on operation and maintenance of system.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Instructor: Manufacturer's training personnel.

### **3.08 MAINTENANCE**

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.
- B. 29 CFR 1910 and ANSI/IWCA I-14 require that anchors first be certified and subsequently inspected on an annual basis. Coordinate with manufacturer and local inspectors as required to maintain compliance.

**END OF SECTION 11 8129**



**SECTION 12 2400  
WINDOW SHADES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Interior manual roller shades.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

**1.03 REFERENCE STANDARDS**

- A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- B. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Sequencing:
  - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
  - 2. Do not install shades until final surface finishes and painting are complete.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, mounting dimension requirements for each product and condition, and operation direction.
- D. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- E. Selection Samples: Include fabric samples in full range of available colors and patterns.
- F. Verification Samples: Minimum size 6 inches (150 mm) square, representing actual materials, color and pattern.
- G. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- H. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- I. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- J. Maintenance contracts.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

- B. Handle and store shades in accordance with manufacturer's recommendations.

#### **1.08 FIELD CONDITIONS**

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

#### **1.09 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
  - 1. Shade Hardware: three years.
  - 2. Fabric: three years.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Interior Manually Operated Roller Shades:
  - 1. Draper, Inc: [www.draperinc.com/](http://www.draperinc.com/)
  - 2. Basis of Design: Hunter Douglas Architectural: [www.hunterdouglasarchitectural.com](http://www.hunterdouglasarchitectural.com)
  - 3. MechoShade Systems LLC: [www.mechoshade.com](http://www.mechoshade.com)
  - 4. SWFcontract, a division of Springs Window Fashions, LLC.: [www.swfcontract.com](http://www.swfcontract.com)
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 ROLLER SHADES**

- A. General:
  - 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
  - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades:
  - 1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
    - a. Drop Position: Regular roll.
    - b. Roll Direction: Roll down, closed position is at window sill.
    - c. Mounting: Window jamb mounted - inside, between jambs.
    - d. Size: As measured in the field.
    - e. Fabric: As indicated under Shade Fabric article.
  - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
    - a. Double Roller Brackets: Configured for light-filtering and room-darkening shades in one opening.
      - 1) Light-Filtering Fabric: Room-side of opening.
      - 2) Room-Darkening Fabric: Glass-side of opening.
  - 3. Roller Tubes: As required for type of shade operation.
    - a. Material: Extruded aluminum, clear anodized finish.
    - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
    - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
  - 4. Hembars: Designed to maintain bottom of shade straight and flat.
  - 5. Manual Operation for Interior Shades:
    - a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
    - b. Drive Chain: Continuous loop beaded ball chain, 95 lb (43 kg) minimum breaking strength. Provide upper and lower limit stops.
    - c. Chain Retainer:
      - 1) Manufacturer's standard clip.

6. Accessories:
  - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
    - 1) Color: White.
    - 2) Profile: Square.
  - b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
  - c. Fasteners: Noncorrosive, and as recommended by shade manufacturer.
- C. Interior Roller Shades - Basis of Design: Draper, Inc; Manual LightBloc FlexShade: [www.draperinc.com/#sle](http://www.draperinc.com/#sle).
  1. Description: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.
    - a. Mounting: Wall mounted.
  2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
  3. Roller Tubes: As required for type of shade operation; designed for removal without removing mounting hardware.
    - a. Material: Extruded aluminum or steel, with wall thickness and material selected by manufacturer.
    - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.

### **2.03 SHADE FABRIC**

- A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
  1. Material: Vinyl coated fiberglass.
  2. Color: As selected by Architect from manufacturer's full range of colors.
  3. Fabrication:
    - a. If height of opening requires multiple panels of railroaded fabric, use battens at seams.
    - b. Battens: Full width of shade, enclose in welded shade fabric pocket.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

### **3.02 PREPARATION**

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

### **3.04 CLEANING**

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

**3.05 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

**3.06 PROTECTION**

- A. Protect installed products from subsequent construction operations.

**3.07 MAINTENANCE**

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

**END OF SECTION 12 2400**

**SECTION 12 3100  
MANUFACTURED METAL CASEWORK**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Manufactured standard and custom casework, with cabinet hardware.
- B. Special purpose units.
- C. Solvent storage cabinets.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Blocking and nailers for anchoring casework.
- B. Section 07 9200 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- C. Section 09 2116 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.
- D. Section 12 3600 - Countertops.

**1.03 REFERENCE STANDARDS**

- A. BHMA A156.9 - Cabinet Hardware; 2020.

**1.04 DESIGN REQUIREMENTS**

- A. Reinforce frame counters \_\_\_\_\_ in \_\_\_\_\_ area, to safely support a load of 200 lbs (90 kg) concentrated on one square foot (0.093 sq m) in any area with no indentation showing on surface and with permanent set not exceeding 0.005 inch (0.127 mm).

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate casework types, sizes, locations, using large scale plans, elevations, cross sections. Include rough-in and anchors, placement dimensions and tolerances, clearances required, and keying information.
- C. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches (51 mm by 75 mm).
- D. Samples: Two samples of each glazing material type. Minimum sample size: 2 by 3 inches (51 by 75 mm).

**1.06 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 and approved by manufacturer.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Accept casework on site. Inspect on arrival for damage.

**1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year warranty against defects. Complete forms in Owner's name and register with manufacturer. Covered defects include, but are not limited to:
  - 1. Ruptured, cracked, or stained finish coating.
  - 2. Discoloration or lack of finish integrity.
  - 3. Cracking or peeling of finish.
  - 4. Failure of hardware.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Metal Casework:
  - 1. Basis of Design: Tristar Vet; [www.tristarvet.com](http://www.tristarvet.com)
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 FABRICATION**

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Casework: Die-formed metal sheet; each unit self-contained and not dependent on adjacent units or building structure for rigidity; factory-fabricated, factory-assembled, and factory-finished.
  - 1. Style: Flush overlay - square edge.
  - 2. Steel Sheet Metal:
    - a. Gables, Front and Back Panels, Gusset Plates, Aprons, and Rails: 18 gauge, 0.0478 inch (1.21 mm) minimum thickness.
    - b. Drawers, Cabinet Floors, Shelves, Filler Panels and Drawer Dividers: 20 gauge, 0.0359 inch (0.91 mm) minimum thickness.
    - c. Backing Sheet to Door and Door Fronts: 22 gauge, 0.0299 inch (0.76 mm) minimum thickness.
  - 3. Structural Performance: Provide components that safely support the following minimum loads, without deformation or damage:
    - a. Base Units: 500 pounds per linear foot (744 kg/linear m) across the cabinet ends.
  - 4. Corners and Joints: Without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
  - 5. Edges and Seams: Smooth. Form counter tops, shelves, and drain boards from continuous sheets.
  - 6. Shelf Edges: Turned down 3/4 inch (19 mm) on each side and returned 3/4 inch (19 mm) front and back.
  - 7. Ends: Close open ends with matching construction.
  - 8. Welding: Electric spot welded; joints ground smooth and flush.
  - 9. Drawers and Doors: Fabricate drawer and door fronts of sandwiched sheets of sheet steel welded together and reinforced for hardware.
    - a. Fill with sound-deadening core.
  - 10. Separation: Use bituminous paint or non-conductive tape to coat metal surfaces in contact with cementitious materials, and to separate dissimilar metals.

### **2.03 SPECIAL PURPOSE UNITS**

### **2.04 CABINET HARDWARE**

- A. Manufacturer's standard types, styles and finishes.
- B. Comply with BHMA A156.9 requirements.
  - 1. Acceptable base materials for plated finishes include brass, bronze, and steel.

### **2.05 MATERIALS**

- A. General: Manufacturer's standard materials for units specified, unless otherwise indicated.

### **2.06 FINISHES**

- A. Shop finish all components.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify adequacy of support framing and anchors.
- B. Verify that service connections are correctly located and of proper characteristics.

**3.02 INSTALLATION**

- A. Install casework, components and accessories in accordance with manufacturer's instructions.
- B. Large Components: Ensure that large components can be moved into final position without damage to other construction.

**3.03 ADJUSTING**

- A. Adjust operating parts, including doors, drawers, hardware, fixtures to function smoothly.

**3.04 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean casework, counters, shelves, glass, legs, hardware, fittings and fixtures.

**3.05 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent installers from standing on or storing tools and materials on casework or countertops.

**END OF SECTION 12 3100**

**SECTION 12 3600  
COUNTERTOPS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Countertops for architectural cabinet work.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 4100 - Architectural Wood Casework.

**1.03 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- G. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- H. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- I. PS 1 - Structural Plywood; 2019.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- C. Verification Samples: For each finish product specified, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- D. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- E. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

**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. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.



1. Flat Sheet Thickness: 1/2 inch (12 mm), minimum.
  2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
    - a. Manufacturers:
      - 1) Avonite Surfaces: [www.avonitesurfaces.com](http://www.avonitesurfaces.com)
      - 2) Formica Corporation: [www.formica.com](http://www.formica.com)
      - 3) Basis of Design: Wilsonart; Quarry Melange 904 ML (3): [www.wilsonart.com](http://www.wilsonart.com)
      - 4) Substitutions: See Section 01 6000 - Product Requirements.
    - b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
    - c. Color and Pattern: As indicated on drawings.
  3. Other Components Thickness: 1/2 inch (12 mm), minimum.
  4. Back and End Splashes: Same sheet material, square top; minimum 4 inches (102 mm) high.
- B. Stainless Steel Countertops: , Type 304, stainless steel sheet; 16 gauge, 0.0625 inch (1.59 mm) nominal sheet thickness.
1. Finish: 4B satin brushed finish.

## 2.02 MATERIALS

- A. Extruded Aluminum: ASTM B211/B211M, 6463 alloy, T5 temper.
- B. 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.
- C. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf (20 kg/cu m) minimum density; minimum 3/4 inch (19 mm) thick; join lengths using metal splines.
- D. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- E. 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. Solid Surfacing: Fabricate tops and wall panels up to 144 inches (3,657 mm) long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
- D. 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.

### **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. Attach stainless steel countertops using stainless steel fasteners and clips.
- C. 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.

**END OF SECTION 12 3600**

**SECTION 21 0500**  
**COMMON WORK RESULTS FOR FIRE SUPPRESSION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Above ground piping.
- B. Buried piping.
- C. Escutcheons.
- D. Expansions - hose and braid.
- E. Mechanical couplings.
- F. Pipe hangers and supports.
- G. Pipe sleeves.
- H. Pipe sleeve-seal systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 09 9113 - Exterior Painting: Preparation and painting of exterior fire protection piping systems.
- C. Section 09 9123 - Interior Painting: Preparation and painting of interior fire protection piping systems.
- D. Section 21 1300 - Fire-Suppression Sprinkler Systems: Sprinkler systems design.

**1.03 REFERENCE STANDARDS**

- A. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.
- B. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- E. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2021.
- F. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- H. ASTM A135/A135M - Standard Specification for Electric-Resistance-Welded Steel Pipe; 2021.
- I. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- J. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.
- K. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- L. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- M. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.
- N. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- O. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- P. AWWA C606 - Grooved and Shouldered Joints; 2022.

- Q. FM (AG) - FM Approval Guide; Current Edition.
- R. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- S. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems; 2024.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's catalog information. Indicate valve data and ratings.
- C. Installer's qualification statement.
- D. Project Record Documents: Record actual locations of components and tag numbering.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store valves in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - 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 GENERAL REQUIREMENTS**

- A. Sprinkler-based System:
  - 1. Comply with NFPA 13.
  - 2. See Section 21 1300.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- C. Provide system pipes, fittings, sleeves, escutcheons, seals, and other related accessories.

#### **2.02 BURIED PIPING**

- A. Ductile Iron Pipe: AWWA C151/A21.51.
  - 1. Fittings: AWWA C110/A21.10, standard thickness.
  - 2. Joints: AWWA C111/A21.11, styrene-butadiene rubber (SBR) or vulcanized SBR gasket.
  - 3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

#### **2.03 ABOVE GROUND PIPING**

- A. Steel Pipe: ASTM A795 Schedule 10, ASTM A135/A135M Schedule 10, or ASTM A795 Schedule 40, black.
  - 1. Steel Fittings: ASME B16.5 steel flanges and fittings.
  - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
  - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
  - 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

#### **2.04 PIPE SLEEVES**

- A. Vertical Piping:
  - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
  - 2. Provide sealant for watertight joint.
  - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
  - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- B. Pipe Passing Through Below Grade Exterior Walls:
  - 1. Zinc-coated or cast-iron pipe.
  - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- C. Clearances:
  - 1. Provide sleeves for all penetrations, and include additional allowance for insulated piping as applicable.
  - 2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.
  - 3. Rated Openings: Caulked tight with firestopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

#### **2.05 PIPE SLEEVE-SEAL SYSTEMS**

- A. Modular Mechanical Seals:
  - 1. Elastomer-based interlocking links to continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
  - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  - 3. Size and select seal component materials in accordance with service requirements.
  - 4. Service Requirements:
    - a. Oil, fuel, gas, and solvent resistant, when installed in locations where these chemicals will be present.
    - b. Underground, buried, and wet conditions.
  - 5. Glass-reinforced plastic pressure end plates.
- B. Wall Sleeve: PVC, HDPE, or Steel material with waterstop collar, and nailer end caps.
- C. Sleeve-Forming Disk: Nonconductive plastic-based material, 3 inch (76.2 mm) thick.
- D. Pipeline-Casing Seals:
  - 1. End Seals: 1/8 inch (3.1 mm), pull-on type, rubber or synthetic rubber based.

#### **2.06 ESCUTCHEONS**

- A. Manufacturers:
  - 1. Fire Protection Products, Inc.
  - 2. Tyco Fire Protection Products
  - 3. Viking Group Inc.
- B. Material:
  - 1. Fabricate from nonferrous metal.
  - 2. Metals and Finish: Comply with ASME A112.18.1.
- C. Construction:
  - 1. One-piece for mounting on chrome-plated piping.
  - 2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

#### **2.07 PIPE HANGERS AND SUPPORTS**

- A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Malleable iron, adjustable swivel, split ring.

- B. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.
- C. Nonmetallic Piping Hangers:
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 inches (80 mm): Cast iron hook.
- F. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- I. Seismic Hangers and Couplings:
  - 1. Provide coupling with a factory set disengagement rating of 140 percent to 160 percent of the static weight.
  - 2. Provide resettable and reusable, break away couplings.
  - 3. Provide tether cables to avoid excessive seismic joint movement.
  - 4. Coupling to be manufactured from non-corrosive materials.

## **2.08 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID**

- A. Provide flexible loops with two flexible sections of hose and braid, two 90-degree elbows, and 180-degree return with support bracket and air release or drain plug.
- B. Provide flexible loops capable of movement in the x, y, and z planes. Flexible loops to impart no thrust loads to the building structure.
- C. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
  - 1. Maximum Allowable Working Pressure: 150 psig (1030 kPa) at 120 degrees F (49 degrees C).
  - 2. Accommodate the Following:
    - a. Axial Deflection in Compression and Expansion: 1/2".
    - b. Lateral Movement: 1".
    - c. Angular Rotation: 15 degrees.
    - d. Force developed by 1.5 times specified maximum allowable operating pressure.
  - 3. End Connections: Same as specified for pipe jointing.
  - 4. Provide necessary accessories including, but not limited to, swivel joints, limit stops, internal guides, anti-torque device, internal flow liners, control rods, and control cables.

## **2.09 MECHANICAL COUPLINGS**

- A. Manufacturers:
  - 1. Anvil International: [www.anvilintl.com/](http://www.anvilintl.com/).
  - 2. Shurjoint Piping Products, Inc: [www.shurjoint.com/](http://www.shurjoint.com/).
  - 3. Tyco Fire Protection Products: [www.tyco-fire.com/](http://www.tyco-fire.com/).
  - 4. Victaulic Company; FireLock Style 009H: [www.victaulic.com/](http://www.victaulic.com/).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Rigid Mechanical Couplings for Grooved Joints:
  - 1. Dimensions and Testing: Comply with AWWA C606.
  - 2. Minimum Working Pressure: 300 psig (2065 kPa).
  - 3. Housing Material: Fabricate of ductile iron complying with ASTM A536.
  - 4. Housing Coating: Factory applied orange enamel
  - 5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).
  - 6. Bolts and Nuts: Hot-dipped-galvanized or zinc-electroplated steel.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

#### **3.02 INSTALLATION**

- A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.
- B. Install standpipe piping, hangers, and supports in accordance with NFPA 14.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Inserts:
  - 1. Provide inserts for placement in concrete formwork.
  - 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
  - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- H. Pipe Hangers and Supports:
  - 1. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
  - 2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  - 3. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  - 4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  - 5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  - 6. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed unless project is located in a coastal environment.
    - a. Painting of interior fire suppression systems is specified in Section 09 9123.
    - b. Painting of exterior fire suppression systems is specified in Section 09 9113.
- I. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
  - 1. Painting of interior fire suppression systems is specified in Section 09 9123.
  - 2. Painting of exterior fire suppression systems is specified in Section 09 9113.
- K. Structural Considerations:
  - 1. Do not penetrate building structural members unless indicated.
  - 2. Locate flexible expansion loops at or near the building seismic joint.
- L. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
  2. Aboveground Piping:
    - a. Pack solid using mineral fiber complying with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
    - c. Exterior locations shall use corrosion-resistant piping and materials with dielectric fittings and connections.
  3. All Rated Openings: Caulk tight with firestopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
  4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- M. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a watertight seal.
  6. Install in accordance with manufacturer's recommendations.
- N. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
  2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
  3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.
- O. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.

### **3.03 CLEANING**

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**END OF SECTION 21 0500**



**SECTION 21 0523**  
**GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Two-piece ball valves with indicators.
- B. Bronze butterfly valves with indicators.
- C. Iron butterfly valves with indicators.
- D. Check valves.
- E. Bronze OS&Y gate valves.
- F. Iron OS&Y gate valves.
- G. NRS gate valves.
- H. Trim and drain valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- D. Section 21 1300 - Fire-Suppression Sprinkler Systems.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. EPDM: Ethylene-propylene diene monomer.
- B. NRS: Non-rising stem.
- C. OS&Y: Outside screw and yoke.
- D. PTFE: Polytetrafluoroethylene.

**1.04 REFERENCE STANDARDS**

- A. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.
- C. ASME B31.9 - Building Services Piping; 2020.
- D. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- E. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS; 2017.
- F. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service; 2023.
- G. AWWA C606 - Grooved and Shouldered Joints; 2022.
- H. FM (AG) - FM Approval Guide; Current Edition.
- I. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- L. UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- M. UL 1091 - Standard for Butterfly Valves for Fire-Protection Service; Current Edition, Including All Revisions.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

**1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications:
  - 1. Obtain valves for each valve type from single manufacturer.
  - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Where listed products are specified, provide products listed, classified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for the purpose indicated.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.
- D. Installer and Maintenance Contractor Qualifications:
  - 1. Company specializing in performing the work of this section with minimum five years documented experience.
  - 2. Trained and approved by manufacturer to design, install, test and maintain the equipment specified herein.
  - 3. Complies with manufacturer's certification requirements.
  - 4. Complies with manufacturer's insurance requirements.

**1.07 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 valves open to minimize exposure of functional surfaces.
- B. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors and maintain at higher than ambient dew point temperature.
    - b. If outdoor storage is unavoidable, store valves off the ground in watertight enclosures.
- C. Use the following precautions for handling:
  - 1. Do not use operating handles or stems as lifting or rigging points.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Manufacturers:
  - 1. Emerson: [www.emerson.com/](http://www.emerson.com/)
  - 2. Ferguson Enterprises Inc: [www.fnw.com/](http://www.fnw.com/)
  - 3. Johnson Controls, Inc.: [www.johnsoncontrols.com](http://www.johnsoncontrols.com)
  - 4. Kennedy Valve: [www.kennedyvalve.com/](http://www.kennedyvalve.com/)
  - 5. Mueller Co., LLC: [www.muellercompany.com](http://www.muellercompany.com)
  - 6. Tyco Fire Products: [www.tycofsfp.com](http://www.tycofsfp.com)

7. Victaulic Company: [www.victaulic.com/](http://www.victaulic.com/)
8. Watts: [www.watts.com](http://www.watts.com)
9. Zurn: [www.zurn.com](http://www.zurn.com)
10. Substitutions: See Section 01 6000 - Product Requirements.

## 2.02 GENERAL REQUIREMENTS

- A. UL Listed: Provide valves listed in UL (DIR) under following headings and bearing UL mark:
  1. Main Level: HAMV - Fire Main Equipment.
    - a. Level 1: HCBZ - Gate Valve.
    - b. Level 1: HLOT - Valves.
    - c. Level 3: HLUG - Ball Valves, System Control.
    - d. Level 3: HLXS - Butterfly Valves.
    - e. Level 3: HMER - Check Valves.
    - f. Level 3: HMRZ - Gate Valves.
  2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
    - a. Level 1: VQGU - Valves, Trim, and Drain.
- B. FM Global Approved: Provide valves listed in FM (AG) Approval Guide under the following headings:
  1. Automated Sprinkler Systems:
    - a. Valves:
      - 1) Gate valves.
      - 2) Miscellaneous valves.
- C. ASME Compliance:
  1. ASME B16.1 for flanges on iron valves.
  2. ASME B1.20.1 for threads on threaded-end valves.
  3. ASME B31.9 for building services piping valves.
- D. Comply with AWWA C606 for grooved-end connections.
- E. Comply with NFPA 13 for valves.
- F. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- G. Valve Sizes: Same as upstream piping unless otherwise indicated.
- H. Valve Actuator Types:
  1. Worm-gear actuator with handwheel for quarter-turn valves, except trim and drain valves.
  2. Handwheel: For other than quarter-turn trim and drain valves.
  3. Hand-lever: For quarter-turn trim and drain valves 2 NPS (50 DN) and smaller.

## 2.03 TWO-PIECE BALL VALVES WITH INDICATORS

- A. UL 1091, except with ball instead of disc and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 1112.
- B. Description:
  1. Minimum Pressure Rating: 175 psig (1200 kPa).
  2. Body Design: Two piece.
  3. Body Material: Forged brass or bronze.
  4. Port Size: Full or standard.
  5. Seat: PTFE.
  6. Stem: Bronze or stainless steel.
  7. Ball: Chrome-plated brass.
  8. Actuator: Worm gear or traveling nut.
  9. Supervisory Switch: Internal or external.

**2.04 BRONZE BUTTERFLY VALVES WITH INDICATORS**

- A. UL 1091 and FM (AG) standard listing for indicating valves, (butterfly or ball type), Class Number 1112.
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- C. Body Material: Bronze.
- D. Seat: EPDM.
- E. Stem: Bronze or stainless steel.
- F. Disc: Bronze with EPDM coating.
- G. Actuator: Worm gear or traveling nut.
- H. Supervisory Switch: Internal or external.

**2.05 IRON BUTTERFLY VALVES WITH INDICATORS**

- A. UL 1091 and FM (AG) standard listing for indicating valves (butterfly or ball type), Class Number 112.
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- C. Body Material: Cast or ductile iron with EPDM or epoxy coating.
- D. Seat: EPDM.
- E. Stem: Stainless steel.
- F. Disc: Ductile iron, nickel plated.
- G. Actuator: Worm gear or traveling nut.
- H. Supervisory Switch: Internal or external.
- I. Body Design: Grooved-end connections.

**2.06 CHECK VALVES**

- A. UL 312 and FM (AG) standard listing for check valves, Class Number 1045.
- B. AWWA C508 compliant check valves.
- C. Minimum Pressure Rating: 175 psig (1200 kPa).
- D. Type: Center guided check valve.
- E. Body Material: Cast iron, ductile iron.
- F. Center guided check with elastomeric seal.
- G. Hinge Spring: Stainless steel.
- H. End Connections: Flanged, grooved, or threaded.

**2.07 BRONZE OS&Y GATE VALVES**

- A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- C. Body and Bonnet Material: Bronze or brass.
- D. Wedge: One-piece bronze or brass.
- E. Wedge Seat: Bronze.
- F. Stem: Bronze or brass.
- G. Packing: Non-asbestos PTFE.
- H. Supervisory Switch: External.
- I. End Connections: Threaded.

**2.08 IRON OS&Y GATE VALVES**

- A. Listed and Body Marked: AWWA C509, FM (AG), and UL 262.
- B. Maximum Working Pressure: 175 psi (1,200 kPa).
- C. Body and Bonnet Material: Cast or ductile iron.
- D. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
- E. Stem: Brass, bronze, or stainless steel.
- F. Packing: Non-asbestos PTFE.
- G. Supervisory Switch: External.

**2.09 NRS GATE VALVES**

- A. UL 262 and FM (AG) standard listing for fire-service water control valves (OS&Y and NRS-type gate valves).
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- C. Body and Bonnet Material: Cast or ductile iron.
- D. Wedge: Cast or ductile iron with elastomeric coating.
- E. Stem: Brass or bronze.
- F. Packing: Non-asbestos PTFE.
- G. Supervisory Switch: External.
- H. End Connections: Flanged.

**2.10 TRIM AND DRAIN VALVES**

- A. Ball Valves:
  - 1. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - b. Body Design: Two piece.
    - c. Body Material: Forged brass or bronze.
    - d. Port Size: Full or standard.
    - e. Seat: PTFE.
    - f. Stem: Bronze or stainless steel.
    - g. Ball: Chrome-plated brass.
    - h. Actuator: Hand-lever.
- B. Angle Valves:
  - 1. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - b. Body Material: Brass or bronze.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc: Bronze.
    - f. Packing: Asbestos free.
    - g. Handwheel: Malleable iron, bronze, or aluminum.
- C. Globe Valves:
  - 1. Description:
    - a. Pressure Rating: 175 psig (1200 kPa).
    - b. Body Material: Bronze with integral seat and screw-in bonnet.
    - c. Ends: Threaded.
    - d. Stem: Bronze.
    - e. Disc Holder and Nut: Bronze.
    - f. Disc Seat: Nitrile.

- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. Confirm valve interior to be free of foreign matter and corrosion.
- B. Remove packing materials.
- C. Examine guides and seats by operating valves from the fully open position to the fully closed position.
- D. Examine valve threads and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage.
  - 1. Check bolting for proper size, length, and material.
  - 2. Verify gasket for size, defects, damage, and suitable material composition for service.
  - 3. Replace all defective valves with new valves.

**3.02 INSTALLATION**

- A. Comply with specific valve installation requirements and application in the following Sections:
  - 1. Section 21 1300 for application of valves in wet and dry pipe, fire-suppression sprinkler systems.
- B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections.
  - 1. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in water supply connections and backflow preventer at potable water supply connections.
- D. Valves with threaded connections to have unions at equipment arranged for easy access, service, maintenance, and equipment removal without system shutdown.
- E. Valves in horizontal piping installed with stem at or above the pipe center.
- F. Position valves to allow full stem movement.
- G. Install valve tags. Comply with Section 21 0553 requirements for valve tags, schedules, and signs on surfaces concealing valves; and the appropriate NFPA standard applying to the piping system in which valves are installed.

**END OF SECTION 21 0523**

**SECTION 21 0548****VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems

**1.02 RELATED REQUIREMENTS**

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.

**1.03 DEFINITIONS**

- A. Fire Suppression Component: Where referenced in this section in regards to seismic controls, applies to any portion of the fire suppression system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

**1.04 REFERENCE STANDARDS**

- A. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. FM 1950 - Examination Standard for Seismic Sway Braces for Pipe, Tubing and Conduit; 2023.
- H. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- J. MFMA-4 - Metal Framing Standards Publication; 2004.
- K. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- M. UL 203A - Standard for Sway Brace Devices for Sprinkler System Piping; Current Edition, Including All Revisions.

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.

2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  4. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
  5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

#### 1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
  2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
1. Include dimensioned plan views and sections indicating proposed fire suppression component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  2. Identify mounting conditions required for equipment seismic qualification.
  3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  4. Indicate proposed arrangement of distributed system trapeze support groupings.
  5. Indicate proposed locations for distributed system flexible fittings and/or connections.
  6. Indicate locations of seismic separations where applicable.
  7. Include point load drawings indicating design loads transmitted to structure at each attachment location.
- F. Seismic Design Data:
1. Compile information on project-specific characteristics of actual installed fire suppression components necessary for determining seismic design forces required to design appropriate seismic controls.
  2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- G. Certification for seismically qualified equipment; identify basis for certification.
- H. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.



- I. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- J. Evidence of qualifications for seismic controls designer.
- K. Evidence of qualifications for manufacturer.
- L. Manufacturer's detailed field testing and inspection procedures.
- M. Field quality control test reports.

#### **1.07 QUALITY ASSURANCE**

- A. Comply with ICC (IBC).
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- D. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing fire suppression equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
  - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise indicated.
- D. Equipment Isolation:
  - 1. Equipment Type: All.
    - a. Mounting: Vibration-isolated structural steel base.
    - b. Isolator Type (Seismic Application): Seismic type restrained spring isolators.
- E. Piping Isolation:
  - 1. Use flexible piping connections to vibration-isolated equipment.

#### **2.02 SEISMIC CONTROL REQUIREMENTS**

- A. Design and provide fire suppression component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor fire suppression components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.

- C. Component Importance Factor (Ip): Fire suppression components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
  - 1. Provide special certification for fire suppression equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
  - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
  - 1. Provide seismic restraints for fire suppression components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  - 2. Seismic Restraint Exemptions, All Seismic Design Categories:
    - a. Fire Suppression Piping Exemptions, All Seismic Design Categories:
      - 1) Lateral sway bracing for piping individually supported within 6 inches (150 mm) of the structure measured between the top of pipe and the point of attachment to the structure, where all conditions for exception specified in NFPA 13 are met.
      - 2) Lateral sway bracing for branch lines smaller than 2-1/2 inches (65 mm) in diameter, where branch line restraint is provided in accordance with NFPA 13.
  - 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
    - a. ASHRAE (HVACA).
    - b. FEMA 412.
    - c. FEMA 413.
    - d. FEMA 414.
    - e. FEMA E-74.
    - f. SMACNA (SRM).
  - 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
  - 5. Seismic Type Vibration Isolators:
    - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 6. External Seismic Snubber Assemblies:
    - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
    - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
  - 7. Seismic Restraint Systems:
    - a. Arrange restraint elements to avoid obstruction of sprinklers in accordance with NFPA 13.
    - b. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
    - c. Use only cable restraints to restrain vibration-isolated fire suppression components.
    - d. Use only one restraint system type for a given fire suppression component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
    - e. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain fire suppression component in all lateral directions; consider bracket

geometry in anchor load calculations.

- f. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported fire suppression component weight.
- g. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported fire suppression component weight.
- h. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
- i. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
- j. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

F. Seismic Attachments:

- 1. Comply with support and attachment requirements of NFPA 13.
- 2. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
- 3. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
- 4. Do not use power-actuated fasteners.
- 5. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps, but not for sway bracing attachments as prohibited by NFPA 13.
- 6. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
- 7. Concrete Housekeeping Pads:
  - a. Increase size of pad as required to comply with anchor requirements.
  - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:

- 1. Include provisions to prevent seismic impact between fire suppression components and other structural or nonstructural components.
- 2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- 3. Comply with minimum clearance requirements between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

H. Seismic Relative Displacement Provisions:

- 1. Use suitable fittings or flexible connections, in accordance with NFPA 13, to accommodate:
  - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
  - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
  - c. Design displacements at seismic separations.
  - d. Anticipated drifts between floors.
- 2. Provide clearance around fire suppression system piping extending through walls, floors, platforms, and foundations in accordance with NFPA 13.

**2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES**

- A. Manufacturers:
  - 1. Vibration-Isolated Equipment Support Bases:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com](http://www.kineticsnoise.com).
    - b. Mason Industries: [www.mason-ind.com](http://www.mason-ind.com).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com](http://www.veco-nyc.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Structural Steel Bases:
  - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- C. Vibration-Isolated Concrete Inertia Bases:
  - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
  - 2. Minimum Base Depth: 6 inches (152 mm).
  - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
  - 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
  - 5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 3000.
  - 6. Pump Applications: Size and configure bases for piping elbow supports as required.

**2.04 VIBRATION ISOLATORS**

- A. Manufacturers:
  - 1. Vibration Isolators:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com](http://www.kineticsnoise.com).
    - b. Mason Industries: [www.mason-ind.com](http://www.mason-ind.com).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com](http://www.veco-nyc.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
  - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
  - 2. Spring Elements for Spring Isolators:
    - a. Color code or otherwise identify springs to indicate load capacity.
    - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    - f. Selected to function without undue stress or overloading.
  - 3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
  - 1. Resilient Material Isolator Pads:

- a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
- b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
- c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
2. Resilient Material Isolator Mounts, Nonseismic:
  - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
3. Open (Unhoused) Spring Isolators:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
  - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
4. Housed Spring Isolators:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
  - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
  - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - d. Furnished with integral leveling device for positioning and securing supported equipment.
5. Restrained Spring Isolators, Nonseismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
  - b. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

- D. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
  2. Restrained Spring Isolators, Seismic:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
    - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
    - c. Furnished with integral leveling device for positioning and securing supported equipment.
    - d. Provides constant free and operating height.
  3. Resilient Material Isolator Hangers, Seismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  4. Spring Isolator Hangers, Seismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
  5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

## 2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

- A. Manufacturers:
1. External Seismic Snubber Assemblies:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com](http://www.kineticsnoise.com).
    - b. Mason Industries: [www.mason-ind.com](http://www.mason-ind.com).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com](http://www.veco-nyc.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:

1. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.

## **2.06 SEISMIC RESTRAINT SYSTEMS**

- A. Manufacturers:
  1. Seismic Restraint Systems:
    - a. AFCON, a brand of Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. Eaton Corporation: [www.eaton.com](http://www.eaton.com).
    - c. Kinetics Noise Control, Inc: [www.kineticsnoise.com](http://www.kineticsnoise.com).
    - d. Mason Industries: [www.mason-ind.com](http://www.mason-ind.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Where required by NFPA 13, provide products listed as complying with UL 203A or FM 1950.
- D. Cable Restraints:
  1. Comply with ASCE 19.
  2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  4. Use protective thimbles for cable loops where potential for cable damage exists.
- E. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
  2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.

3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch (6.4 mm) or less between equipment support frame and seismic restraint; periodic inspection.
  4. Verification of required clearances between other equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
    - a. Provide specified minimum clearance beneath base.
  2. Spring Isolators:
    - a. Position equipment at operating height; provide temporary blocking as required.
    - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
  3. Isolator Hangers:
    - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  6. Adjust isolators to be free of isolation short circuits during normal operation.
  7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- F. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
  2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
  4. Equipment with Sheet Metal Housings:
    - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.



- b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
  - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
- 5. Concrete Housekeeping Pads:
  - a. Size in accordance with seismic design to meet anchor requirements.
  - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
- 6. Seismic Restraint Systems:
  - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
  - b. Install restraints within permissible angles in accordance with seismic design.
  - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
  - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
  - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:
  - 1. Verify isolator static deflections.
  - 2. Verify required clearance beneath vibration-isolated equipment support bases.
  - 3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
  - 1. Verify snubbing element air gaps.
- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 21 0548**

**SECTION 21 0553**  
**IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9123 - Interior Painting: Stencil paint.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. List: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- C. Product Data: Provide manufacturers catalog literature for each product required.
- D. Samples: Submit digital samples of labels, including measurement examples of each label type and size to be used in the project.
- E. Manufacturer's Installation Instructions: Indicate special procedures, and installation instructions.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Automatic Controls: Tags.
- B. Control Panels: Nameplates.
- C. Instrumentation: Tags.
- D. Major Control Components: Nameplates.
- E. Piping: Pipe markers.
- F. Pumps: Nameplates.
- G. Relays: Tags.
- H. Small-sized Equipment: Tags.
- I. Thermostats: Nameplates.
- J. Valves: Nameplates and ceiling tacks where above lay-in ceilings.

**2.02 NAMEPLATES**

- A. Manufacturers:
  - 1. Brimar Industries, Inc.: [www.brimar.com/](http://www.brimar.com/)
  - 2. Kolbi Pipe Marker Company.: [kolbipipemarkers.com/](http://kolbipipemarkers.com/)
  - 3. Seton Identification Products, a Tricor Direct Company.: [www.seton.com/](http://www.seton.com/)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Laminated three-layer plastic with engraved letters.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch (6 mm).
  - 3. Background Color: Black.

4. Thickness: 1/8 inch (3 mm).
5. Plastic: Comply with ASTM D709.

**2.03 TAGS**

- A. Manufacturers:
  1. Advanced Graphic Engraving, LLC
  2. Brady Corporation: [www.bradycorp.com/](http://www.bradycorp.com/).
  3. Brimar Industries, Inc: [www.brimar.com/](http://www.brimar.com/)
  4. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  5. Kolbi Pipe Marker Company: [kolbipipemarkers.com/](http://kolbipipemarkers.com/)
  6. Seton Identification Products, a Tricor Direct Company: [www.seton.com/](http://www.seton.com/)
  7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Metal Tags: Stainless Steel with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- C. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.

**2.04 PIPE MARKERS**

- A. Manufacturers:
  1. Brady Corporation: [www.bradycorp.com/](http://www.bradycorp.com/).
  2. Brimar Industries, Inc: [www.brimar.com/](http://www.brimar.com/)
  3. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  4. Kolbi Pipe Marker Company: [kolbipipemarkers.com/](http://kolbipipemarkers.com/)
  5. Seton Identification Products, a Tricor Company
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Underground Plastic Pipe Markers: Bright-colored continuously printed plastic ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.
- E. Color code as follows:
  1. Fire Quenching Fluids: Red with white letters.

**2.05 CEILING TACKS**

- A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- B. Color code as follows:
  1. Piping: Red.
  2. Sprinkler Valves: Red.

**PART 3 EXECUTION****3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

**3.02 INSTALLATION**

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.

- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Install underground plastic pipe markers 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried pipe.
- F. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
  - 1. Identify service, flow direction, and pressure.
  - 2. Install in clear view and align with axis of piping.
  - 3. Locate identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- G. Locate ceiling tacks to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION 21 0553**

**SECTION 21 1300  
FIRE-SUPPRESSION SPRINKLER SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wet-pipe sprinkler system.
- B. Dry-pipe sprinkler system.
- C. System design, installation, and certification.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- C. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- D. Section 21 0548 - Vibration and Seismic Controls for Fire Suppression Piping and Equipment.
- E. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.
- F. Section 28 4600 - Fire Detection and Alarm.

**1.03 REFERENCE STANDARDS**

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- C. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- D. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- E. UL (DIR) - Online Certifications Directory; Current Edition.

**1.04 ADMINISTRATIVE REQUIREMENTS**

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

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on sprinklers, valves, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.
- C. Shop Drawings:
  - 1. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
  - 2. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
  - 3. Submit shop drawings to Authorities Having Jurisdiction for approval. Shop Drawings must be stamped by a Fire Protection Engineer. Submit proof of approval to Architect.
- D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds specified requirements and code requirements.
- E. Designer's qualification statement.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and

numbers of service depot.

- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements for additional provisions.
  - 2. Extra Sprinklers: Type and size matching those installed in quantity required by referenced NFPA design and installation standard.
  - 3. Sprinkler Wrenches: For each sprinkler type.
- J. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

#### **1.06 QUALITY ASSURANCE**

- A. Maintain one copy of referenced design and installation standard on site.
- B. Comply with FM (AG) requirements.
- C. Designer Qualifications: Design system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- D. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- E. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by manufacturer.
- F. Equipment and Components: Provide products that bear FM (AG) label or marking.
- G. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Sprinklers, Valves, and Equipment:
  - 1. Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
  - 2. Tyco Fire Protection Products
  - 3. Viking Corporation
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 SPRINKLER SYSTEM**

- A. Sprinkler System: Provide coverage for building areas as indicated on drawings.
- B. Occupancy: as indicated on drawings.
- C. Water Supply: Determine volume and pressure from water flow test data.
  - 1. Refer to the flow test information on the drawings.
  - 2. Revise design when test data available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Storage Cabinet for Spare Sprinklers and Tools: Steel, located adjacent to alarm valve.
- F. Pipe Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  - 1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  - 2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  - 3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  - 4. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

### 2.03 SPRINKLERS

- A. Suspended Ceiling Type: Semi-recessed pendant type with matching push on escutcheon plate.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Chrome plated.
  - 4. Escutcheon Plate Finish: Brushed Chrome.
  - 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- B. Exposed Area Type: Pendant type with guard.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Chrome plated.
  - 4. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Chrome plated.
  - 4. Escutcheon Plate Finish: Brushed Chrome.
  - 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- D. Dry Sprinklers: Concealed pendant type with matching push on escutcheon plate.
  - 1. Response Type: Quick.
  - 2. Coverage Type: Standard.
  - 3. Finish: Chrome plated.
  - 4. Cover Plate Finish: Brushed Chrome.
  - 5. Fusible Link: Fusible solder link type temperature rated for specific area hazard.
- E. Flexible Drop System: Stainless steel, multiple use, open gate type.
  - 1. Application: Use to properly locate sprinkler heads.
  - 2. Include all supports and bracing.
  - 3. Provide braided type tube as required for the application.
  - 4. Manufacturers:
    - a. FlexHead Industries, a brand of Anvil International: [www.anvilintl.com/](http://www.anvilintl.com/).
    - b. Victaulic Company: [www.victaulic.com/](http://www.victaulic.com/).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

### 2.04 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm, pressure retard chamber and variable pressure trim with the following additional capabilities and features:
  - 1. Activate electric alarm.
  - 2. Test and drain valve.
  - 3. Replaceable internal components without removing valve from installed position.
- B. Dry Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm, accelerator, and with the following additional capabilities and features:
  - 1. Activate electric alarm.
  - 2. Test and drain valve.
- C. Backflow Preventer: Reduced pressure principle valve assembly backflow preventer with drain and OS & Y gate valve on each end.
- D. Test Connections:
  - 1. Inspector's Test Connection:

- a. Provide test connections approximately 6 ft (2 m) above floor for each or portion of each sprinkler system equipped with an alarm device, located at the most remote part of each system.
- b. Route test connection to an open-site drain location, excluding janitor sinks, accepting full flow without negative consequences.
- c. Supply discharge orifice with same size as corresponding sprinkler orifice.
- d. Limit vertical height of exterior wall penetration to 2 ft (0.61 m) above finished grade.
- 2. Backflow Preventer Test Connection:
  - a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch (65 mm) National Standard male hose threads with cap and chain.
  - b. Furnish one valve for each 250 gpm (16 L/s) of system demand or fraction thereof.
  - c. Provide permanent sign reading "Test Valve" in accordance with Section 21 0553.
- E. Electric Alarm: Electrically operated chrome plated gong with pressure alarm switch.
- F. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with referenced NFPA design and installation standard.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Install buried shut-off valves in valve box. Provide post indicator.
- D. Provide approved reduced pressure principle backflow assembly at sprinkler system water source connection.
- E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- F. Locate outside alarm gong on building wall as indicated on drawings.
- G. Place pipe runs to minimize obstruction to other work and to avoid all required equipment access, electrical, and maintenance clearances.
- H. Place piping in concealed spaces above finished ceilings.
- I. Center sprinklers in two directions in ceiling tile and provide piping offsets as required.
- J. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- K. Flush entire piping system of foreign matter.
- L. Install guards on sprinklers where indicated.
- M. Hydrostatically test entire system.
- N. Require test be witnessed by Fire Marshal and Authority Having Jurisdiction.

#### **3.02 INTERFACE WITH OTHER PRODUCTS**

- A. Ensure required devices are installed and connected as required to fire alarm system.

**END OF SECTION 21 1300**



**SECTION 22 0500  
COMMON WORK RESULTS FOR PLUMBING**

**PART 1 GENERAL**

**1.01 APPLICABILITY**

- A. **The instructions outlined in this section shall apply to all sections under Division 22, except where specifically noted otherwise in the individual specification sections.**

**1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- C. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to and supplement all work specified in Division 22. If conflicts arise, the Contractor shall be responsible for communicating the conflict to the Architect prior to performing any work or ordering any equipment. **The Plumbing Drawings are diagrammatic. Refer to Architectural, Structural, and Civil drawings for all building dimensions.**

**1.03 DEFINITIONS**

- A. Exposed: Revealed to view or subject to weather.
- B. Fittings: All connecting pieces of a system.
- C. Provide: Furnish, install, and connect completely.
- D. Piping: Pipe installed with all required fittings, valves, and accessories, and forming a complete system.
- E. Wiring: Wire or cable installed in raceway with all required boxes, fittings, connectors, and accessories completely installed.

**1.04 CODES AND STANDARDS**

- A. **These specifications and associated design drawings do not give permission, implicit or inferred, to ignore the requirements of the applicable building codes or the Authority Having Jurisdiction. By placing a bid on this project, Contractor acknowledges and agrees to the requirement that they shall be versed in all applicable code requirements relevant to this specific project, and shall bring any conflicts to the attention of the Architect prior to performing any work. If work performed is found to be in violation of code, Contractor shall rectify any such work at their own expense.**

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the installation of all equipment and systems with size, location and installation of service utilities.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner, and that coordination between all affected installers has been performed to ensure proper installation order of all systems (e.g., electrical, mechanical, fire protection, millwork, etc.).
- C. The locations, arrangement, and extent of equipment, devices, piping, and other appurtenances related to the installation of the Plumbing work shown on the drawings are approximate and define the intent of the design. Contractor shall not scale the Plumbing drawings but shall refer to the Architectural drawings for exact dimensions of building components. Should a conflict exist between the Architectural and Plumbing drawings regarding dimensions and scale, notify the Architect of the discrepancy.
- D. At the discretion of Owner, Architect, or the Authority Having Jurisdiction, relocate all conflicts arising from uncoordinated piping, equipment, etc. installed, should such installation be determined to interfere with the proper installation and mounting of equipment, ceilings, piping,

conduit, or any other Architectural or Structural systems or finishes. **Corrective work arising from these conditions shall be performed without additional expense to the contract.**

1. Stacking of piping, conduit, etc. where it would cause an obstruction or restricted path for egress or serviceability of equipment from any trade is prohibited.
2. Coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation. In areas where more than one trade is required to use common openings in structure, joists, chases, shafts, and sleeves to route conduits, raceways, piping, or any other materials, coordinate the positions of all piping and equipment to be furnished under this section so that all items – including the materials and equipment of other trades – may be accommodated within the space available.
3. Confirm that work to be performed under Division 22 does not interfere with the clearances required for finished soffits, columns, millwork, pilasters, partitions, walls, or other Architectural or Structural elements as shown on the Drawings or Specifications. **Work that interferes with the Architectural design or building structure shall be removed and relocated at the direction of the Owner or Architect at no additional cost to the contract.**
4. All piping shall be run tight to structure, regardless of whether piping and equipment are above or below structural elements. Free-standing piping and equipment spanning open spaces or voids is prohibited. All piping routed through areas with exposed ceilings, cloud ceilings, or any other areas where piping may be visible to building occupants shall be routed to maintain a low-profile installation or shall be hidden from view, to provide the least-visible installation possible.
  - a. **If any of these conditions are identified in the field by Owner, Architect, or the Authority Having Jurisdiction, remove and reinstall the indicated piping, specialties, or equipment in accordance with these directions at no additional cost to the Contract.**
  - b. If there are areas where necessary routing cannot comply with these instructions, furnish a sketch to the Architect identifying such areas and how the design drawing routing in the indicated areas will differ from these instructions, and obtain written approval to proceed with the proposed routing from the Architect prior to installation.

#### 1.06 PERMITS, UTILITIES, SERVICES, AND FEES

- A. Sanitary: Provide sanitary drainage, connecting to sewer. Make arrangements for and pay all fees in connection with this installation.
- B. Water: Provide domestic (City) water, connecting to water mains. Arrange for tap to main and installation of meter. Pay all fees associated with new water service.
- C. Natural Gas: Provide natural gas service, connecting to gas mains. Arrange with local gas company for installation of gas service including meter. Pay all fees associated with new or revised gas service.
- D. Obtain all permits, inspections and approvals as required by all Authorities Having Jurisdiction and deliver certificates of approval to the Architect. Assume and pay all fees and costs of any nature whatsoever incidental to these permits.

#### 1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Plumbing systems and all associated equipment, piping, accessories, and specialties shall not be installed without first coordinating the installation of the same with all other building trades (Architectural, Structural, Mechanical, etc.). **Coordination shall be accomplished prior to, and shall be reflected in, the equipment submittals for approval.**
- C. ELECTRICAL COORDINATION STATEMENT: Submit a written statement confirming coordination of voltage and power connection requirements for all Plumbing equipment and controls requiring an electrical connection. Statement shall bear the names and signatures of the Plumbing and Electrical subcontractors.

- D. RECORD DRAWINGS: Submit record drawings no more than 14 days after completion of equipment installation and acceptance testing. Update Plumbing system drawings to reflect final record as-built conditions after related work is completed. As-built drawings shall be performed using CAD or Revit. Hand-drawn "hard copy" markups and hand-edited PDF markups are not acceptable.
1. **Record drawing submittal shall include digital images** (minimum resolution of 1152 x 864 pixels in JPEG standard image file format, and delivered via email, CD, or solid state thumb drive) **of any and all installed underground utilities or piping prior to cover up, and shall include a reference drawing indicating the location and direction of where each picture was taken.** The reference drawing shall dimension the utility or pipe from a prominent fixed object that is demonstrably unaltered from the time the photo was taken to the time when the file is delivered.

#### 1.08 QUALITY ASSURANCE

- A. Inverts: All inverts shall be verified immediately following award of Contract. All inverts shall be coordinated with Structural footings.
- B. Manufacturer Qualifications: Unless specifically noted otherwise in the specifications or drawings, all products shall be manufactured by a company specializing in manufacturing the specific products used in this project, with at least three years of documented experience.
- C. Fabricator Qualifications: Unless specifically noted otherwise in the specifications or drawings, a company specializing in fabricating the specific products used in this project, with at least three years of documented experience.
- D. Installer Qualifications: Unless specifically noted otherwise in the specifications or drawings, a company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.
- E. **NOTICE: Manufacturer's Startup Representative Qualifications:** Unless specifically noted otherwise in the specifications or drawings, when the project documents specify startup services by a manufacturer's factory technician or representative, those services may not be delegated to the contractor or subcontractor who performed the installation, but must be provided directly by the manufacturer's personnel or by the manufacturer's contracted independent third party representative.
- F. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

#### 1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store all products and equipment under cover and elevated above grade, protected completely against weather. **Do not install materials or equipment in a partially constructed structure exposed to weather**, unless all material and equipment is continuously protected from damage by weather or the construction process.
- B. Products such as copper piping and fittings that are stored outside must be protected against contamination by the elements within sealed plastic containers, or must be plugged and purged per the manufacturer's recommendations to ensure no damage to the inside of the piping.
- C. **Material and equipment with suspected or observable damage caused by improper protection during construction is subject to replacement based on the judgment of Architect at no cost to Owner.**

#### 1.10 WARRANTY

- A. The installation and Plumbing equipment and components shall be provided with a one-year warranty from the date of final acceptance by Owner unless specifically noted otherwise in the contract documents. The warranty shall cover all materials and workmanship. During this warranty period, correct all defects in materials and workmanship by repair or replacement without incurring any additional cost to the owner. Warranty defects shall be corrected within thirty (30) days after being notified in writing of failure to meet the warranty. Failure to address repairs within the specified period constitutes grounds for having the corrective action and

repairs performed by others and billing the cost to the Contractor.

- B. Correct any and all defective Work uncovered within a five year period after Date of Substantial Completion.
- C. See Section 01 7800 - Closeout Submittals, as well as all individual specifications sections for additional warranty requirements.

## **PART 2 PRODUCTS**

### **2.01 EQUIPMENT**

- A. MOTORS:
  - 1. Unless otherwise specified, single-phase fractional-horsepower alternating-current motors must be high efficiency types corresponding to the applications listed in NEMA MG 11.
  - 2. Unless otherwise specified, polyphase motors must be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings must meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.
  - 3. Provide controllers for motors rated 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

### **2.02 MANUFACTURERS**

- A. If substitution of alternate equipment is requested, the Contractor is responsible for any and all costs required by the substitution, including necessary engineering and construction revisions in their – or any – contract or trade to satisfy the design intent shown on the Drawings and described in the Specifications.
- B. If the products and equipment used as the basis of design are modified, coordinate with all other trades prior to purchasing any material or equipment. **Such coordination shall occur before purchasing and delivering equipment from the manufacturer and shall be clearly indicated on the shop drawings.** Perform all related modifications without incurring cost to the Contract.
- C. Substitutions: See Section 01 6000 - Product Requirements.

### **2.03 MATERIALS**

- A. All products shall be new and shall bear the Underwriter's Laboratories, Inc. (UL) label or the Factory Mutual Underwriters (FM) label unless specifically indicated otherwise. Furnish materials and equipment compatible with the existing system.
- B. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications are not intended to indicate every item of material, equipment, or labor required to produce a complete and properly functioning installation.
- C. **FLAME SPREAD AND SMOKE DEVELOPED RATINGS OF MATERIALS:**
  - 1. Materials and adhesives used throughout the plumbing systems for any system shall have a flame spread rating not over 25, and a smoke developed rating not to exceed 50. If such materials are to be applied with adhesives, test them as applied with such adhesives, or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating not to exceed 50.
  - 2. Determine flame spread rating and smoke developed rating by the Method of Testing of Surface Burning Characteristics of Building Materials, NFPA 255, ASTM E84, and Underwriters' Laboratories, Inc. standards.

### **2.04 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products must have been in satisfactory commercial or industrial use

for three years prior to bid opening. The three-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the three-year period.

1. Products having less than a three-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

### **PART 3 EXECUTION**

#### **3.01 GENERAL**

- A. The Plumbing drawings do not give exact elevations or location of lines, nor do they show all the offsets, control lines or installation details. Carefully lay out the work at the site to conform to the structural conditions, to provide proper grading of lines, to avoid all obstructions.
- B. Properly locate and size of all slots and openings in the building structure pertaining to the work and correctly locate sleeves, inserts, and cores.
- C. Offset valves in piping systems down to within one foot of the access point. Group runs of piping whenever it is feasible to do so.
- D. Provide access to equipment and valves requiring operation, service or maintenance within the life of the system. Equipment located above lay-in type ceilings is considered accessible.
- E. Piping and insulation located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man.

#### **3.02 EXAMINATION**

- A. Verification of Conditions: Verify existing conditions and operability of all existing equipment and systems prior to beginning work.
- B. The work shall be carefully laid out in advance, to avoid unnecessary cutting of construction. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by workers skilled in the trade(s) involved.

#### **3.03 INSTALLATION**

- A. Install all equipment and materials in accordance with manufacturer's instructions. Where the manufacturer's instructions and the drawings/specifications conflict, submit an RFI to the Design Professional for resolution.
- B. Minor deviations from the drawings required to conform to space conditions and to provide the designed operation, service, or maintenance accessibility shall be made at no additional cost, and shall be subject to approval by the Owner.
- C. All piping shall be run parallel with the lines of the building, in a neat and workmanlike manner.
- D. Piping, equipment, or ductwork shall not be installed in electrical equipment rooms, unless such piping serves equipment inside these spaces exclusively. Do not locate or route piping, ductwork, or equipment within 42" in front (and rear, if free-standing) of electrical equipment, or within 36" of sides of equipment. Clearances shall apply from floor level to underside of structural deck, and shall apply to the following electrical equipment:
  1. Switchboards
  2. Panel boards
  3. Power panels
  4. Motor control centers
  5. Dry-type transformers
- E. SEISMIC AND WIND DESIGN
  1. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, plumbing fixtures, and equipment, to permit freedom of movement between pipe

anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units, and to protect similar exterior-mounted components and equipment against the effects of high velocity winds. See Structural drawings for project Seismic Design Classification and for Wind Design Classification.

2. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

F. SANITARY AND STORMWATER

1. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means.
2. Piping Slopes: Unless noted otherwise, all sanitary waste piping less than 3" shall slope at a minimum of 1/4" per foot, and all Sanitary piping 3" and larger shall slope at a minimum of 1/8" per foot.
3. Provide base cleanout at lowest floor level of all stacks (waste, vent, stormwater, etc.). Exact location of all cleanouts shall be coordinated and approved by Design Professional prior to installation.
4. The minimum size sanitary and vent piping shall be 2 inches, and the minimum size sanitary below floor shall be 3 inches, unless specifically noted otherwise.
5. INDIRECT WASTE:
  - a. All indirect waste piping shall discharge through an air gap or air break into a waste receptor.
  - b. All indirect waste piping that exceeds two feet (24 inches) in developed length measured horizontally or four feet (48 inches) in total developed length shall be trapped.
  - c. All indirect waste receptors shall be located where they are readily accessible for inspection and cleaning.
6. All storm drain piping, including the underside of roof drain bodies, shall be insulated for the prevention of condensation and for acoustics.

G. DOMESTIC WATER

1. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve within 18 inches of the main to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures.
2. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.
3. Valves shall be installed with control no lower than the valve body.
4. All direct connect appliances shall be individually protected against backflow. Each piece of equipment (e.g., ice machines, coffee makers, and similar equipment with direct connections to potable water) shall be protected by a dedicated backflow preventer conforming to ASSE 1024.
5. Provide automatic air release valves at all high points of domestic hot and cold water systems.

H. GAS PIPING

1. All gas piping joints located in inaccessible spaces shall be welded.

I. Exterior underground utilities shall be at least 12 inches below the average local frost depth or as indicated on the drawings; whichever is deeper.

J. Cover ends of open pipes during construction except when working on such end prohibits covering. Pipe openings shall be closed with caps or plugs during installation. The use of duct tape or similar improvised coverings is not acceptable. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and

operated. Safety guards shall be provided for exposed rotating equipment.

- K. Provide access to equipment and valves requiring operation, service or maintenance within the life of the system. Locate such equipment where access will not require installation of access panels wherever possible. If an access panel is required to be installed in hard ceilings, walls, soffits, etc., and is not shown on the Architectural drawings, Contractor shall notify Architect in writing. Such notification shall include both the specific equipment requiring access, and the proposed location and size of the access panel, and Contractor shall obtain written approval to proceed prior to installation. All access panels shall be located in the least-visible location possible. If written approval for the required access panel location is not obtained prior to installation, Architect reserves the right to direct Contractor to remove and relocate the equipment or valves requiring access to a less visible location as chosen by Architect at no additional cost to the Contract. Equipment located above lay-in type ceilings is considered accessible.
- L. Expansion and Contraction of Piping: Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation system shall have expansion loops or other provisions such as offsets and changes in direction where indicated. Risers shall be securely anchored to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of the Architect.
- M. Thrust Restraint: Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 4 inches in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 2000 psi after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.
- N. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.
- O. Sound Stopping: Provide sound stopping and operating clearance to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Construct penetrations with finishes compatible with surface being penetrated. Sound stopping and vapor-barrier sealing of pipe

shafts, and large floor and wall openings may be accomplished by packing with mineral fiber insulation installed and supported in accordance with manufacturer's instructions, or by foaming-in-place with self-extinguishing 2-pound-density polyurethane foam to a depth not less than 6 inches. Finish foam with a rasp. Ensure vapor barrier is not less than 1/8-inch thickness of vinyl mastic applied to visible and accessible surfaces. Where fire stopping is a consideration, use only mineral fiber, and, in addition, cover openings with 16-gauge sheet metal.

- P. Vibration Isolation: Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by specified vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.
- Q. Vertical Piping Support: The use of split clamp and threaded rod to support vertical pipe along walls or columns is prohibited. Provide B-Line 22 strut and B-2000 pipe clamp. Support all pipe bases at base of riser.
- R. Water Closets: Carriers for water closets shall be sized specifically for the thickness of the wall in which they are installed. Refer to Architectural drawings for wall details.

### 3.04 WELDING

- A. Piping requiring welding shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Authority Having Jurisdiction shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

### 3.05 PAINTING

- A. New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.
- B. Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117 and ASTM B-287, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.
- C. Repaint factory painted equipment that has been scratched or marred to match original factory color.
- D. Clean and paint all un-insulated black ferrous metal items exposed to sight inside the building such as piping, equipment hangers, and supports with one coat of zinc chromate primer. In addition, paint such items in finished spaces with two coats of finish paint in a color to match adjacent surfaces or as otherwise directed by the Architect.
- E. Clean and paint black ferrous metal items exposed outside the building such as insulated and un-insulated pipe, escutcheons, and pipe supports with one coat of rust inhibiting primer and two coats of an asphaltic base aluminum paint. Clean and paint all piping installed outside the building that is to be insulated with one coat of rust inhibiting primer before installing insulation.
- F. Do not paint over nameplates on equipment.



- G. **Re-coat galvanizing broken during construction with cold galvanizing compound.**
- H. Paint all piping, insulation, conduit, structural members or other appurtenances visible through ceiling grilles flat black, unless specifically noted otherwise.

### 3.06 SYSTEM STARTUP

- A. See individual specifications sections for systems startup instructions for systems and equipment.

### 3.07 CLEANING

- A. System Flushing: Before operational tests or disinfection, flush new water piping systems with hot potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 4 fps through all portions of the piping system.
  - 1. In the event that this is impossible due to size of system, the Authority Having Jurisdiction shall specify the number of fixtures to be operated during flushing.
  - 2. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system.
  - 3. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.
  - 4. All faucets and drinking water fountains, to include any device considered as an end point device by NSF/ANSI 61, Section 9, shall be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.
  - 5. After flushing, system shall be drained at low points, and strainer screens shall be removed, cleaned, and replaced.
  - 6. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water.
  - 7. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to Contractor failure to properly clean the piping system shall be repaired by Contractor at no additional expense to Owner.
  - 8. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation according to manufacturer's instructions.
- B. Disinfection: See STERILIZATION section below.
- C. Remove all stickers, rust, stains, labels and temporary covers before final acceptance.
- D. Leave equipment rooms clean.
- E. At the completion of the work, clean all parts of the installation. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Adjust automatic control devices for proper operation.
- F. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

### 3.08 STERILIZATION

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable domestic water piping as follows:
  - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
- b. Fill and isolate system according to either of the following:
  - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
  - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

### 3.09 FLAME SPREAD AND SMOKE DEVELOPED RATINGS OF MATERIALS

- A. Materials and adhesives used throughout the mechanical systems for any system shall have a flame spread rating not over 25, and a smoke developed rating not to exceed 50. If such materials are to be applied with adhesives, test them as applied with such adhesives, or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating not to exceed 50.
- B. Determine flame spread rating and smoke developed rating by the Method of Testing of Surface Burning Characteristics of Building Materials, NFPA 255, ASTM E84, and Underwriters' Laboratories, Inc. standards.
- C. Failure to adhere to these requirements will require Contractor to replace the non-compliant materials with compliant equivalents at no additional cost to Owner.

### 3.10 TESTS

- A. Upon completion of flushing and prior to disinfection procedures, Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:
  - 1. Time, date, and duration of test.
  - 2. Water pressures at the most remote and the highest fixtures.
  - 3. Operation of each fixture and fixture trim.
  - 4. Operation of each valve, hydrant, and faucet.
  - 5. Pump suction and discharge pressures.
  - 6. Temperature of each domestic hot-water supply.
  - 7. Operation of each floor and roof drain by flooding with water.
  - 8. Operation of each vacuum breaker and backflow preventer.
- B. Contractor is responsible for approved disposal of contaminated water used for all system tests.
- C. Prior to acceptance of the work, test completed systems in the presence of the Authority Having Jurisdiction. Upon approval, provide certificates of testing.
- D. Conduct a hydrostatic test, unless otherwise specified. Use only potable water for testing.
- E. Test domestic hot- and cold-water piping for a continuous period of not less than four hours at a hydrostatic pressure of not less than 125 psig and make free from leaks. Completely remake leaky joints with piping dry. Retest system after leaks are corrected.
- F. Plug all necessary openings in the drainage and vent piping systems and fill the entire system with water to the level of the highest vent stack above the roof. Hold this water for 30 minutes without showing a drop in water level greater than 4 inches. Final test shall include a smoke test.
- G. Backflow Prevention Assemblies: Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies.
- H. Shower Pans: After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 1 inch for a period of 24 hours. Any drop in the water level during test, except for

evaporation, will be reason for rejection, repair, and retest.

### **3.11 ADJUSTING**

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
- B. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
- C. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- D. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
- E. Check plumbing specialties and verify proper settings, adjustments, and operation.

### **3.12 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Conduct walking tour of project.
  - 3. Briefly describe function, operation, and maintenance of each component.
- D. Training: Schedule training for the major plumbing equipment at the end of construction. The training shall include operation and maintenance of water heaters, boilers, and pumps. Training shall be minimum 4 hours.
  - 1. Instructor: Manufacturer's training personnel for each piece of specific equipment.
  - 2. Location: At project site.

### **3.13 MAINTENANCE**

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

**END OF SECTION 22 0500**

**SECTION 22 0517**  
**SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 09 9113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 09 9123 - Interior Painting: Preparation and painting of interior piping systems.

**1.03 REFERENCE STANDARDS**

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

**1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

**PART 2 PRODUCTS**

**2.01 PIPE SLEEVES**

- A. Manufacturers:
  - 1. Flexicraft Industries; Pipe Wall Sleeve: [www.flexicraft.com/](http://www.flexicraft.com/).
- B. Vertical Piping:
  - 1. Sleeve Length: 2 inches above finished floor.
  - 2. Provide sealant for watertight joint.
  - 3. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- C. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- D. Pipe Passing Through Below Grade Exterior Walls:
  - 1. Zinc coated or cast iron pipe.
  - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.
- E. Clearances:
  - 1. Provide allowance for insulated piping.

2. Wall, Floor, Partitions, and Beam Flanges: two pipe sizes greater than external pipe diameter.
3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

## **2.02 PIPE-SLEEVE SEALS**

- A. Manufacturers:
  1. Advance Products & Systems, LLC; Innerlynx: [www.apsonline.com/](http://www.apsonline.com/).
  2. Flexicraft Industries; PipeSeal: [www.flexicraft.com/](http://www.flexicraft.com/).

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- C. Structural Considerations: Do not penetrate building structural members unless indicated.
- D. Provide sleeves when penetrating footings, floors, walls, and rated assemblies. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
  1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
  2. Aboveground Piping:
    - a. Pack solid using mineral fiber complying with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
  3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
- E. Manufactured Sleeve-Seal Systems:
  1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- F. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

**END OF SECTION 22 0517**

**SECTION 22 0519**  
**METERS AND GAUGES FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pressure Gauges:
  - 1. Bourdon tube for liquids and gases.
- B. Thermometers.
- C. Pressure-Temperature test plugs.

**1.02 REFERENCE STANDARDS**

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- D. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- E. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- F. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.
- G. UL 404 - Gauges, Indicating Pressure, for Compressed Gas Service; Current Edition, Including All Revisions.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide red-marked product data sheets for each furnished item with associated components and accessories.

**PART 2 PRODUCTS**

**2.01 PRESSURE GAUGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: <https://www.dwyer-inst.com/#sle>.
  - 2. Moeller Instrument Company, Inc: [www.moellerinstrument.com/#sle](http://www.moellerinstrument.com/#sle).
  - 3. Omega Engineering, Inc: [www.omega.com/#sle](http://www.omega.com/#sle).
  - 4. Weksler Glass Thermometer Corp: [www.wekslerglass.com/#sle](http://www.wekslerglass.com/#sle).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Bourdon Tube for Liquids and Gases:
  - 1. Dial Size and Cover: 4-1/2 inch (115 mm) diameter scale with polycarbonate window.
  - 2. Dial Text and Markings: Black color on white background with scaled kPa and psi units.
  - 3. Accuracy: ASME B40.100, adjustable commercial grade (D) with 5 percent of span.
  - 4. Process Connection: Lower-back, 1/4 inch (6.35 mm) NPT male except where noted.
  - 5. Gauge Wetted Materials: Painted steel case and brass socket rated to match process pressure and temperature range.
  - 6. Comply with UL 393 when used for fire protection service or UL 404 when used for compressed gas service.
- C. Accessories:
  - 1. Gauge Cock: Carbon steel with tee or lever handle for maximum 150 psi (1034 kPa).

**2.02 THERMOMETERS**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com/#sle](http://www.dwyer-inst.com/#sle).

2. Moeller Instrument Company, Inc: [www.moellerinstrument.com/#sle](http://www.moellerinstrument.com/#sle).
  3. Watts Water Technologies, Inc: [www.watts.com/#sle](http://www.watts.com/#sle).
  4. Weiss Instruments, LLC: [www.weissinstruments.com/#sle](http://www.weissinstruments.com/#sle).
  5. Weksler Glass Thermometer Corp: [www.wekslerglass.com/#sle](http://www.wekslerglass.com/#sle).
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. General:
1. Product Compliance: ASTM E1.
  2. Lens: Clear glass or polycarbonate (indoors, not exposed to direct sunlight only), except where stated.
  3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
  4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.
- C. Thermometers - Adjustable Angle: 7 inch (177.8 mm) v-shape aluminum case with window scale, 6 inch (152.4 mm) NPT stem, red or blue organic non-toxic liquid filled glass tube, and adjustable joint with positive locking device allowing 360 degrees in horizontal plane or 180 degrees in vertical plane adjustments.
- D. Thermometers - Dial Type:
1. Adjustable Angle: 5 inch (125 mm) diameter liquid-filled dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed shatterproof-lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.

### **2.03 PRESSURE-TEMPERATURE TEST PLUGS:**

- A. Size: 500 psi (34.5 bar) capacity; 1/2 inch (13 mm) MPT brass fitting with gasket, cap, and retaining strap for 1/8 inch (3 mm) pressure gauge or temperature probe.
- B. Wetted Materials per Temperature Range:
1. Up to 200 degrees F (93 degrees C): Brass probe with neoprene core.
- C. Accessories: Brass, lever-handle cock and snubber-filter.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

### **3.02 INSTALLATION**

- A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.
- B. Install pressure gauges as follows:
1. At Pumps: Place single gauge before strainer, suction side and discharge side.
  2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
  3. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
- C. Install thermometers as follows:
1. Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
  2. Piping: Install thermometers in branch butt weld connection fitting or socket-weld thermowell. Enlarge pipes smaller than 2-1/2 inch (60 mm) to accommodate sockets. Ensure sockets are above insulation clearance.
- D. Locate test plugs adjacent to thermometers and thermometer sockets, adjacent to pressure gauges and pressure gauge taps, adjacent to control device sockets, and where indicated.

### **3.03 SCHEDULES**

- A. Pressure Gauges, Location and Scale Range:
1. Pumps, 0 to 200psi.

2. Pressure reducing valves, .
  3. Backflow preventers and Reduced Pressure Zone Assemblies (RPZA) - Street side of service.
- B. Pressure Gauge Tappings, Location:
1. Control valves 3/4 inch (20 mm) & larger - inlets and outlets.
- C. Thermometers, Location and Scale Range:
1. Domestic water heaters - supply outlet and recirculation within 3 feet of last fixture served at end of line (or integral to pump), 0 to 240 degrees F.

**END OF SECTION 22 0519**



**SECTION 22 0523**  
**GENERAL-DUTY VALVES FOR PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Ball valves.
- B. Check valves.
- C. Gate valves.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 3100 - Access Doors and Panels.
- B. Section 22 1005 - Plumbing Piping.

**1.03 ABBREVIATIONS AND ACRONYMS**

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

**1.04 REFERENCE STANDARDS**

- A. API STD 594 - Check Valves: Flanged, Lug, Wafer, and Butt-Welding; 2022.
- B. ASME B1.20.1 - Pipe Threads, General Purpose, Inch; 2013 (Reaffirmed 2018).
- C. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022, with Errata (2023).
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- F. ASME B31.9 - Building Services Piping; 2020.
- G. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- H. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- I. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- J. ASTM F3226 - Standard Specification for Metallic Press-Connect Fittings for Piping and Tubing Systems; 2019 Edition, August 1st 2019.
- K. MSS SP-45 - Drain and Bypass Connections; 2020.
- L. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- M. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- N. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- O. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- P. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- Q. NSF 372 - Drinking Water System Components - Lead Content; 2022.

### 1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
  - 1. Maintain valve end protection and protect flanges and specialties from dirt.
    - a. Provide temporary inlet and outlet caps.
    - b. Maintain caps in place until installation.
  - 2. Store valves in shipping containers and maintain in place until installation.
    - a. Store valves indoors in dry environment.
    - b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

### 1.07 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Avoid the use of operating handles or stems as rigging or lifting points.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers:
  - 1. Anvil International: [www.anvilintl.com/](http://www.anvilintl.com/)
  - 2. Aquatherm: <https://aquatherm.com/>
  - 3. Apollo Valves: [www.apollovalves.com/](http://www.apollovalves.com/)
  - 4. ITT Bell & Gossett: [www.bellgossett.com/](http://www.bellgossett.com/)
  - 5. CTS Flange USA: [www.ctsflange.com/](http://www.ctsflange.com/)
  - 6. Danfoss: [www.danfoss.com/](http://www.danfoss.com/)
  - 7. Grinnell Products: [www.grinnell.com/](http://www.grinnell.com/)
  - 8. Hammond Valve: [www.hammondvalve.com/](http://www.hammondvalve.com/)
  - 9. Kitz Corporation: [www.kitz.com](http://www.kitz.com)
  - 10. Milwaukee Valve: [www.milwaukeevalve.com/](http://www.milwaukeevalve.com/)
  - 11. Nexus Valve, Inc: [www.nexusvalve.com/](http://www.nexusvalve.com/)
  - 12. Schneider Electric: [www.schneider-electric.us/](http://www.schneider-electric.us/)
  - 13. Shurjoint Piping Products, Inc: [www.shurjoint.com/](http://www.shurjoint.com/)
  - 14. Uponor, Inc: [www.uponorpro.com/](http://www.uponorpro.com/)
  - 15. Victaulic Company: [www.victaulic.com/](http://www.victaulic.com/)
  - 16. Watts: [www.watts.com](http://www.watts.com)
  - 17. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
  - 1. Shutoff: Ball, or gate.
  - 2. Swing Check (Pump Outlet):
    - a. 2 inch (50 mm, DN) and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    - b. 2-1/2 inch (65 mm, DN) and Larger for Domestic Water: Iron swing check valves with closure control, metal or resilient seat check valves.
- D. Substitutions of valves with higher CWP classes or WSP ratings for same valve types are permitted when specified CWP ratings or WSP classes are not available.
- E. Required Valve End Connections for Non-Wafer Types:

1. Copper Tube:
  - a. 2 inch (50 mm, DN) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
  - b. 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Grooved or flanged ends except where threaded valve-end option is indicated in valve schedules below.
- F. Domestic, Hot and Cold Water Valves:
  1. 2 inch (50 mm, DN) and Smaller:
    - a. Bronze and Brass: Provide with solder-joint, threaded, or press ends.
    - b. Ball: One or two piece, full port, brass or bronze with matching brass or bronze, or stainless steel trim.
    - c. Bronze Swing Check: Class 125, bronze disc.
    - d. Bronze Gate: Class 125, NRS.
  2. 2-1/2 inch (65 mm, DN) and Larger:
    - a. Iron, 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN): Provide with flanged ends.
    - b. Iron Ball: Class 150.
    - c. Iron Swing Check with Closure Control: Class 125, lever and spring.

## **2.03 GENERAL REQUIREMENTS**

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
  1. Hand Lever: Quarter-turn valves 6 inch (150 mm, DN) and smaller except plug valves.
- D. Insulated Piping Valves: With 2 inch (50 mm, DN) stem extensions and the following features:
  1. Gate Valves: Rising stem.
  2. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
- E. Valve-End Connections:
  1. Threaded End Valves: ASME B1.20.1.
  2. Press-Connect Fittings: ASTM F3226.
  3. Solder Joint Connections: ASME B16.18.
- F. General ASME Compliance:
  1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
  2. Solder-joint Connections: ASME B16.18.
  3. Building Services Piping Valves: ASME B31.9.
- G. Potable Water Use:
  1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
  2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Valve Bypass and Drain Connections: MSS SP-45.

## **2.04 BRASS, BALL VALVES**

- A. One Piece, Full Port with Brass Trim :
  1. Comply with MSS SP-110.
  2. CWP Rating: 200 psi (1379 kPa).
  3. Body: Forged brass.
  4. Seats: PTFE.
  5. Stem: Brass.
  6. Ball: Chrome-plated brass.
  7. Operator: Handle.

## **2.05 BRONZE, BALL VALVES**

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Two Piece, Full Port with Bronze or Stainless Steel Trim:
  - 1. Comply with MSS SP-110.
  - 2. WSP Rating: 150 psi (1035 kPa).
  - 3. WOG Rating: 600 psi (4140 kPa).
  - 4. Body: Forged bronze or dezincified-brass alloy.
  - 5. Seats: PTFE.

## **2.06 IRON, BALL VALVES**

- A. Class 125, Full Port, Stainless Steel Trim:
  - 1. Comply with MSS SP-72.
  - 2. CWP Rating: 200 psi (1380 kPa).
  - 3. Body: ASTM A536 Grade 65-45-12, ductile iron.
  - 4. Seats: PTFE.
  - 5. Operator: Lever with locking handle.

## **2.07 BRASS, INLINE CHECK VALVES**

- A. Class 150:
- B. Maximum Service Temperature: 250 degrees F (121.1 degrees C).
- C. Body: Forged brass.
- D. Disc: Forged brass.
- E. Seal: PTFE, bubble-tight.

## **2.08 BRONZE, SWING CHECK VALVES**

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.
- B. Class 125:
  - 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
  - 2. Design: Y-pattern, horizontal or vertical flow.
  - 3. WOG Rating: 200 psi (1380 kPa).
  - 4. Body: Bronze, ASTM B62.
  - 5. Disc: Bronze.

## **2.09 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL**

- A. Class 125 with Lever and Spring-Closure Control.
  - 1. Comply with MSS SP-71, Type I.
  - 2. Description:
    - a. CWP Rating: 200 psi (1380 kPa).
    - b. Design: Clear or full waterway.
    - c. Body: ASTM A126, gray iron with bolted bonnet.
    - d. Trim: Bronze.
    - e. Gasket: Asbestos free.
    - f. Closer Control: Factory installed, exterior lever, and weight.

## **2.10 BRONZE, GATE VALVES**

- A. General:
  - 1. Fabricate from dezincification resistant material.
  - 2. Copper alloys containing more than 15 percent zinc are not permitted.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

#### **3.02 INSTALLATION**

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- C. Where valve support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- D. Install check valves where necessary to maintain direction of flow as follows:
  - 1. Lift Check: Install with stem plumb and vertical.
  - 2. Swing Check: Install horizontal maintaining hinge pin level.
  - 3. Orient plate-type and center-guided into horizontal or vertical position, between flanges.

**END OF SECTION 22 0523**

**SECTION 22 0529**  
**HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Strut systems for pipe or equipment support.
- B. Beam clamps.
- C. Pipe hangers.
- D. Pipe supports, guides, shields, and saddles.
- E. Instructions for Interior and Exterior Hangars and Supports

**1.02 RELATED REQUIREMENTS**

- A. Section 22 0500 - Common Work Results for Plumbing
- B. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- C. Section 09 9113 - Exterior Painting: Final finishes and painting instructions.
- D. Section 09 9123 - Interior Painting: Final finishes and painting instructions.
- E. Section 22 0548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2022).
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- M. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- N. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

#### **1.06 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Installer Qualifications for Field-Welding: As specified in Section 05 5000.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Materials for Metal Fabricated Supports: Comply with Section 05 5000.
  - 1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
  - 2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.
- D. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

#### **2.02 BEAM CLAMPS**

- A. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

- B. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

### 2.03 PIPE HANGERS

- A. Clevis Hangers, Adjustable:
1. Manufacturers:
    - a. B-Line, a brand of Eaton Corporation; \_\_\_\_: [www.eaton.com/#sle](http://www.eaton.com/#sle).
    - b. FNW; 7005: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. nVent Caddy, a brand of nVent; \_\_\_\_: [www.erico.com/#sle](http://www.erico.com/#sle).

### 2.04 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

- A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- B. Pipe Shields for Insulated Piping:
1. Manufacturers:
    - a. Anvil International; \_\_\_\_: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
    - b. FNW; 7753: [www.fnw.com/#sle](http://www.fnw.com/#sle).
    - c. Gregory Industries, Inc; \_\_\_\_: [www.gregorycorp.com/#sle](http://www.gregorycorp.com/#sle).
  2. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
  3. General Construction and Requirements:
    - a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
    - b. Shields Material: UV-resistant polypropylene with glass fill.
    - c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch (321 mm).
    - d. Service Temperature: Minus 40 to 178 degrees F (Minus 40 to 81 degrees C).
    - e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- C. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
  2. Liquid Temperatures Up to 122 degrees F (50 degrees C):
    - a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
    - b. Support From Below: MSS SP-58 types 35 through 38.
- D. Pipe Supports, Thermal Insulated:
1. General Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    - c. Provide pipe supports for 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
    - d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
  2. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
    - b. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
    - c. Minimum Thickness: 60 mil, 0.06 inch (1.524 mm).

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.



- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 03 3000.
  - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
  - 6. Grouting: Place grout under supports for equipment and make bearing surface smooth.
  - 7. 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.
  - 8. Install lateral bracing with pipe hangers and supports to prevent swaying.
  - 9. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
  - 10. 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.
- H. Secure fasteners according to manufacturer's recommended torque settings.
- I. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.
- J. Remove temporary supports.

### 3.03 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint or cold-galvanizing compound to comply with ASTM A780/A780M.
- C. See Section 09 9113 - Exterior Painting and 09 9123 - Interior Painting for additional instructions.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.

- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 22 0529**

**SECTION 22 0548****VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.

**1.03 DEFINITIONS**

- A. Plumbing Component: Where referenced in this section in regards to seismic controls, applies to any portion of the plumbing system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

**1.04 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- D. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- E. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. MFMA-4 - Metal Framing Standards Publication; 2004.
- I. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  - 2. Seismic Controls: Include seismic load capacities.

**1.06 QUALITY ASSURANCE**

- A. Comply with applicable building code.

- B. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.

1. Designer may be employed by the manufacturer of the seismic restraint products.

### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
1. Select vibration isolators to provide required static deflection.
  2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- D. Equipment Isolation: As indicated on drawings.
- E. Piping Isolation:
1. Provide vibration isolators for piping supports:
    - a. Located in equipment rooms.
    - b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
    - c. For piping over 2 inch (50 mm) located below or within 50 feet (15.2 m) of noise-sensitive areas indicated.
  2. Minimum Static Deflection:
    - a. First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
    - b. Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.
  3. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
  4. Suspended Piping, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
  5. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
  6. Floor-Mounted Piping, Seismic Applications: Use seismic type restrained spring isolators.
  7. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

### **2.02 SEISMIC CONTROL REQUIREMENTS**

- A. Design and provide plumbing component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor plumbing components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.
- C. Component Importance Factor (Ip): Plumbing components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes

but is not limited to:

1. Plumbing components required to function for life safety purposes after an earthquake.
  2. **Plumbing components that support or otherwise contain hazardous substances, e.g., Chemical Waste piping.**
- D. Premanufactured Modular Plumbing Equipment: Where not otherwise seismically qualified, premanufactured modules 6 feet (1.8 m) high and taller furnished under other sections to be designed in accordance with seismic provisions for nonbuilding structures.
- E. Seismic Restraints:
1. Provide seismic restraints for plumbing components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  2. Seismic Restraint Exemptions:
    - a. Exemptions for Seismic Design Category C:
      - 1) Plumbing components where either of the following apply:
        - (a) The component importance factor ( $I_p$ ) is 1.0 and the component is positively attached to the structure.
        - (b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
      - 2) Plumbing piping with component importance factor ( $I_p$ ) of 1.5 and nominal pipe size of 2 inch (50 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
    - b. Plumbing Piping Exemptions, All Seismic Design Categories:
      - 1) Plumbing piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
        - (a) Trapeze supported piping weighing less than 10 pounds per foot (146 N/m), where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
        - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor ( $I_p$ ) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
        - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor ( $I_p$ ) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds (890 N) or less.
        - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor ( $I_p$ ) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.

- (e) Hanger supported piping with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where pipe has a component importance factor ( $I_p$ ) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds (220 N) or less.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
  - a. FEMA 412.
  - b. FEMA 413.
  - c. FEMA 414.
  - d. FEMA E-74.
  - e. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- 5. Seismic Type Vibration Isolators:
  - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- 6. External Seismic Snubber Assemblies:
  - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
  - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
- 7. Seismic Restraint Systems:
  - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
  - b. Use only cable restraints to restrain vibration-isolated plumbing components, including distributed systems.
  - c. Use only one restraint system type for a given plumbing component or distributed system (e.g., piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
  - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain plumbing component in all lateral directions; consider bracket geometry in anchor load calculations.
  - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported plumbing component weight.
  - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported plumbing component weight.
  - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
  - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
  - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
- F. Seismic Attachments:
  - 1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.

2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
  3. Do not use power-actuated fasteners.
  4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
  5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  6. Concrete Housekeeping Pads:
    - a. Increase size of pad as required to comply with anchor requirements.
    - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
- G. Seismic Interactions:
1. Include provisions to prevent seismic impact between plumbing components and other structural or nonstructural components.
  2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
    - a. Relative displacements at connections between components, including distributed systems (e.g., piping); do not exceed load limits for equipment utility connections.
    - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
    - c. Design displacements at seismic separations.
    - d. Anticipated drifts between floors.

## **2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES**

- A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
    - b. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
  2. Minimum Base Depth: 6 inches (152 mm).
  3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
  4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
  5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 3000.
  6. Pump Applications: Size and configure bases for piping elbow supports as required.

## **2.04 VIBRATION ISOLATORS**

- A. Manufacturers:
1. Vibration Isolators:

- a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/#sle](http://www.kineticsnoise.com/#sle).
  - b. Mason Industries: [www.mason-ind.com/#sle](http://www.mason-ind.com/#sle).
  - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/#sle](http://www.veco-nyc.com/#sle).
  - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
  2. Spring Elements for Spring Isolators:
    - a. Color code or otherwise identify springs to indicate load capacity.
    - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    - f. Selected to function without undue stress or overloading.
  3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
1. Resilient Material Isolator Pads:
    - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
    - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
  2. Resilient Material Isolator Mounts, Nonseismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
  3. Open (Unhoused) Spring Isolators:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
    - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
    - c. Furnished with integral leveling device for positioning and securing supported equipment.
  4. Housed Spring Isolators:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
    - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
    - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
    - d. Furnished with integral leveling device for positioning and securing supported equipment.



5. Restrained Spring Isolators, Nonseismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
  - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
6. Resilient Material Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
7. Spring Isolator Hangers, Nonseismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- D. Vibration Isolators for Seismic Applications:
  1. Resilient Material Isolator Mounts, Seismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
  2. Restrained Spring Isolators, Seismic:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
    - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
    - c. Furnished with integral leveling device for positioning and securing supported equipment.
    - d. Provides constant free and operating height.
  3. Resilient Material Isolator Hangers, Seismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  4. Spring Isolator Hangers, Seismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
  5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and

cushion impact.

- b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

## **2.05 ACOUSTICAL AND VIBRATION ISOLATORS**

### **A. General Requirements:**

- 1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

## **2.06 EXTERNAL SEISMIC SNUBBER ASSEMBLIES**

- A. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.

### **B. Seismic Snubbing Elements:**

- 1. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
- 2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.

## **2.07 SEISMIC RESTRAINT SYSTEMS**

- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

### **B. Cable Restraints:**

- 1. Comply with ASCE 19.
- 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
- 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
- 4. Use protective thimbles for cable loops where potential for cable damage exists.

- C. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.

2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
  3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch (6.4 mm) or less between equipment support frame and seismic restraint; periodic inspection.
  4. Verification of required clearances between plumbing equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
1. Vibration-Isolated Equipment Support Bases:
    - a. Provide specified minimum clearance beneath base.
  2. Spring Isolators:
    - a. Position equipment at operating height; provide temporary blocking as required.
    - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
  3. Isolator Hangers:
    - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  6. Adjust isolators to be free of isolation short circuits during normal operation.
  7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- F. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
  2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.

4. Equipment with Sheet Metal Housings:
  - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
  - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
  - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
5. Concrete Housekeeping Pads:
  - a. Size in accordance with seismic design to meet anchor requirements.
  - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
  - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
  - b. Install restraints within permissible angles in accordance with seismic design.
  - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
  - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
  - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:
  1. Verify isolator static deflections.
  2. Verify required clearance beneath vibration-isolated equipment support bases.
  3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
  1. Verify snubbing element air gaps.
- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

#### **3.05 ATTACHMENTS**

- A. Statement of special inspections.

**END OF SECTION 22 0548**

**SECTION 22 0553**  
**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Pipe markers.
- D. Ceiling tacks.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9123 - Interior Painting: Identification painting.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers catalog literature for each product required.

**PART 2 PRODUCTS**

**2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE**

- A. Nameplates:
  - 1. Heat exchangers, water heaters, and other heat transfer products.
  - 2. Control panels, transducers, and other related control equipment products.
  - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
  - 1. Piping: 3/4 inch (20 mm) diameter and smaller.
  - 2. Manual operated and automated control valves.
  - 3. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.
- C. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

**2.02 NAMEPLATES**

- A. Manufacturers:
  - 1. Brimar Industries, Inc: [www.pipemarker.com](http://www.pipemarker.com)
  - 2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com)
  - 3. Seton Identification Products: [www.seton.com](http://www.seton.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Laminated piece with up to three lines of text.
  - 1. Letter Color: White.
  - 2. Letter Height: 1/4 inch (6 mm).
  - 3. Background Color: Black.

**2.03 TAGS**

- A. Manufacturers:
  - 1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com](http://www.advancedgraphicengraving.com)
  - 2. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com)
  - 3. Brimar Industries, Inc: [www.pipemarker.com](http://www.pipemarker.com)
  - 4. Craftmark Pipe Markers: [www.craftmarkid.com](http://www.craftmarkid.com)
  - 5. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com)
  - 6. Seton Identification Products: [www.seton.com](http://www.seton.com)

- 7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Flexible: Vinyl with engraved black letters on light contrasting background color with up to three lines of text. Minimum tag size 1-1/2 inch (40 mm) in diameter.
- C. Metal: brass or stainless steel, 19 gauge 1-1/2 inch (40 mm) in diameter with smooth edges, blank, smooth edges, and corrosion-resistant ball chain. Up to three lines of text.
- D. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
- E. Piping: 3/4 inch (20 mm) diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.

## 2.04 PIPE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradycorp.com](http://www.bradycorp.com)
  - 2. Brimar Industries, Inc: [www.pipemarker.com](http://www.pipemarker.com)
  - 3. Craftmark Pipe Markers: [www.craftmarkid.com](http://www.craftmarkid.com)
  - 4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com)
  - 5. Seton Identification Products: [www.seton.com](http://www.seton.com)
  - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Comply with ASME A13.1.
- C. Flexible Marker: Factory fabricated, semi-rigid, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid conveyed.
- D. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Identification Scheme, ASME A13.1:
  - 1. Primary: Nominal Pipe Diameter
    - a. 3/4 to 1-1/4 inches (19 to 32 mm): Use 8 inch (203 mm) field-length with 1/2 inch (13 mm) text height.
    - b. 1-1/2 to 2 inches (38 to 51 mm): Use 8 inch (203 mm) field-length with 3/4 inch (19 mm) text height.
    - c. 2-1/2 to 6 inches (64 to 152 mm): Use 12 inch (305 mm) field-length with 1-1/4 inch (32 mm) text height.
    - d. 8 to 10 inches (204 to 254 mm): Use 24 inch (610 mm) field-length with 2-1/2 inch (64 mm) text height.
    - e. Over 10 inches (over 254 mm): Use 32 inch (813 mm) field-length with 3-1/2 inch (89 mm) text height.
  - 2. Secondary: Color scheme per fluid service.
    - a. Combustible Fluids: White text on brown background.
    - b. Compressed Air: White text on blue background.
    - c. Fire Quenching Fluids: White text on red background.
    - d. Flammable and Oxidizing Fluids: Black text on yellow background.
    - e. Toxic and Corrosive Fluids: Black text on orange background.
    - f. Water; Potable, Cooling, Boiler/Chilled Water Makeup Water Feed, and Other: White text on green background.
  - 3. Tertiary: Other Details.
    - a. Directional flow arrow.
    - b. Line pressure (compressed air / gas only).
    - c. Line temperature (domestic hot water only).

## 2.05 CEILING TACKS

- A. Manufacturers:
  - 1. Craftmark Pipe Markers: [www.craftmarkid.com](http://www.craftmarkid.com)
  - 2. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com](http://www.kolbipipemarkers.com)
  - 3. Seton Identification Products: [www.seton.com](http://www.seton.com)

- 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive identification products.

#### **3.02 INSTALLATION**

- A. Install flexible nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags in clear view and align with axis of piping
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- E. Apply ASME A13.1 Pipe Marking Rules:
  - 1. Place pipe marker adjacent to changes in direction.
  - 2. Place pipe marker adjacent each valve port and flange end.
  - 3. Place pipe marker at both sides of floor and wall penetrations.
  - 4. Place pipe marker every 25 to 50 feet (7.6 to 15.2 m) interval of straight run.
- F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION 22 0553**

**SECTION 22 0719  
PLUMBING PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Flexible elastomeric cellular insulation.
- B. Glass fiber insulation.
- C. Polyethylene insulation.
- D. Jacketing and accessories.
- E. Insulation Schedules for:
  - 1. Domestic Hot Water Supply
  - 2. Domestic Hot Water Recirculation
  - 3. Domestic Cold Water
  - 4. Condensate Drain Piping
  - 5. Field-Applied Jacketing

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 22 0553 - Identification for Plumbing Piping and Equipment: Labeling formatting, colors, and additional instructions for insulation and field-applied jacketing.
- C. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts .

**1.03 REFERENCE STANDARDS**

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2019).
- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- F. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- G. ASTM C755 - Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation; 2020.
- H. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- I. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- J. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds; 2020.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- M. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).



- N. MIL-A-3316 - Adhesives, Fire-Resistant, Thermal Insulation; 1987c (Amended 1990).
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

#### **1.06 FIELD CONDITIONS**

- A. Maintain ambient conditions required by manufacturers of each product.

### **PART 2 PRODUCTS**

#### **2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
- B. 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.
- C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

#### **2.02 GLASS FIBER INSULATION**

- A. Manufacturers:
  - 1. CertainTeed Corporation; \_\_\_\_\_: [www.certainteed.com/#sle](http://www.certainteed.com/#sle).
  - 2. Johns Manville Corporation; \_\_\_\_\_: [www.jm.com/#sle](http://www.jm.com/#sle).
  - 3. Knauf Insulation; Earthwool 1000 Degree Pipe Insulation: [www.knaufinsulation.com/#sle](http://www.knaufinsulation.com/#sle).
  - 4. Owens Corning Corporation; Fiberglas Pipe Insulation ASJ: [www.ocbuildingspec.com/#sle](http://www.ocbuildingspec.com/#sle).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
  - 1. K (Ksi) Value: ASTM C177, 0.24 at 75 degrees F (0.035 at 24 degrees C).
  - 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
  - 3. Maximum Moisture Absorption: 0.2 percent by volume.
- C. Vapor Barrier Jacket: White Kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm inch (0.029 ng/(Pa s m)).
- D. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.
- E. Vapor Barrier Lap Adhesive: Compatible with insulation, and complying with MIL-A-3316C.
- F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.
- G. Indoor Vapor Barrier Finish:
  - 1. Vinyl emulsion type acrylic, compatible with insulation, black color. Suitable for indoor use on below-ambient services.
    - a. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2 for insulation type and service conditions.
    - b. Service temperature range: -20°F to 180°F .
- H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation.

- I. Insulating Cement: ASTM C449.

## **2.03 POLYETHYLENE INSULATION**

- A. Manufacturers:
1. Armacell LLC; \_\_\_\_\_: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: Flexible closed-cell polyethylene tubing, slit lengthwise for installation, complying with applicable requirements of ASTM D1056.
1. K (Ksi) Value: ASTM C177; 0.25 at 75 degrees F (0.036 at 24 degrees C).
  2. Maximum Service Temperature: 200 degrees F (93 degrees C).
  3. Density: 2 pcf (32 kg/cu m).
  4. Maximum Moisture Absorption: 1.0 percent by volume.
  5. Moisture Vapor Permeability: 0.05 perm inch (0.073 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
  6. Connection: Contact adhesive.

## **2.04 FLEXIBLE ELASTOMERIC CELLULAR INSULATION**

- A. Manufacturers:
1. Aeroflex USA, Inc; Aerocel Stay-Seal with Protape (SSPT): [www.aeroflexusa.com/#sle](http://www.aeroflexusa.com/#sle).
  2. Armacell LLC; AP Armaflex: [www.armacell.us/#sle](http://www.armacell.us/#sle).
  3. K-Flex USA LLC; Insul-Tube: [www.kflexusa.com/#sle](http://www.kflexusa.com/#sle).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
  2. Maximum Service Temperature: 220 degrees F (104 degrees C).
  3. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

## **2.05 JACKETING AND ACCESSORIES**

- A. PVC Plastic.
1. Manufacturers:
    - a. Johns Manville Corporation: [www.jm.com/#sle](http://www.jm.com/#sle).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
  2. Jacket: High-impact resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; one-piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: 0 degrees F (Minus 18 degrees C).
    - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
    - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
    - e. Connections: Brush on welding adhesive as recommended by jacket material manufacturer.
    - f. Factory-fabricated fitting covers to match jacket.
      - 1) Shapes: 45° and 90° short- and long-radius ells, Tees, Valves, Flanges, Unions, Reducers, End caps, Soil-pipe hubs, Traps, Mechanical joints, and P-trap and supply water piping covers for lavatories.
- B. ABS Plastic:
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
    - b. Maximum Service Temperature: 180 degrees F (82 degrees C).
    - c. Moisture Vapor Permeability: 0.012 perm inch (0.018 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.

- d. Thickness: 30 mil, 0.03 inch (0.75 mm).
- e. Connections: Brush on welding adhesive.
- C. Stainless Steel Jacket: ASTM A666, Type 304 stainless steel.
  - 1. Thickness: 0.018 inch (0.45 mm).
  - 2. Finish: Smooth.
  - 3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. **IMPORTANT! Verify that piping system has been tested before applying insulation materials.**
- B. Verify that surfaces are clean and dry, with foreign material removed.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions. 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 in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- 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 multiple layers of insulation with longitudinal and end seams staggered.
- E. Exposed Piping: Locate insulation and cover seams in least visible locations.
- F. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- G. Insulation Methods for Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. **For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.**
9. **Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.**
- H. Glass fiber insulated pipes conveying fluids below ambient temperature:
  1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
  2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.
- I. Glass fiber insulated pipes conveying fluids above ambient temperature:
  1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
  2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- J. Flexible Elastomeric Insulated pipes:
  1. 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.
- K. Inserts and Shields:
  1. Application: Piping 1-1/2 inches (40 mm) diameter or larger.
  2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
  3. Insert Location: Between support shield and piping and under the finish jacket.
  4. Insert Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
  5. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- L. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.
- M. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with PVC jacket and fitting covers.
- N. Penetrations:
  1. Install insulation continuously through floor and wall penetrations, including fire-rated walls and partitions. Seal penetrations through fire-rated assemblies in accordance with Section 07 8400 - Firestopping.
  2. Install insulation continuously through exterior wall and roof penetrations. Seal penetrations with flashing sealant.
  3. For applications requiring only indoor insulation, terminate insulation on exterior of wall or roof surface and seal with joint sealant.
- O. Buried Piping: Provide factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with one mil (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film. Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- P. Field-Applied Jacketing:

1. PVC Plastic or ABS Plastic Jackets: Install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive. Apply minimum of two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge, in addition to sealant beads directed by manufacturer.
2. Metal Jackets: 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, or as recommended by manufacturer's instructions.

### 3.03 FINISHES

- A. Paint jacket with primer compatible with jacket material, and finish with minimum two finish coats. Add fungicidal agent to render insulation and jacketing materials mildew-resistant. See Section 09 9113 - Exterior Painting and 09 9123 - Interior Painting for additional instructions.
- B. Label piping with system information as indicated in Section 22 0553 - Identification for Plumbing Piping and Equipment.

### 3.04 SCHEDULES

- A. Plumbing System Insulation:
  1. Domestic Hot Water Supply:
    - a. Glass Fiber Insulation: All locations, except exterior or high humidity locations.

| <u>Pipe Size Range</u> | <u>Insulation Depth</u> |
|------------------------|-------------------------|
| Up to 1" Dia.          | 1" Thickness            |
| 1-1/4" to 3-1/2" Dia.  | 1-1/2" Thickness        |
| 4" Dia. and above      | 2" Thickness            |
    - b. Polyethylene Insulation: All locations, including exterior and high humidity locations.

| <u>Pipe Size Range</u> | <u>Insulation Depth</u> |
|------------------------|-------------------------|
| Up to 1" Dia.          | 1" Thickness            |
| 1-1/4" to 3-1/2" Dia.  | 1-1/2" Thickness        |
| 4" Dia. and above      | 2" Thickness            |
  2. Domestic Hot Water Recirculation:
    - a. Glass Fiber Insulation: All locations, except exterior or high humidity locations.

| <u>Pipe Size Range</u> | <u>Insulation Depth</u> |
|------------------------|-------------------------|
| Up to 1" Dia.          | 1" Thickness            |
| 1-1/4" to 3-1/2" Dia.  | 1-1/2" Thickness        |
| 4" Dia. and above      | 2" Thickness            |
    - b. Polyethylene Insulation: All locations, including exterior and high humidity locations.

| <u>Pipe Size Range</u> | <u>Insulation Depth</u> |
|------------------------|-------------------------|
| Up to 1" Dia.          | 1" Thickness            |
| 1-1/4" to 3-1/2" Dia.  | 1-1/2" Thickness        |
| 4" Dia. and above      | 2" Thickness            |
  3. Domestic Cold Water:
    - a. Glass Fiber Insulation: All locations, except exterior or high humidity locations.

| <u>Pipe Size Range</u> | <u>Insulation Depth</u> |
|------------------------|-------------------------|
| Up to 1" Dia.          | 1" Thickness            |
| 1-1/4" to 3-1/2" Dia.  | 1-1/2" Thickness        |
| 4" Dia. and above      | 2" Thickness            |
    - b. Polyethylene Insulation: All locations, including exterior and high humidity locations.

| <u>Pipe Size Range</u> | <u>Insulation Depth</u> |
|------------------------|-------------------------|
| Up to 1" Dia.          | 1" Thickness            |
| 1-1/4" to 3-1/2" Dia.  | 1-1/2" Thickness        |

4" Dia. and above                      2" Thickness

- 4. Sanitary Stack Acoustics (all non-Cast Iron):
  - a. Glass Fiber Insulation:
    - 1) Pipe Size Range: All sizes.
    - 2) Thickness: 1 inch (25 mm).
- 5. Condensate Drain Piping:
  - a. Glass Fiber Insulation:
    - 1) Pipe Size Range: All sizes.
    - 2) Thickness: 1 inch (25 mm).
  - b. Flexible Elastomeric Insulation:
    - 1) Pipe Size Range: All sizes.
    - 2) Thickness: 1 inch (25 mm).
- B. Field-Applied Jacketing
  - 1. Interior Piping:
    - a. Not exposed to view, not subject to damage: Canvas Jacket or None.
    - b. Exposed to view, not subject to damage: PVC Plastic or ABS Plastic.
    - c. Exposed to view, subject to damage: Aluminum or Stainless Steel.

**END OF SECTION 22 0719**

**SECTION 22 1005  
PLUMBING PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sanitary waste piping, buried within 5 ft of building
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 ft of building.
- D. Domestic water piping, above grade.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 09 9113 - Exterior Painting.
- D. Section 09 9123 - Interior Painting.
- E. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- F. Section 22 0719 - Plumbing Piping Insulation.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z21.22 - American National Standard for Relief Valves for Hot Water Supply Systems; 2015 (Reaffirmed 2020).
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- D. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings: DWV; 2021.
- E. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings—DWV; 2022.
- F. ASME B31.9 - Building Services Piping; 2020.
- G. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.
- I. ASTM B32 - Standard Specification for Solder Metal; 2020.
- J. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.
- K. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- L. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- M. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2020.
- N. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- O. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- P. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- Q. ASTM C1277 - Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- R. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.

- S. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.
- T. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- U. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- V. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.
- W. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- X. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- Y. AWWA C651 - Disinfecting Water Mains; 2014, with Addendum (2020).
- Z. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- AA. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2020.
- BB. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- CC. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- DD. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

#### **1.05 QUALITY ASSURANCE**

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.



## **2.02 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING**

- A. Cast Iron Pipe: ASTM A74 service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
- B. PVC Pipe: ASTM D2665 or ASTM D3034.
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

## **2.03 SANITARY WASTE PIPING, ABOVE GRADE**

- A. Cast Iron Pipe: CISPI 301, hubless, service weight.
  - 1. Fittings: Cast iron.
  - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. Copper Tube: ASTM B306, DWV.
  - 1. Fittings: ASME B16.29, wrought copper, or ASME B16.23, solvent.
  - 2. Joints: ASTM B32, alloy Sn50 solder.
- C. Copper Pipe: ASTM B42.
  - 1. Fittings: ASME B16.23, cast copper, or ASME B16.29, wrought copper.
  - 2. Joints: ASTM B32, alloy Sn50 solder.
- D. PVC Pipe: ASTM D2729. **(PROHIBITED IN RETURN AIR PLENUMS)**
  - 1. Fittings: PVC.
  - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

## **2.04 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING**

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H).
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: ASTM B32, alloy Sn95 solder.
  - 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
  - 1. Fittings: Ductile or gray iron, standard thickness.
  - 2. Joints: AWWA C111/A21.11, styrene butadiene rubber (SBR) or vulcanized SBR gasket with 3/4 inch (19 mm) diameter rods.

## **2.05 DOMESTIC WATER PIPING, ABOVE GRADE**

- A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
  - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
  - 2. Joints: Grooved mechanical couplings.
  - 3. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.
    - a. Manufacturers:
      - 1) Anvil International: [www.anvilintl.com/#sle](http://www.anvilintl.com/#sle).
      - 2) Apollo Valves: [www.apollovalves.com/#sle](http://www.apollovalves.com/#sle).
      - 3) Grinnell Products: [www.grinnell.com/#sle](http://www.grinnell.com/#sle).
      - 4) Viega LLC: [www.viega.us/#sle](http://www.viega.us/#sle).
      - 5) Substitutions: See Section 01 6000 - Product Requirements.

## **2.06 PIPE FLANGES, UNIONS, AND COUPLINGS**

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
  - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
  - 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. No-Hub Couplings:

1. Testing: In accordance with ASTM C1277 and CISPI 310.
2. Gasket Material: Neoprene complying with ASTM C564.
3. Band Material: Stainless steel.
4. Eyelet Material: Stainless steel.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that excavations are to required grade, dry, and not over-excavated.

#### **3.02 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
  1. Coordinate size and location of access doors with Section 08 3100.
- G. Establish elevations of buried piping outside the building to ensure sufficient cover as to place piping not less than 12 inches below frost line.
- H. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.
- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.
  1. See Section 09 9123 for painting of interior plumbing systems and components.
  2. See Section 09 9113 for painting of exterior plumbing systems and components.
- K. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.
- L. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- M. **HOT WASTE APPLICATIONS**
  1. For any application where waste piping is conveying waste from a fixture that either 1) has a maximum service water temperature equal to or greater than 121°F, or 2) that uses service water to generate steam, then only the metallic piping types listed in this section shall be used for a minimum of 15 feet downstream of the hot waste receptor. Plastic pipe (e.g., PVC, ABS, etc.) shall NOT be used.
  2. Hot waste applications include at least the following:
    - a. Kitchen grease waste piping.
    - b. Hot condensate drain piping (e.g., boiler drains, water heater T&P drains, autoclave drains, etc.).
- N. Pipe Hangers and Supports:
  1. Install in accordance with ASME B31.9 and Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.
  2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

### **3.04 APPLICATION**

- A. Use grooved mechanical couplings and fasteners only in accessible locations.
- B. Install unions downstream of valves and at equipment or apparatus connections.
- C. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

### **3.05 TOLERANCES**

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/8 inch per foot (1:100) slope, unless noted otherwise..
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

### **3.06 FIELD TESTS AND INSPECTIONS**

- A. Verify and inspect systems according to requirements by the Authority Having Jurisdiction. In the absence of specific test and inspection procedures proceed as indicated below.
- B. Domestic Water Systems:
  1. Perform hydrostatic testing for leakage prior to system disinfection.
  2. Test Preparation: Close each fixture valve or disconnect and cap each connected fixture.
  3. General:
    - a. Fill the system with water and raise static head to 10 psi (345 kPa) above service pressure. Minimum static head of 50 to 150 psi (345 to 1,034 kPa). As an exception, certain codes allow a maximum static pressure of 80 psi (551.6 kPa).
  4. Metal Piping Systems Subject to Freezing Conditions:
    - a. Inject 40 psi (275.8 kPa) of compressed air into piping to spot check for leaks with liquid soap. Document and repair leaks as necessary.
    - b. Raise injected compressed air pressure to 1.5 times rated service pressure or minimum pressure of 100 psi (689.5 kPa) for a duration of 2 hours and verify with a gauge that no perceptible pressure drop is measured.
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

### **3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM**

- A. Disinfect water distribution system in accordance with Section 33 0110.58.
- B. Prior to starting work, verify system is complete, flushed, and clean.
- C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.
- E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.
- F. Maintain disinfectant in system for 24 hours.
- G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.
- H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

- I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

### 3.08 SCHEDULES

#### A. Pipe Hanger Spacing:

##### 1. Metal Piping:

- a. Pipe Size: 1/2 inch (15 mm, DN) to 1-1/4 inch (32 mm, DN):
  - 1) Maximum Hanger Spacing: 6.5 ft (2 m).
  - 2) Hanger Rod Diameter: 3/8 inches (9 mm).
- b. Pipe Size: 1-1/2 inch (40 mm, DN) to 2 inch (50 mm, DN):
  - 1) Maximum Hanger Spacing: 10 ft (3 m).
  - 2) Hanger Rod Diameter: 3/8 inch (9 mm).
- c. Pipe Size: 2-1/2 inch (65 mm, DN) to 3 inch (80 mm, DN):
  - 1) Maximum Hanger Spacing: 10 ft (3 m).
  - 2) Hanger Rod Diameter: 1/2 inch (13 mm).
- d. Pipe Size: 4 inch (100 mm, DN) to 6 inch (150 mm, DN):
  - 1) Maximum Hanger Spacing: 10 ft (3 m).
  - 2) Hanger Rod Diameter: 5/8 inch (15 mm).
- e. Pipe Size: 8 inch (200 mm, DN) to 12 inch (300 mm, DN):
  - 1) Maximum hanger spacing: 14 ft (4.25 m).
  - 2) Hanger Rod Diameter: 7/8 inch (22 mm).

##### 2. Plastic Piping:

- a. All Sizes:
  - 1) Maximum Hanger Spacing: 6 ft (1.8 m).
  - 2) Hanger Rod Diameter: 3/8 inch (9 mm).

**END OF SECTION 22 1005**

**SECTION 22 1006  
PLUMBING PIPING SPECIALTIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Washing machine boxes and valves.
- F. Refrigerator valve and recessed box.
- G. Backwater valves.
- H. Backflow preventers.
- I. Double check valve assemblies.
- J. Water hammer arrestors.
- K. Mixing valves.
- L. Relief valves.
- M. Floor drain trap seals.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Product requirements for Owner furnished kitchen equipment.
- B. Section 22 1005 - Plumbing Piping.
- C. Section 22 3000 - Plumbing Equipment.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2022.
- C. ASSE 1011 - Performance Requirements for Hose Connection Vacuum Breakers; 2023.
- D. ASSE 1012 - Performance Requirements for Backflow Preventers with an Intermediate Atmospheric Vent; 2021.
- E. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- F. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2023.
- G. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- H. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- I. PDI-WH 201 - Water Hammer Arresters; 2017.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Accept specialties on site in original factory packaging. Inspect for damage.

## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

### **2.02 DRAINS**

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company: [www.jrsmith.com](http://www.jrsmith.com)
  2. Josam Company: [www.josam.com](http://www.josam.com)
  3. MIFAB, Inc; \_\_\_\_\_: [www.mifab.com](http://www.mifab.com)
  4. Whitehall Manufacturing; \_\_\_\_\_: [www.whitehallmfg.com](http://www.whitehallmfg.com)
  5. Zurn Industries, LLC; \_\_\_\_\_: [www.zurn.com](http://www.zurn.com)
- B. Floor Drains:
1. Manufacturers:
    - a. ACO, Inc; \_\_\_\_\_: [www.acobuildingdrainage.us](http://www.acobuildingdrainage.us)
    - b. Jay R. Smith Manufacturing Company; \_\_\_\_\_: [www.jrsmith.com](http://www.jrsmith.com)
    - c. MIFAB, Inc; FS1100-C Series: [www.mifab.com](http://www.mifab.com)
    - d. Zurn Industries, LLC; Z415-BZ1: [www.zurn.com](http://www.zurn.com)
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- C. Shower Channel Drain (SCD-1): Factory fabricated channel and grate with built in outlet pipe.

### **2.03 CLEANOUTS**

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company; \_\_\_\_\_: [www.jrsmith.com](http://www.jrsmith.com)
  2. Josam Company; \_\_\_\_\_: [www.josam.com](http://www.josam.com)
  3. MIFAB, Inc; C1100-R: [www.mifab.com](http://www.mifab.com)
  4. Zurn Industries, LLC; \_\_\_\_\_: [www.zurn.com](http://www.zurn.com)
  5. Substitutions: See Section 01 6000 - Product Requirements.

### **2.04 HOSE BIBBS**

- A. Manufacturers:
1. Jay R. Smith Manufacturing Company; \_\_\_\_\_: [www.jrsmith.com](http://www.jrsmith.com)
  2. Watts Regulator Company; \_\_\_\_\_: [www.wattsregulator.com](http://www.wattsregulator.com)
  3. Zurn Industries, LLC; \_\_\_\_\_: [www.zurn.com](http://www.zurn.com)
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Interior Hose Bibbs:
1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, chrome-plated where exposed with handwheel, integral vacuum breaker in compliance with ASSE 1011.
- C. Interior Mixing Type Hose Bibbs:
1. Bronze or brass, wall mounted, double service faucet with hose thread spout, integral stops, chrome-plated where exposed with handwheels, and vacuum breaker in compliance with ASSE 1011.

### **2.05 HYDRANTS**

- A. Manufacturers:
1. Arrowhead Brass & Plumbing, LLC: [www.arrowheadbrass.com](http://www.arrowheadbrass.com)
  2. Jay R. Smith Manufacturing Company: [www.jrsmith.com](http://www.jrsmith.com)
  3. Watts Regulator Company; [www.wattsregulator.com](http://www.wattsregulator.com)
  4. Zurn Industries, LLC: [www.zurn.com](http://www.zurn.com)
  5. Substitutions: See Section 01 6000 - Product Requirements.

## **2.06 WASHING MACHINE BOXES AND VALVES**

- A. Box Manufacturers:
  - 1. IPS Corporation/Water-Tite: [www.ipscorp.com](http://www.ipscorp.com)
  - 2. Oatey Supply Chain Services, Inc: [www.oatey.com](http://www.oatey.com)
  - 3. Viega LLC: [www.viega.us](http://www.viega.us)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

## **2.07 REFRIGERATOR VALVE AND RECESSED BOX**

- A. Box Manufacturers:
  - 1. IPS Corporation/Water-Tite: [www.ipscorp.com](http://www.ipscorp.com)
  - 2. Oatey Supply Chain Services, Inc: [www.oatey.com](http://www.oatey.com)
  - 3. Viega LLC: [www.viega.us](http://www.viega.us)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

## **2.08 BACKWATER VALVES**

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company: [www.jrsmith.com](http://www.jrsmith.com)
  - 2. Savko Plastic Pipe & Fittings, Inc: [www.savko.com](http://www.savko.com)
  - 3. Zurn Industries, LLC: [www.zurn.com](http://www.zurn.com)
- B. Cast Iron Backwater Valves: ASME A112.6.4; lacquered cast iron body and cover, brass valve, extension sleeve, and access cover.

## **2.09 BACKFLOW PREVENTERS**

- A. Manufacturers:
  - 1. Apollo Valves: [www.apollovalves.com](http://www.apollovalves.com)
  - 2. MIFAB, Inc; FRP: [www.mifab.com](http://www.mifab.com)
  - 3. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com](http://www.wattsregulator.com)
  - 4. Zurn Industries, LLC; 375XL: [www.zurn.com](http://www.zurn.com)
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Reduced Pressure Backflow Preventer Assembly:
  - 1. ASSE 1013; cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.
  - 2. Size: \_\_\_\_\_ inch (\_\_\_\_\_ mm) assembly with threaded gate valves.

## **2.10 DOUBLE CHECK-VALVE ASSEMBLIES**

- A. Manufacturers:
  - 1. Apollo Valves: [www.apollovalves.com](http://www.apollovalves.com)
  - 2. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com](http://www.wattsregulator.com)
  - 3. Zurn Industries, LLC; 350AST: [www.zurn.com](http://www.zurn.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Double Check Valve Assembly:
  - 1. ASSE 1012; cast bronze body with corrosion resistant internal parts and stainless steel springs; two independently operating check valves with intermediate atmospheric vent.
  - 2. Size: 3/4 to 2 inch, NPS (20 to 50 mm, DN) assembly with threaded full port ball valves.

## **2.11 WATER HAMMER ARRESTORS**

- A. Manufacturers:
  - 1. Jay R. Smith Manufacturing Company: [www.jrsmith.com](http://www.jrsmith.com)
  - 2. Watts Regulator Company, a part of Watts Water Technologies: [www.wattsregulator.com](http://www.wattsregulator.com)
  - 3. Zurn Industries, LLC: [www.zurn.com](http://www.zurn.com)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.

B. Water Hammer Arrestors:

1. Stainless steel construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F (minus 73 to 149 degrees C) and maximum 250 psi (1700 kPa) working pressure.

**2.12 MIXING VALVES**

A. Thermostatic Mixing Valves:

1. Manufacturers:
  - a. ESBE: [www.esbe.se/en](http://www.esbe.se/en).
  - b. Honeywell International Inc: [www.honeywellhome.com](http://www.honeywellhome.com)
  - c. Leonard Valve Company: [www.leonardvalve.com](http://www.leonardvalve.com)
  - d. Watts Regulator Company; [www.wattsregulator.com](http://www.wattsregulator.com)
  - e. Substitutions: See Section 01 6000 - Product Requirements.
2. Valve: Chrome-plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment.
3. Accessories:
  - a. Check valve on inlets.
  - b. Volume control shut-off valve on outlet.
4. Cabinet: 16 gauge, 0.0598 inch (1.52 mm) prime-coated steel, for recessed mounting with keyed lock.

**2.13 RELIEF VALVES**

A. Manufacturers:

1. Cash Acme, a brand of Reliance Worldwide Corporation; \_\_\_\_\_: [www.cashacme.com](http://www.cashacme.com)
2. ITT Bell & Gossett; \_\_\_\_\_: [www.bellgossett.com](http://www.bellgossett.com)
3. Substitutions: See Section 01 6000 - Product Requirements.

- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

**2.14 FLOOR DRAIN TRAP SEALS**

A. Manufacturers:

1. Green Drains; GD4: [www.greendrains.com](http://www.greendrains.com)
2. MIFAB, Inc; \_\_\_\_\_: [www.mifab.com](http://www.mifab.com)
3. RectorSeal; Sureseal: <https://rectorseal.com>
4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Description: Mechanical trap Push-fit EPDM or silicone fitting with a one-way membrane.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs.
- F. Pipe relief from backflow preventer to nearest drain.



- G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, janitor sinks, ice machines, washing machines, and break room sinks or any other quick-closing valve.

**END OF SECTION 22 1006**

**SECTION 22 3000  
PLUMBING EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Tankless gas-fired water heaters.
- B. Diaphragm-type compression tanks.
- C. Acid-effluent neutralizers.
- D. In-line circulator pumps.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.
- D. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Product Data:
  - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
  - 2. Indicate pump type, capacity, power requirements.
  - 3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
  - 4. Provide electrical characteristics and connection requirements.
- C. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
  - 1. Water Heaters: NSF approved.
  - 2. Gas Water Heaters: AHRI Directory of Certified Product Performance.
  - 3. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
  - 4. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

### **PART 2 PRODUCTS**

#### **2.01 WATER HEATERS**

- A. Manufacturers:
  - 1. A.O. Smith Water Products Co: [www.hotwater.com/](http://www.hotwater.com/).
  - 2. Bock Water Heaters, Inc: [www.rockwaterheaters.com/](http://www.rockwaterheaters.com/).
  - 3. Bosch Thermotechnology: [www.bosch-thermotechnology.us/](http://www.bosch-thermotechnology.us/).
  - 4. Bradford White Water Heaters: [www.bradfordwhite.com](http://www.bradfordwhite.com)
  - 5. Rinnai: <https://www.rinnai.us/>
  - 6. Chronomite: [www.chronomite.com](http://www.chronomite.com)
  - 7. EEmax: [www.eemax.com](http://www.eemax.com)
  - 8. Intellihot, Inc.: [www.intellihot.com/](http://www.intellihot.com/).
  - 9. Rheem Manufacturing Company: [www.rheem.com/](http://www.rheem.com/).
  - 10. Substitutions: See Section 01 6000 - Product Requirements.
- B. Tankless Gas-Fired Water Heaters:
  - 1. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
  - 2. Water Inlet Pressure: From 30 psi (207 kPa) to 150 psi (1034 kPa).
  - 3. Supply Gas Type: Natural gas.
  - 4. Heater Type: Self-contained, wall-mounted unit capable of handling listed capacity, air intake valve, condensate solenoid drain valve, water-inlet strainer, removable thermally-insulated front panel, blower access cover, and threaded water, gas, and condensate pipe-end connections.
  - 5. Burner-Heat Exchanger: Stainless steel assembly with single flue passage, flue baffle, and draft hood; thermally insulated and encased in corrosion-resistant steel jacket; baked-on enamel finish.
  - 6. Safeties: Provide internal safeties for vent side, water flow, flame detection, fan speed, electrical load, and thermal load.
  - 7. Controls: Color touchscreen interface for internal controls and built-in gas pressure regulator; temperature range adjustable from 100 to 185 degrees F (37.7 to 85 degrees C) using hot surface ignition and power vent.
  - 8. Accessories: Provide cold water inlet expansion tank, hot water recirculation pump, inlet ball valve, outlet ball valve, outlet ASME-rated temperature-pressure relief valve, and pipe-mounted thermometers.

#### **2.02 DIAPHRAGM-TYPE COMPRESSION TANKS**

- A. Manufacturers:
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig (80 kPa).

#### **2.03 ACID-EFFLUENT NEUTRALIZERS**

- A. Performance:

1. Maximum Low pH Water Flow Rate: as indicated on drawings.
  2. Media consists of calcite or limestone mineral media.
- B. Mineral Tank: Glass fiber reinforced tank, size and fill media as indicated on drawings.

## **2.04 IN-LINE CIRCULATOR PUMPS**

- A. Manufacturers:
1. Armstrong Fluid Technology: [www.armstrongfluidtechnology.com/](http://www.armstrongfluidtechnology.com/).
  2. Bell & Gossett, a brand of Xylem, Inc: [www.bellgossett.com/](http://www.bellgossett.com/).
  3. Grundfos: [www.grundfos.com](http://www.grundfos.com)
  4. Taco Comfort Solutions: [www.tacomfort.com](http://www.tacomfort.com)
  5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Casing: Bronze, rated for 125 psig (860 kPa) working pressure, with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against a stationary ceramic seat.
- F. Drive: Flexible coupling.

## **2.05 ELECTRICAL WORK**

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated on drawings.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Install all water tanks larger than 5 gallons with a minimum 6" high poured concrete housekeeping pad, or a minimum 6" high floor-mounted manufactured water tank support rail listed and rated to support the served equipment weight and application.
- C. All water tanks larger than 5 gallons must be secured to structure with retention straps that have been listed and rated for the application.
- D. Coordinate with plumbing piping and related electrical work to achieve operating system.
- E. Domestic Water Storage Tanks:
1. Provide steel pipe support, independent of building structural framing members.
  2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- F. Pumps:
1. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and isolating valve on discharge.
  2. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches (100 mm) and over.
  3. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

**END OF SECTION 22 3000**

**SECTION 22 4000  
PLUMBING FIXTURES**

**PART 1 GENERAL**

**1.01 RELATED REQUIREMENTS**

- A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.02 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- C. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- D. ASTM C1822 - Standard Specification for Insulating Covers on Accessible Lavatory Piping; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- G. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- H. NSF 61 - Drinking Water System Components - Health Effects; 2022, with Errata.
- I. NSF 372 - Drinking Water System Components - Lead Content; 2022.
- J. UL (DIR) - Online Certifications Directory; Current Edition.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

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

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Accept fixtures on site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Water Efficiency: EPA WaterSense label is required for all water closets, urinals, lavatory faucets, and showerheads.
- C. All product requirements listed shall be considered minimum performance standards, and shall be adhered to unless specified or scheduled otherwise on drawings. Where the requirements of the Drawings deviate from these specifications, the more stringent requirement of the two shall be maintained.

## **2.02 REGULATORY REQUIREMENTS**

- A. Comply with applicable codes for installation of plumbing systems.
- B. Comply with UL (DIR) requirements.
- C. Perform work in accordance with local health department regulations.
- D. All manufacturer products must be commercial-rated. Residential-grade fixtures are disallowed.

## **2.03 MANUFACTURERS**

- A. Acorn Engineering Company: [www.acorneng.com/](http://www.acorneng.com/)
- B. American Standard, Inc: [www.americanstandard-us.com/](http://www.americanstandard-us.com/)
- C. Bemis Manufacturing Company: [www.bemismfg.com/](http://www.bemismfg.com/)
- D. The Chicago Faucet Company: [www.chicagofaucets.com/](http://www.chicagofaucets.com/)
- E. Church Seat Company: [www.churchseats.com/](http://www.churchseats.com/)
- F. Elkay Manufacturing Company: [www.elkay.com/](http://www.elkay.com/)
- G. Fiat: [www.fiatproducts.com/](http://www.fiatproducts.com/)
- H. Grohe America, Inc: [www.grohe.com/us/](http://www.grohe.com/us/)
- I. Halsey Taylor: [www.halseytaylor.com/](http://www.halseytaylor.com/)
- J. Haws Corporation: [www.hawesco.com/](http://www.hawesco.com/)
- K. Jay R. Smith Manufacturing Company: [www.jrsmith.com/](http://www.jrsmith.com/)
- L. JOSAM Company: [www.josam.com/](http://www.josam.com/)
- M. Just Manufacturing Company: [www.justmfg.com/](http://www.justmfg.com/)
- N. Kohler Company: [www.kohler.com/](http://www.kohler.com/)
- O. Leonard Valve Company: <http://leonardvalve.com/>
- P. Moen Incorporated: [www.moen.com/](http://www.moen.com/)
- Q. Oasis International: [www.oasiscoolers.com/](http://www.oasiscoolers.com/)
- R. Sloan Valve Company: [www.sloanvalve.com/](http://www.sloanvalve.com/)
- S. Symmons, Inc.: <https://www.symmons.com/>
- T. TotoUSA: <https://www.totousa.com/>
- U. IPS Corp., Truebro-LavGuard 2: <https://ipscorp.com/>
- V. Watts: [www.watts.com/](http://www.watts.com/)
- W. Zurn Industries, Inc: [www.zurn.com/](http://www.zurn.com/)
- X. Gerber
- Y. Woodford
- Z. Delta
- AA. MIFAB
- BB. ACO Trench Drains
- CC.

## **2.04 UNDER-LAVATORY PIPE SUPPLY COVERS**

- A. Manufacturers:
  - 1. IPS Corp., Truebro-LavGuard 2: <https://ipscorp.com/>
  - 2. Plumberex Specialty Products, Inc: [www.plumberex.com/](http://www.plumberex.com/)
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. General:

1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
2. Adhesives, sewing threads and two ply laminated materials are prohibited.
3. Exterior Surfaces: Smooth nonabsorbent with no finger recessed indentations for easy cleaning.
4. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
  - a. Comply with ASTM E84 for flame and smoke development.
  - b. Comply with ASTM C1822 Type III for covers on accessible lavatory piping.
  - c. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
  - d. Comply with ICC A117.1.
  - e. Thermal Resistance: R value of 0.504 or lower when tested by ASTM C177.
  - f. Thermal Conductivity: K value of 0.358 or density of 21.61 pcf per ASTM C518.
  - g. Microbial and Fungal Resistance for Interior and Exterior: Comply with ASTM G21.
5. Color: High gloss white.
6. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.  
**No cable ties allowed.**

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Verify that electric power is available and of the correct characteristics.
- C. Confirm that millwork is constructed with adequate provision for the installation of lavatories and sinks, and **confirm that lavatory and sink mounting types (undermount, drop-in, integral, etc.) match those called for on Architectural Millwork drawings and details.**

#### **3.02 INSTALLATION**

- A. Install per manufacturer's instructions.
- B. Install fixtures at heights indicated on drawings.
- C. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- D. Install components level and plumb.

#### **3.03 INTERFACE WITH WORK OF OTHER SECTIONS**

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

#### **3.04 ADJUSTING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

#### **3.05 CLEANING**

- A. Clean plumbing fixtures and equipment.
- B. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

#### **3.06 PROTECTION**

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

**END OF SECTION 22 4000**

**SECTION 23 0050  
COMMON WORK RESULTS FOR MECHANICAL**

**PART 1 GENERAL**

**1.01 APPLICABILITY**

- A. The instructions outlined in this section shall apply to all sections under Division 23, except where specifically noted otherwise in the individual specification sections. Where these instructions and the instructions contained in other sections deviate, the more stringent requirement shall stand.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Contract descriptions, description of alterations work, work by others, future work, occupancy conditions, use of site and premises, work sequence.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- C. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to and supplement all work specified in Division 23. If conflicts arise, Contractor shall be responsible for communicating the conflict to Architect prior to performing any work or ordering any equipment. The Mechanical Drawings are diagrammatic except where specifically indicated otherwise. Refer to Architectural, Structural, and Civil drawings for all building dimensions.

**1.03 DEFINITIONS**

- A. Exposed: Revealed to view or subject to weather.
- B. Fittings: All connecting pieces of a system.
- C. Provide: Furnish, install, and connect completely.
- D. Piping: Pipe installed with all required fittings, valves, and accessories, and forming a complete system.
- E. Wiring: Wire or cable installed in raceway with all required boxes, fittings, connectors, and accessories completely installed.

**1.04 CODES AND STANDARDS**

- A. These specifications and associated design drawings do not give permission, implicit or inferred, to ignore the requirements of the applicable building codes or the AHJ. By placing a bid on this project, Contractor acknowledges and agrees to the requirement that they shall be versed in all applicable code requirements relevant to this specific project, and shall bring any conflicts to the attention of the Architect prior to performing any work. If work performed is found to be in violation of code, Contractor shall rectify any such work at their own expense.

**1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate the installation of all equipment and systems with size, location and installation of service utilities.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner, and that coordination between all affected installers has been performed to ensure proper installation order of all systems (e.g., electrical, plumbing, fire protection, millwork, etc.).
- C. The locations, arrangement, and extent of equipment, devices, piping, and other appurtenances related to the installation of the Mechanical work shown on the drawings are approximate and define the intent of the design. Contractor shall not scale the Engineer's drawings but shall refer to the Architectural drawings for exact dimensions of building components. Should a conflict exist between the Architectural and Engineering drawings regarding dimensions and scale, notify Architect of the discrepancy.



#### 1.06 PERMITS, UTILITIES, SERVICES, AND FEES

- A. Obtain all permits, inspections and approvals as required by Authority Having Jurisdiction and deliver certificates of approval to the Architect. Assume and pay all fees and costs of any nature whatsoever incidental to these permits.

#### 1.07 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Mechanical systems and all associated equipment, piping, accessories, and specialties shall not be installed without first coordinating the installation of the same with all other building trades (Architectural, Structural, Plumbing, etc.). Coordination shall be accomplished prior to, and shall be reflected in, the equipment submittals for approval. See individual sections for details.
- C. SHOP DRAWINGS:
  - 1. Where indicated in these specifications or on drawings, submit Mechanical shop drawings for review by the Owner and the Architect prior to beginning work. Background information shall be CAD or other computer-drawn versions of the floor plans or reflected ceiling plans of the Contract Drawings. Drawing from the Contract Documents shall not be copied for use as backgrounds, and hand drawings or sketch "markups" of the Contract Drawings shall not be accepted.
  - 2. Submit Mechanical shop drawings for all Mechanical Rooms that show coordination and sizes between all equipment, piping, ductwork, and other discipline systems.
    - a. Drawings from the Contract Documents Plan shall detail major elements, components, and system elements of Mechanical systems and materials in relation to other systems, installations, and building components. Sheet metal work shall be drawn using symbols and designations found in the latest edition of *SMACNA Duct Construction Standards - Metal and Flexible*.
    - b. Show detailed space requirements for installation and maintenance access after installation is complete.
    - c. Indicate if sequence and coordination of installations with other trades are important to efficient flow of the work.
    - d. Include the following, at a minimum:
      - 1) Ductwork and equipment layouts, shown coordinated with required maintenance access for mechanical, electrical, structural, and fire protection equipment and systems, including space for disassembly required for periodic maintenance.
      - 2) Dampers and valves, with access shown coordinated with architectural ceilings and furniture, and coordinated damper placement or damper cabling used to omit access panels in walls or ceilings wherever possible.
      - 3) Equipment and accessory service connections and support details.
      - 4) Location of all control equipment (e.g., thermostats, humidistats, VFDs, control panels, etc.), coordinated with architectural furniture, and with all electrical power connections provided by others.
      - 5) Exterior wall and foundation penetrations.
      - 6) Rated wall and floor penetrations (e.g., fire, smoke, etc.).
- D. **ELECTRICAL COORDINATION STATEMENT:** With each submittal having equipment requiring electrical power, include a written statement confirming coordination of voltage and power connection requirements with all Mechanical equipment and controls submittals requiring an electrical connection with the Electrical installer. Equipment that is connected to incorrect voltages for any reason shall be replaced at Contractor's expense.

#### 1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Unless specifically noted otherwise in the specifications or drawings, all products shall be manufactured by a company specializing in manufacturing the specific products used in this project, with at least three years of documented experience.

- B. Fabricator Qualifications: Unless specifically noted otherwise in the specifications or drawings, a company specializing in fabricating the specific products used in this project, with at least three years of documented experience.
- C. Installer Qualifications: Unless specifically noted otherwise in the specifications or drawings, a company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.
- D. **NOTICE: Manufacturer's Startup Representative Qualifications:** Unless specifically noted otherwise in the specifications or drawings, when the project documents specify startup services by a manufacturer's factory technician or representative, those services may not be delegated to the contractor or subcontractor who performed the installation, but must be provided directly by the manufacturer's personnel or by the manufacturer's contracted independent third party representative.
- E. Copies of Documents at Project Site: Maintain at the project site a copy (or provide access to a digital copy) of each referenced document that prescribes execution requirements.

#### 1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store all products and equipment under cover and elevated above grade, protected completely against weather. Do not install materials or equipment in a partially constructed structure exposed to weather, unless all material and equipment is continuously protected from damage by weather or the construction process. Comply with all manufacturer requirements for safe and effective storage of each product. Where Manufacturer's instructions and these specifications differ, maintain the more stringent standard.
- B. Products such as refrigerant piping and fittings that are stored outside must be protected against contamination by the elements within sealed plastic containers, or must be plugged and purged per the manufacturer's recommendations to ensure no damage to the inside of the piping.
- C. Ductwork and air terminals are required to be covered and stored protected from dust and debris in accordance with most current edition *SMACNA Duct Cleanliness for New Construction Guidelines* "Intermediate" Duct Cleanliness Level unless specifically noted otherwise.
- D. Material and equipment with suspected or observable damage caused by improper protection during construction is subject to replacement based on the judgment of Architect at no cost to Owner.

#### 1.10 WARRANTY

- A. The installation and mechanical equipment and components shall be provided with a one-year warranty from the date of final acceptance by Owner unless specifically noted otherwise in the contract documents. The warranty shall cover all materials and workmanship. During this warranty period, correct all defects in materials and workmanship by repair or replacement without incurring any additional cost to the owner. Warranty defects shall be corrected within thirty (30) days after being notified in writing of failure to meet the warranty.
- B. Provide manufacturer warranty for all air conditioning compressors for an additional four years beyond the initial one-year warranty. This additional warranty shall include parts at a minimum.
- C. Provide manufacturer warranty for all heat exchangers for an additional nine years beyond the initial one-year warranty. This additional warranty shall include parts at a minimum.
- D. Correct any and all defective Work uncovered within a five year period after Date of Substantial Completion.
- E. See Section 01 7800 - Closeout Submittals, as well as all individual specifications sections for additional warranty requirements.

#### 1.11 ELECTRICAL SYSTEMS INTERFACE

- A. All control wiring and associated raceway systems serving mechanical systems shall be provided under Division 23 unless specifically shown on Electrical drawings or Division 26

specifications.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. If substitution of alternate equipment is requested, Contractor is responsible for any and all costs required by the substitution, including necessary engineering and construction revisions in their – or any – contract or trade to satisfy the design intent shown on the Drawings and described in the Specifications.
- B. If the products and equipment used as the basis of design are modified, coordinate with all other trades prior to purchasing any material or equipment. Such coordination shall occur before purchasing and delivering equipment from the manufacturer and shall be clearly indicated on the shop drawings. Perform all related modifications without incurring cost to the Contract.
- C. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 MATERIALS**

- A. All products shall be new and shall bear the Underwriter's Laboratories, Inc. (UL) label or the Factory Mutual Underwriters (FM) label unless specifically indicated otherwise. Furnish materials and equipment compatible with the existing system.
- B. Materials, equipment, or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications are not intended to indicate every item of material, equipment, or labor required to produce a complete and properly functioning installation.
- C. FLAME SPREAD AND SMOKE DEVELOPED RATINGS OF MATERIALS:
  - 1. Materials and adhesives used throughout the mechanical systems for any system shall have a flame spread rating not over 25, and a smoke developed rating not to exceed 50. If such materials are to be applied with adhesives, test them as applied with such adhesives, or the adhesives used shall have a flame spread rating not over 25 and a smoke developed rating not to exceed 50.
  - 2. Determine flame spread rating and smoke developed rating by the Method of Testing of Surface Burning Characteristics of Building Materials, NFPA 255, ASTM E84, and Underwriters' Laboratories, Inc. standards.

### **2.03 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products must have been in satisfactory commercial or industrial use for three years prior to bid opening. The three-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the three-year period.
  - 1. Products having less than a three-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

## **PART 3 EXECUTION**

### **3.01 GENERAL**

- A. The mechanical, plumbing, and fire protection drawings do not give exact elevations or location of lines, nor do they show all the offsets, control lines or installation details. Carefully lay out the work at the site to conform to the structural conditions, to provide proper grading of lines, to avoid all obstructions.
- B. Offset valves in piping systems down to within one foot of the access point. Group runs of piping whenever it is feasible to do so.

- C. Do not install piping, equipment or ductwork in electrical rooms, elevator machine rooms or electronic data rooms except as serving only those rooms. Do not run piping or ductwork or locate equipment with respect to switchboards, panelboards, power panels, motor control centers or dry type transformers. Clearances apply vertically from floor to structure:
  - 1. Within 42" in front of electrical equipment.
  - 2. Within 36" of sides of electrical equipment.
- D. Provide access to equipment and valves requiring operation, service or maintenance within the life of the system. Equipment located above lay-in type ceilings is considered accessible.
- E. Valves and dampers for terminal units, grilles, or diffusers shall be located in areas accessible for maintenance and adjustment. Where dampers are installed above hard ceilings, provide damper adjustment cabling to allow remote adjustment of the damper without the use of an access panel.

### **3.02 EXAMINATION**

- A. Verification of Conditions: Verify existing conditions and operability of all existing equipment and systems prior to beginning work.

### **3.03 INSTALLATION**

- A. Install all equipment and materials in accordance with manufacturer's instructions.
- B. Minor deviations from the drawings required to conform to space conditions and to provide the required operation, service, or maintenance accessibility shall be made at no additional cost, and shall be subject to approval by the Owner.
- C. At the discretion of the Owner, the Architect, or the Authority Having Jurisdiction, relocate all conflicts arising from uncoordinated piping, equipment, ductwork, etc. installed, should such installation be determined to interfere with the proper installation and mounting of equipment, ceilings, piping, conduit, or any other Architectural or Structural systems or finishes. Corrective work arising from these conditions shall be performed without additional expense to the contract.
  - 1. Stacking of piping, conduit, ductwork, etc. where it would cause an obstruction or restricted path for egress or serviceability of equipment from any trade is prohibited.
  - 2. Coordinate the elevations of all piping and equipment above ceilings and in exposed areas with the work of all other disciplines prior to installation. In areas where more than one trade is required to use common openings in structure, joists, chases, shafts, and sleeves to route conduits, raceways, piping, ductwork, or any other materials, coordinate the positions of all piping and equipment to be furnished under this section so that all items – including the materials and equipment of other trades – may be accommodated within the space available.
  - 3. Confirm that work to be performed under Division 23 does not interfere with the clearances required for finished soffits, columns, millwork, pilasters, partitions, walls, or other Architectural or Structural elements as shown on the Drawings or Specifications. Work that interferes with the Architectural design or building structure shall be removed and relocated at the direction of the Architect at no additional cost to the contract.
  - 4. All piping and ductwork shall be run tight to structure, regardless of whether piping, ductwork, and equipment are above or below structural elements. Free-standing piping and equipment spanning open spaces or voids is prohibited. All piping routed through areas with exposed ceilings, cloud ceilings, or any other areas where piping may be visible to building occupants shall be routed to maintain a low-profile installation or shall be hidden from view, to provide the least-visible installation possible.
    - a. If any of these conditions are identified in the field by the Owner, the Architect, or the AHJ, remove and reinstall the indicated piping, ductwork, or equipment in accordance with these directions at no additional cost to the Contract.
    - b. If there are areas where necessary routing cannot comply with these instructions, furnish a sketch to the Architect identifying such areas and how the design drawing routing in the indicated areas will differ from these instructions, and obtain written

- approval to proceed with the proposed routing from the Architect prior to installation.
5. Give full cooperation to other trades and furnish all information necessary to permit the work of all trades to be installed satisfactorily, and with the least possible interference or delay.
- D. SEISMIC AND WIND DESIGN
1. Install hangers and supports to allow controlled thermal and seismic movement of piping and ductwork systems and mechanical equipment, to permit freedom of movement between pipe/duct anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units, and to protect similar exterior-mounted components and equipment against the effects of high velocity winds. See Structural drawings for project Seismic Design Classification and for Wind Design Classification.
  2. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- E. Piping, equipment, or ductwork shall not be installed in electrical equipment rooms, unless such piping serves equipment inside these spaces exclusively. Do not locate or route piping, ductwork, or equipment within 42" in front (and rear, if free-standing) of electrical equipment, or within 36" of sides of equipment. Clearances shall apply from floor level to underside of structural deck, and shall apply to the following electrical equipment:
1. Switchboards
  2. Panel boards
  3. Power panels
  4. Motor control centers
  5. Dry-type transformers

### 3.04 SLEEVES AND FRAMES

- A. For sleeves and sleeve seals below grade, see Section 23 0517 - Sleeves and Sleeve Seals for HVAC Piping.
- B. Install in concrete, carpentry or masonry construction, all sleeves, frames, hangers, expansion bolts, inserts and other fixtures and appurtenances indicated on the drawings or in these specifications for the support of all pipe, duct, equipment and devices furnished under Division 23.
- C. Cut openings and install sleeves or frames through walls and surfaces in a neat workmanlike manner. Cut openings only as large as required for the installation. Install sleeves and/or frames flush with finished surfaces and grout in place unless otherwise indicated. Leave surfaces around openings smooth and finish to match surrounding surface.
- D. Where pipes pass through floor slabs above grade, sleeves shall be standard weight black steel pipe with top of sleeve 1 inch above finished floor. Where pipes pass through walls above grade, sleeves shall be standard weight black steel pipe or 20-gauge galvanized sheet metal with ends flush with both surfaces.
- E. Provide each pipe or duct passing through walls, floors, ceilings or partitions with sleeves having an internal diameter 1 inch larger than the outside dimensions of the insulated pipe or duct.
- F. New Construction Projects:
  1. Build all pipe sleeves through floors, roofs and masonry walls in place as the affected walls, floors and roofs are built.
- G. Pack all penetrations through rated walls and floors with mineral wool and cap off with an approved fire-rated sealant as manufactured by Hilti, 3M or Dow. Materials shall meet or exceed UL 1479 or ASTM E814 requirements.
- H. Sleeves through exterior walls shall be steel pipe or cast iron pipe flush with both wall surfaces, and with the space between the pipe and the sleeve caulked watertight.

### **3.05 ESCUTCHEONS**

- A. Install escutcheons on all pipes where they pass through floors, ceilings, walls, or partitions in finished and exposed construction areas.
- B. Escutcheons shall be split, hinged, stamped brass type designed to fit the pipe and to cover the terminating pipe sleeve. Escutcheons shall be chrome plated finish unless otherwise specified with a securing device to hold them tight to the pipe.
- C. Allow sufficient spacing between parallel pipe runs to ensure installation of escutcheons without modification. Do not alter the escutcheons in any manner to allow for installation.

### **3.06 PAINTING**

- A. See Section 09 9113 - Exterior Painting for general project painting specifications and instructions. Additionally, the following requirements in this section apply.
- B. New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.
- C. Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117 and ASTM B-287, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark. The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.
- D. Repaint factory painted equipment that has been scratched or marred to match original factory color.
- E. Clean and paint all un-insulated black ferrous metal items exposed to sight inside the building such as piping, equipment hangers, and supports with one coat of zinc chromate primer. In addition, paint such items in finished spaces with two coats of finish paint in a color to match adjacent surfaces or as otherwise directed by the Architect.
- F. Clean and paint black ferrous metal items exposed outside the building such as piping, cooling tower beams, un-insulated pipe, and pipe supports with one coat of rust inhibiting primer and two coats of an asphaltic base aluminum paint. Clean and paint all piping installed outside the building that is to be insulated with one coat of rust inhibiting primer before installing insulation.
- G. Do not paint nameplates on equipment.
- H. Re-coat galvanizing broken during construction with cold galvanizing compound.
- I. Paint all ductwork, piping, insulation, conduit, structural members or other appurtenances visible through ceiling grilles flat black, unless specifically noted otherwise.

### **3.07 SYSTEM STARTUP**

- A. Independent Startup Verification: System startup services shall be performed by a manufacturer authorized and factory-trained technician that is independent from the installing contractor. Manufacturer shall be prohibited from delegating this duty to the installing contractor.
- B. See individual specifications sections for systems startup instructions for systems and equipment.

### **3.08 CLEANING**

- A. Flush new water piping systems until water runs clean. Mild chemical cleaning may be required. If so, flush all cleaning chemicals out of the piping system before recharging with water.

- B. Remove all stickers, rust, stains, labels and temporary covers before final acceptance.
- C. Clean the interior of all ducts, plenums and casings of all debris and blow free all particles of rubbish and dust before installing outlet faces. If duct closure film is not properly used to protect all duct openings throughout the course of construction, or if directed by the Architect or Owner, ducts shall be cleaned using the methods specified under Section 23 0130.51 - HVAC Air-Distribution System Cleaning, at no additional cost to the Contract.
- D. Lubricate bearings that require lubrication in accordance with the manufacturer's recommendations.
- E. Leave equipment rooms clean.
- F. Provide temporary filters for any fans operated during construction. Change temporary filters regularly (minimum once per week) to prevent contamination of the equipment and duct systems. Install new and unused permanent filters one week prior to final inspection.
- G. Cover ends of open ducts and pipes during construction except when working on such end prohibits covering, per SMACNA Duct Cleanliness Standards noted in Part 1. Cover with minimum 4 mil thick polyethylene taped, tied or wired in place.
- H. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

### **3.09 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
  - 1. Use operation and maintenance data as reference during demonstration.
  - 2. Conduct walking tour of project.
  - 3. Briefly describe function, operation, and maintenance of each component.
  - 4. See individual specifications sections and drawings for additional training requirements.
- D. Training: Train Owner's personnel on operation and maintenance of system. Schedule training for the major mechanical equipment at the end of construction. The training shall include operation and maintenance of all air conditioning units, air handling units, exhaust fans, temperature controls or building automation system, chillers, boilers, cooling towers, and variable frequency drives.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of 18 hours of training, divided into 3-hour sessions, or as directed by Owner.
  - 3. Instructor: Manufacturer's training personnel for each piece of specific equipment.
  - 4. Location: At project site.

### **3.10 MAINTENANCE**

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for the service and maintenance of all systems for 12 months from Date of Substantial Completion.

**END OF SECTION 23 0050**

**SECTION 23 0130.51**  
**HVAC AIR-DISTRIBUTION SYSTEM CLEANING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Cleaning of HVAC duct system, equipment, and related components.
- B. Testing and inspection agency employed by Owner.

**1.02 DEFINITIONS**

- A. HVAC System: For purposes of this section, the surfaces to be cleaned include all interior surfaces of the heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system, including the inside of air distribution equipment, coils, and condensate drain pans; see NADCA ACR for more details.

**1.03 REFERENCE STANDARDS**

- A. NADCA ACR - The NADCA Standard for Assessment, Cleaning, and Restoration of HVAC System; 2021.
- B. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- C. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submittal 23 0130.51.1:
  - 1. Project Closeout Report: Include field quality control reports, evidence of satisfactory cleaning, and documentation of items needing further repair.

**1.05 QUALITY ASSURANCE**

- A. Cleaning Contractor Qualifications: Company specializing in the cleaning and restoration of HVAC systems as specified in this section.
  - 1. Certified by the following:
    - a. NADCA, National Air Duct Cleaners Association: [www.nadca.com](http://www.nadca.com).
  - 2. Having minimum of three years documented experience.
  - 3. Employing for this project a supervisor certified as an Air Systems Cleaning Specialist by NADCA.

**PART 2 PRODUCTS**

**2.01 TOOLS AND EQUIPMENT**

- A. Vacuum Devices and Other Tools: Exceptionally clean, in good working order, and sealed when brought into the facility.
- B. Vacuum Devices That Exhaust Air Inside Building, Including Hand-Held and Wet Vacuums: Equipped with HEPA filtration with 99.97 percent collection efficiency for minimum 0.3-micron size particles and DOP test number.
- C. Vacuum Devices That Exhaust Air Outside Building, Including Truck- and Trailer-Mounted Types: Equipped with particulate collection including adequate filtration to contain debris removed from the HVAC system; exhausted in manner that prevents contaminant re-entry to building; compliant with applicable regulations as to outdoor environmental contamination.

**PART 3 EXECUTION**

**3.01 PROJECT CONDITIONS**

- A. Comply with applicable federal, state, and local requirements.



- B. Perform cleaning, inspection, and remediation in accordance with the recommendations of NADCA "Assessment, Cleaning and Restoration of HVAC Systems" (ACR) and as specified herein.
- C. Where NADCA ACR uses the terms "recommended", "highly recommended", or "ideally" in regard to a certain procedure or activity, do that unless it is clearly inapplicable to the project.
- D. Obtain Owner's approval of proposed temporary locations for large equipment.
- E. Designate a decontamination area and obtain Owner's approval.
- F. If unforeseen mold or other biological contamination is encountered, notify Architect immediately, identifying areas affected and extent and type of contamination.

### **3.02 PREPARATION**

- A. When cleaning work might adversely affect life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
- B. Ensure that electrical components that might be adversely affected by cleaning are de-energized, locked out, and protected prior to beginning work.
- C. Air-Volume Control Devices: Mark the original position of dampers and other air-directional mechanical devices inside the HVAC system prior to starting cleaning.
- D. Access to Concealed Spaces: Use existing service openings and make additional service openings as required to accomplish cleaning and inspection.
  - 1. Do not cut openings in non-HVAC components without obtaining prior approval.
  - 2. Make new openings in HVAC components in accordance with NADCA Standard 05; do not compromise the structural integrity of the system.
  - 3. Do not cut service openings into flexible duct; disconnect at ends for cleaning and inspection.
- E. Ceiling Tile: Lay-in ceiling tile may be removed to gain access to HVAC systems during the cleaning process; protect tile from damage and reinstall upon completion; replace damaged tile.

### **3.03 CLEANING**

- A. Use any cleaning method recommended by NADCA ACR unless otherwise specified; do not use methods prohibited by NADCA ACR, or that will damage HVAC components or other work, or that will significantly alter the integrity of the system.
- B. Obtain Owner's approval before using wet cleaning methods; ensure that drainage is adequate before beginning.
- C. Ducts: Mechanically clean all portions of ducts.
- D. Hoses, Cables, and Extension Rods: Clean using suitable sanitary damp wipes at the time they are being removed or withdrawn from their normal position.
- E. Registers, Diffusers, and Grilles: When removing, take care to prevent containment exposure due to accumulated debris.
- F. Coils: Follow NADCA ACR completely including measuring static pressure drop before and after cleaning; do not remove refrigeration coils from system to clean; report coils that are permanently impacted.
- G. Collect debris removed during cleaning; ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- H. Store contaminated tools and equipment in polyethylene bags until cleaned in the designated decontamination area.

### **3.04 REPAIR**

- A. Repair openings cut in the ventilation system so that they do not significantly alter the airflow or adversely impact the facility's indoor air quality.

- B. At insulated ducts and components, accomplish repairs in such a manner as to achieve the equivalent thermal value.
- C. Reseal new openings in accordance with NADCA Standard 05.
- D. Reseal rigid fiber glass duct systems using closure techniques that comply with UL 181 or UL 181A.
- E. When new openings are intended to be capable of being re-opened in the future, clearly mark them and report their locations to Owner in project report documents.

### **3.05 FIELD QUALITY CONTROL**

- A. Ensure that the following field quality control activities are completed prior to application of any treatments or coatings and prior to returning HVAC system to normal operation.
- B. Visually inspect all portions of the cleaned components; if not visibly clean as defined in NADCA ACR, re-clean and reinspect.
- C. Coils: Cleaning must restore the coil pressure drop to within 10 percent of the coil's original installed pressure drop; if original pressure drop is not known, coil will be considered clean if free of foreign matter and chemical residue based on visual inspection.
- D. Notify Architect when cleaned components are ready for inspection.
- E. Notify Owner's testing and inspection agency when cleaned components are ready for inspection.
- F. Owner reserves the right to verify cleanliness using NADCA ACR Surface Comparison Testing or NADCA Vacuum Test.
- G. When directed, re-clean components until they pass.
- H. Contractor shall bear the costs of retesting due to inadequate cleaning.
- I. Submit evidence that all portions of the system required to be cleaned have been cleaned satisfactorily.

### **3.06 ADJUSTING**

- A. After satisfactory completion of field quality control activities, restore adjustable devices to original settings, including, but not limited to, dampers, air directional devices, valves, fuses, and circuit breakers.

### **3.07 WASTE MANAGEMENT**

- A. Double-bag waste and debris in 6 mil, 0.006 inch (0.1524 mm) thick polyethylene plastic bags.
- B. Dispose of debris off-site in accordance with applicable federal, state and local requirements.

**END OF SECTION 23 0130.51**

**SECTION 23 0517**  
**SLEEVES AND SLEEVE SEALS FOR HVAC PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe sleeves.
- B. Pipe-sleeve seals.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 09 9113 - Exterior Painting: Preparation and painting of exterior piping systems.
- C. Section 09 9123 - Interior Painting: Preparation and painting of interior piping systems.

**1.03 REFERENCE STANDARDS**

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.

**1.04 QUALITY ASSURANCE**

- A. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

**PART 2 PRODUCTS**

**2.01 PIPE SLEEVES**

- A. Manufacturers:
  - 1. Flexicraft Industries; Pipe Wall Sleeve: [www.flexicraft.com](http://www.flexicraft.com)
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Vertical Piping:
  - 1. Sleeve Length: 1 inch (25 mm) above finished floor.
  - 2. Provide sealant for watertight joint.
  - 3. Blocked Out Floor Openings: Provide 1-1/2 inch (40 mm) angle set in silicon adhesive around opening.
  - 4. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.
- C. Clearances:
  - 1. Provide allowance for insulated piping.
  - 2. Wall, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external pipe diameter.
  - 3. All Rated Openings: Caulked tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

**2.02 PIPE-SLEEVE SEALS**

- A. Manufacturers:
  - 1. Advance Products & Systems, LLC; Innerlynx: [www.apsonline.com/](http://www.apsonline.com/)
  - 2. Flexicraft Industries; PipeSeal: [www.flexicraft.com/](http://www.flexicraft.com/)
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Modular Mechanical Sleeve-Seal:
  - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.

2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
  3. Size and select seal component materials in accordance with service requirements.
  4. Glass-reinforced plastic pressure end plates.
- C. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
  2. Combined packing and seal compound is to match partition fire-resistance hourly rating.
- D. Pipe Sleeve Material:
1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
  2. Masonry Structures: Sheet metal or fiber.
- E. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Structural Considerations:
1. Do not penetrate building structural members unless indicated.
- E. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Aboveground Piping:
    - a. Pack solid using mineral fiber in compliance with ASTM C592.
    - b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.
  2. All Rated Openings: Caulk tight with fire stopping material in compliance with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.
- F. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
  2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
  3. Locate piping in center of sleeve or penetration.
  4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
  5. Tighten bolting for a water-tight seal.
  6. Install in accordance with manufacturer's recommendations.
- G. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

#### **3.02 CLEANING**

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.
- C. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

**END OF SECTION 23 0517**

**SECTION 23 0529**  
**HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Support and attachment components for equipment, piping, and other HVAC/hydronic work.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 23 0548 - Vibration and Seismic Controls for HVAC: Seismic and Wind Restraint Requirements for Hangers and Supports.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

**1.05 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. For all seismic systems: Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

**PART 2 PRODUCTS****2.01 SUPPORT AND ATTACHMENT COMPONENTS**

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 3.0. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
  - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
  - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
  - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
  - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
  - e. Stainless Steel: 304 or 316 Stainless Steel.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.

1. Manufacturers:
  - a. Cooper B-Line, a division of Eaton Corporation: [www.cooperindustries.com/](http://www.cooperindustries.com/)
  - b. Ferguson Enterprises Inc: [www.fnw.com/](http://www.fnw.com/)
  - c. Thomas & Betts Corporation: [www.tnb.com/](http://www.tnb.com/)
  - d. Unistrut, a brand of Atkore International Inc: [www.unistrut.com/](http://www.unistrut.com/)
  - e. Substitutions: See Section 01 6000 - Product Requirements.
  - f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Comply with MFMA-4.
3. Channel Material:
  - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
  - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
4. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
5. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.

C. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:
  - a. Equipment Supports: 1/2 inch (13 mm) diameter.
  - b. Piping up to 1 inch (27 mm) nominal: 1/4 inch (6 mm) diameter.
  - c. Piping larger than 1 inch (27 mm) nominal: 3/8 inch (10 mm) diameter.
  - d. Trapeze Support for Multiple Pipes: 3/8 inch (10 mm) diameter.

D. Steel Cable:

1. Manufacturers:

- a. Ductmate Industries, Inc, a DMI Company; Clutcher Cable Hanging System:  
[www.ductmate.com/](http://www.ductmate.com/)
  - b. Substitutions: See Section 01 6000 - Product Requirements.
  - c. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
- E. Thermal Insulated Pipe Supports:
1. Manufacturers:
    - a. Aeroflex USA, Inc: [www.aeroflexusa.com/](http://www.aeroflexusa.com/)
    - b. Buckaroos, Inc: [www.buckaroos.com/](http://www.buckaroos.com/)
    - c. KB Enterprises: [www.snappitz.com/](http://www.snappitz.com/)
    - d. Armacell, Inc.; Insuguard: <https://www.insuguard.com>.
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. General Construction and Requirements:
    - a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    - b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    - c. Pipe supports to be provided for nominally sized, 1/2 inch to 30 inch (12.7 mm to 762 mm) iron pipes.
    - d. Insulation inserts to consist of rigid polyisocyanurate (urethane) insulation surrounded by a 360 degree, PVC jacketing.
  3. PVC Jacket:
    - a. Pipe insulation protection shields to be provided with a ball bearing hinge and locking seam.
    - b. Moisture Vapor Transmission: 0.0071 perm inch (0.0092 ng/Pa s m), when tested in accordance with ASTM E96/E96M.
    - c. Thickness: 60 mil (1.524 mm).
- F. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.
- G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
  2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
  3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
  4. Hollow Masonry: Use toggle bolts.
  5. Hollow Stud Walls: Use toggle bolts.
  6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
  7. Sheet Metal: Use sheet metal screws.
  8. Wood: Use wood screws.
  9. Plastic and lead anchors are not permitted.
  10. Hammer-driven anchors and fasteners are not permitted.
  11. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
  12. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

**3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
  - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
  - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
  - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

**3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using cold galvanizing compound recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

**END OF SECTION 23 0529**



**SECTION 23 0548  
VIBRATION AND SEISMIC CONTROLS FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. Seismic restraint systems.
- F. Vibration-isolated and/or seismically engineered roof curbs.
- G. In-curb sound attenuation treatment.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- D. Section 23 0529 - Hangers and Supports for HVAC Piping and Equipment.

**1.03 DEFINITIONS**

- A. HVAC Component: Where referenced in this section in regards to seismic controls, applies to any portion of the HVAC system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., ductwork, piping).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

**1.04 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVAC) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- E. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- F. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- G. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- H. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- I. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- K. MFMA-4 - Metal Framing Standards Publication; 2004.
- L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

### 1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
  - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
  - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
  - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
  - 4. Seismic Controls:
    - a. Coordinate the arrangement of seismic restraints with piping, conduit, equipment, and other potential conflicts installed under other sections or by others.
    - b. Coordinate the work with other trades to accommodate relative positioning of essential and nonessential components in consideration of seismic interaction.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

### 1.06 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  - 2. Seismic Controls: Include seismic load capacities.
- D. Shop Drawings - Vibration Isolation Systems:
  - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
  - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.
- E. Shop Drawings - Seismic Controls:
  - 1. Include dimensioned plan views and sections indicating proposed HVAC component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
  - 2. Identify mounting conditions required for equipment seismic qualification.
  - 3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
  - 4. Indicate proposed arrangement of distributed system trapeze support groupings.
  - 5. Indicate proposed locations for distributed system flexible fittings and/or connections.
  - 6. Indicate locations of seismic separations where applicable.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Evidence of qualifications for seismic controls designer.
- H. Manufacturer's detailed field testing and inspection procedures.
- I. Field quality control test reports.

### **1.07 QUALITY ASSURANCE**

- A. Comply with applicable building code.
- B. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing HVAC equipment and/or HVAC connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 4. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise indicated.
- D. Piping Isolation:
  - 1. Provide vibration isolators for piping supports:
    - a. Systems required by code to be seismically protected (e.g., natural gas piping).
    - b. Located within 50 feet (15.2 m) of connected vibration-isolated equipment and pressure-regulating valve (PRV) stations.
  - 2. Suspended Piping, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
  - 3. Floor-Mounted Piping, Nonseismic Applications: Use open (unhoused) spring isolators.
  - 4. Use modular seal or approved resilient material where vibration-isolated piping penetrates building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.
- E. Thrust Restraint Applications:
  - 1. Use thrust restraints to resist horizontal motion due to thrust for fan heads, suspended fans, and base-mounted and suspended air handling equipment operating at 2.0 inches wg (0.5 kPa) or greater total static pressure.
  - 2. Limit lateral movement to 0.25 inch (6 mm) or less unless otherwise indicated.

### **2.02 SEISMIC CONTROL REQUIREMENTS**

- A. Design and provide HVAC component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor HVAC components.
- B. Seismic Design Criteria: Obtain from project Structural Engineer of Record.

- C. **Component Importance Factor (Ip): HVAC components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required by applicable codes or the Authority Having Jurisdiction. This includes but is not limited to:**
1. **HVAC components required to function for life safety purposes after an earthquake.**
  2. **HVAC components that support or otherwise contain hazardous substances (e.g., Systems with Natural Gas Supply, Animal Area Supply and Exhaust Systems and Equipment, Isolation Area Supply and Exhaust Systems and Equipment, Dryer Exhaust Systems, etc.).**
- D. **Seismic Qualification of Equipment:**
1. Provide special certification for HVAC equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
  4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. **Seismic Restraints:**
1. Provide seismic restraints for HVAC components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  2. **Seismic Restraint Exemptions:**
    - a. **Exemptions for Seismic Design Category C:**
      - 1) HVAC components where either of the following apply:
        - (a) The component importance factor (Ip) is 1.0 and the component is positively attached to the structure.
        - (b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
      - 2) HVAC piping with component importance factor (Ip) of 1.5 and nominal pipe size of 2 inch (50 mm) or less, where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, and where piping is positively attached to the structure; exemption does not apply to piping constructed of low-deformability materials (e.g., cast iron, glass, nonductile plastics).
    - b. **Duct System Exemptions, All Seismic Design Categories:**
      - 1) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control with component importance factor (Ip) of 1.0, where flexible connections or other assemblies are provided between duct system and associated components, where duct system is positively attached to the structure, and where one of the following apply:
        - (a) Trapeze supported duct with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.
        - (b) Trapeze supported duct with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds (890 N) or less.
        - (c) Trapeze supported duct with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.

- (d) Hanger supported duct with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds (220 N) or less.
  - 2) Duct systems not designed to carry toxic, highly toxic, or flammable gases and not used for smoke control, where there are provisions to avoid impact with other ducts or mechanical components or to protect ducts in the event of such impact, and where duct system is positively attached to the structure and has a cross sectional area of less than 6 square feet (0.557 sq m) and weighs 20 pounds per foot (292 N/m) or less.
- c. HVAC Piping Exemptions, All Seismic Design Categories:
  - 1) HVAC piping where flexible connections, expansion loops, or other assemblies are provided between piping and associated components, where piping is positively attached to the structure, and where one of the following apply:
    - (a) Trapeze supported piping weighing less than 10 pounds per foot (146 N/m), where all pipes supported meet size requirements for exemption as single pipes described under specific seismic design category exemptions above.
    - (b) Trapeze supported piping with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
    - (c) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 200 pounds (890 N) or less.
    - (d) Trapeze supported piping with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, where all pipes supported have a component importance factor (Ip) of 1.0 and meet size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single trapeze is 100 pounds (445 N) or less.
    - (e) Hanger supported piping with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, where pipe has a component importance factor (Ip) of 1.0 and meets size requirements for exemption as single pipes described under specific seismic design category exemptions above, and where the total weight supported by any single rod is 50 pounds (220 N) or less.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
  - a. ASHRAE (HVACA).
  - b. FEMA 412.
  - c. FEMA 413.
  - d. FEMA 414.
  - e. FEMA E-74.
  - f. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer

- acceptable to authorities having jurisdiction.
5. Seismic Type Vibration Isolators:
    - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  6. Seismic Restraint Systems:
    - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
    - b. Use only cable restraints to restrain vibration-isolated HVAC components, including distributed systems.
    - c. Use only one restraint system type for a given HVAC component or distributed system (e.g., ductwork, piping) run; mixing of cable and rigid restraints on a given component/run is not permitted.
    - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain HVAC component in all lateral directions; consider bracket geometry in anchor load calculations.
    - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported HVAC component weight.
    - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported HVAC component weight.
    - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
    - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
    - i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.
  7. Ductwork Applications:
    - a. Provide independent support and seismic restraint for in-line components (e.g., fans, heat exchangers, humidifiers) having an operating weight greater than 75 pounds (334 N).
    - b. Positively attach appurtenances (e.g., dampers, louvers, diffusers) with mechanical fasteners.
  - F. Seismic Attachments:
    1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
    2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
    3. Do not use power-actuated fasteners.
    4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
    5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
    6. Concrete Housekeeping Pads:
      - a. Increase size of pad as required to comply with anchor requirements.
      - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.
  - G. Seismic Interactions:

1. Include provisions to prevent seismic impact between HVAC components and other structural or nonstructural components.
  2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
- H. Seismic Relative Displacement Provisions:
1. Use suitable fittings or flexible connections to accommodate:
    - a. Relative displacements at connections between components, including distributed systems (e.g., ductwork, piping); do not exceed load limits for equipment utility connections.
    - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
    - c. Design displacements at seismic separations.
    - d. Anticipated drifts between floors.

## **2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES**

- A. Manufacturers:
1. Vibration-Isolated Equipment Support Bases:
    - a. Kinetics Noise Control, Inc; : [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - b. Mason Industries; : [www.mason-ind.com/](http://www.mason-ind.com/)
    - c. Vibration Eliminator Company, Inc; : [www.veco-nyc.com/](http://www.veco-nyc.com/)
    - d. Vibro-Acoustics Swegon North America; : <https://vibro-acoustics.com/>
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Concrete Inertia Bases:
1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
  2. Minimum Base Depth: 6 inches (152 mm).
  3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
  4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
  5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 3000.
  6. Centrifugal Fan Applications: Provide adjustable motor slide rails as required.

## **2.04 VIBRATION ISOLATORS**

- A. Manufacturers:
1. Vibration Isolators:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - b. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/](http://www.veco-nyc.com/)
    - d. Vibro-Acoustics Swegon North America; : <https://vibro-acoustics.com/>
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
  2. Spring Elements for Spring Isolators:
    - a. Color code or otherwise identify springs to indicate load capacity.
    - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.

- d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    - f. Selected to function without undue stress or overloading.
  - 3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
  - 1. Resilient Material Isolator Pads:
    - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
    - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.
  - 2. Resilient Material Isolator Mounts, Nonseismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
  - 3. Restrained Spring Isolators, Nonseismic:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
    - b. Bottom Load Plate: Steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
    - c. Furnished with integral leveling device for positioning and securing supported equipment.
    - d. Provides constant free and operating height.
  - 4. Resilient Material Isolator Hangers, Nonseismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
  - 5. Spring Isolator Hangers, Nonseismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
  - 6. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
  - 7. Thrust Restraints:
    - a. Description: Assembly utilizing free-standing, laterally stable steel spring designed for resisting horizontal motion due to thrust (e.g., air pressure from a fan), and intended for installation in pairs.
- D. Vibration Isolators for Seismic Applications:



1. Resilient Material Isolator Mounts, Seismic:
  - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.
2. Restrained Spring Isolators, Seismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
  - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

## **2.05 ACOUSTICAL AND VIBRATION ISOLATORS**

- A. General Requirements:
  1. Acoustical Isolation System: Through-stud isolators, pipe clamps, riser clamp pads, neoprene and felt lining material and associated support brackets.

## **2.06 SEISMIC RESTRAINT SYSTEMS**

- A. Manufacturers:
  1. Seismic Restraint Systems:
    - a. Eaton Corporation: [www.eaton.com/](http://www.eaton.com/)
    - b. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - c. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)
    - d. Vibro-Acoustics: [www.vibro-acoustics.com/](http://www.vibro-acoustics.com/)
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.

- C. Cable Restraints:
  - 1. Comply with ASCE 19.
  - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

## **2.07 VIBRATION-ISOLATED AND/OR SEISMICALLY ENGINEERED ROOF CURBS**

- A. Manufacturers:
  - 1. Vibration-Isolated and/or Seismically Engineered Roof Curbs:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - b. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/](http://www.veco-nyc.com/)
    - d. Vibro-Acoustics: [www.vibro-acoustics.com/](http://www.vibro-acoustics.com/)
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Source Limitations: Furnish vibration-isolated roof curbs and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration Isolation Curbs:
  - 1. Nonseismic Curb Rail:
    - a. Location: Between existing roof curb and rooftop equipment.
    - b. Construction: Aluminum.
    - c. Integral vibration isolation to comply with requirements of this section.
    - d. Weather exposed components consist of corrosion resistant materials.
  - 2. Nonseismic Curb:
    - a. Location: Between structure and rooftop equipment.
    - b. Construction: Aluminum.
    - c. Integral vibration isolation to comply with requirements of this section.
    - d. Weather exposed components consist of corrosion resistant materials.
  - 3. Seismic Curb:
    - a. Location: Between structure and rooftop equipment.
    - b. Construction: Steel.
    - c. Integral vibration isolation to comply with requirements of this section.
    - d. Snubbers consist of minimum 0.25 inch (6 mm) thick resilient pads to avoid metal-to-metal contact without compromising vibration isolating capabilities.
    - e. Weather exposed components consist of corrosion resistant materials.

## **2.08 IN-CURB SOUND ATTENUATION TREATMENT**

- A. Description: Prefabricated composite acoustical panels for installation in equipment curb. Designed to attenuate sound transfer from mechanical equipment into spaces below curb.
- B. Sound Transmission Class: Not less than 30 when tested in accordance with ASTM E90.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

### 3.02 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  - 1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with the certificate of compliance.
  - 2. Installation and anchorage of piping systems designed to carry hazardous materials and their associated mechanical units for Seismic Design Categories C, D, E, and F; periodic inspection.
  - 3. Installation and anchorage of ductwork designed to carry hazardous materials for Seismic Design Categories C, D, E and F; periodic inspection.
  - 4. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where the approved Contract Documents require a nominal clearance of 1/4 inch (6.4 mm) or less between equipment support frame and seismic restraint; periodic inspection.
  - 5. Verification of required clearances between HVAC equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Secure fasteners according to manufacturer's recommended torque settings.
- D. Install flexible piping connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- E. Vibration Isolation Systems:
  - 1. Vibration-Isolated Equipment Support Bases:
    - a. Provide specified minimum clearance beneath base.
  - 2. Spring Isolators:
    - a. Position equipment at operating height; provide temporary blocking as required.
    - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
  - 3. Isolator Hangers:

- a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  4. Thrust Restraints:
    - a. Adjust restraint movement under normal operating static pressure.
  5. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  6. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  7. Adjust isolators to be free of isolation short circuits during normal operation.
  8. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- F. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris, or other obstructions.
  2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
  4. Equipment with Sheet Metal Housings:
    - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
  5. Concrete Housekeeping Pads:
    - a. Size in accordance with seismic design to meet anchor requirements.
    - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
  6. Seismic Restraint Systems:
    - a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
    - b. Install restraints within permissible angles in accordance with seismic design.
    - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
    - d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
    - e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.
  7. Sound Attenuation Systems:
    - a. Provide sound attenuation curbs with in-curb attenuation for all rooftop-mounted fan-powered equipment.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide manufacturer representative or authorized technician services to assist with inspection and testing of vibration isolation systems and seismic controls. Submit a detailed copy of manufacturer recommended inspection, testing, and field report procedures.
- D. Vibration Isolation Systems:

1. Verify isolator static deflections.
  2. Verify required clearance beneath vibration-isolated equipment support bases.
  3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
1. Verify snubbing element air gaps.
- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 23 0548**

**SECTION 23 0553**  
**IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Dryer Exhaust duct maximum equivalent length markers.
- E. Pipe markers.
- F. Ceiling tacks.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9123 - Interior Painting: Identification painting.

**1.03 REFERENCE STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 0553.1:
  - 1. Tag List: Submit table including all equipment to receive a permanent nameplate tag including the following information:

| Unit Mark | Area or System Served | Tag Material | Tag Colors |
|-----------|-----------------------|--------------|------------|
| -         | -                     | -            | -          |

- C. Submittal 23 0553.2:
  - 1. Product Data: Provide manufacturers catalog literature for each product required.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION APPLICATIONS**

- A. Air Handling Units: Nameplates.
- B. Air Terminal Units: Tags.
- C. Automatic Controls: Tags. Key to control schematic.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks, where located above lay-in ceiling.
- F. Ductwork: Duct Markers.
- G. Major Control Components: Nameplates.
- H. Piping: Pipe markers.
- I. Small-sized Equipment: Tags.
- J. Thermostats: Nameplates.
- K. Valves: Tags and ceiling tacks where located above lay-in ceiling.

**2.02 NAMEPLATES**

- A. Manufacturers:
  - 1. Advanced Graphic Engraving, LLC: [www.advancedgraphicengraving.com/](http://www.advancedgraphicengraving.com/).
  - 2. Brimar Industries, Inc: [www.pipemarker.com/](http://www.pipemarker.com/).
  - 3. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  - 4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/](http://www.kolbipipemarkers.com/).

5. Seton Identification Products, a Tricor Direct Company: [www.seton.com/](http://www.seton.com/).
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Letter Height: 1/4 inch (6 mm).

### 2.03 TAGS

- A. Manufacturers:
1. Advanced Graphic Engraving: [www.advancedgraphicengraving.com/](http://www.advancedgraphicengraving.com/).
  2. Brady Corporation: [www.bradycorp.com/](http://www.bradycorp.com/).
  3. Brimar Industries, Inc: [www.pipemarker.com/](http://www.pipemarker.com/).
  4. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  5. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/](http://www.kolbipipemarkers.com/).
  6. Seton Identification Products, a Tricor Company: [www.seton.com/](http://www.seton.com/).
  7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

### 2.04 ADHESIVE-BACKED DUCT MARKERS

- A. Manufacturers:
1. Brimar Industries, Inc: [www.pipemarker.com/](http://www.pipemarker.com/).
  2. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  3. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/](http://www.kolbipipemarkers.com/).
  4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.
- C. Style: Individual Label.
- D. Color Table:

| System Type:                                                                   | Color        |
|--------------------------------------------------------------------------------|--------------|
| Supply Air                                                                     | Blue/White   |
| Return Air                                                                     | Green/White  |
| Exhaust Air                                                                    | Green/White  |
| 100% Outside Air                                                               | Blue/White   |
| Hazardous Exhaust Air (e.g., Isolation Area Exhaust, Combustion Exhaust, etc.) | Yellow/White |

### 2.05 DRYER EXHAUST DUCT MAXIMUM EQUIVALENT LENGTH MARKERS

- A. Manufacturers:
1. In-O-Vate Dryer products; DryerPlacard: <https://dryerplacard.com/>
  2. Brimar Industries, Inc: [www.pipemarker.com/](http://www.pipemarker.com/).
  3. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/](http://www.kolbipipemarkers.com/).
- B. Material: 3M Scotchcal 3650-10 substrate with pressure sensitive Hi Tack heat-resistant adhesive 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks, and designed to accept permanent marker notations.
- C. Style: Multiple Markers on a Roll, with blank white fillable fields for duct equivalent length.
- D. Size: Minimum 3"x4"
- E. Color: Red with white lettering.
- F. Content: Complies with IMC and UL 969 marking system(s) for dryer vent maximum length labeling.

## 2.06 PIPE MARKERS

- A. Manufacturers:
  - 1. Brady Corporation: [www.bradycorp.com/](http://www.bradycorp.com/).
  - 2. Brimar Industries, Inc: [www.pipemarker.com/](http://www.pipemarker.com/).
  - 3. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  - 4. Kolbi Pipe Marker Co: [www.kolbipipemarkers.com/](http://www.kolbipipemarkers.com/).
  - 5. Seton Identification Products, a Tricor Company: [www.seton.com/](http://www.seton.com/).
  - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Color: Comply with ASME A13.1.
- C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- E. Color code as follows:
  - 1. Natural Gas: Yellow with black letters.
  - 2. Condensate Drain: Green with white letters.
  - 3. Refrigerant: Yellow with black letters.

## 2.07 CEILING TACKS

- A. Manufacturers:
  - 1. Craftmark Pipe Markers: [www.craftmarkid.com/](http://www.craftmarkid.com/).
  - 2. Kolbi Pipe Marker Co : [www.kolbipipemarkers.com/](http://www.kolbipipemarkers.com/).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Description: Steel with 3/4 inch (20 mm) diameter color coded head.
- C. Color code as follows:
  - 1. HVAC Equipment: Yellow.
  - 2. Fire Dampers and Smoke Dampers: Red.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### 3.02 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. Use tags on piping 3/4 inch (20 mm) diameter and smaller.
- F. Identify service, flow direction, and pressure.
- G. Install in clear view and align with axis of piping.
- H. Install piping with pipe markers. Include System Type (e.g. Refrigerant Suction) and Flow Direction (with arrow). Locate piping identification not to exceed 20 feet (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- I. Install ductwork with adhesive-backed duct markers. Include System Type (e.g. Supply Air) and Airflow Direction (with arrow). Locate identification at air handling unit or appliance, at each side



of penetration of structure or enclosure, at each obstruction, and at every 25 feet.

- J. Install dryer exhaust duct maximum equivalent length identification labels on **each dryer exhaust duct system, regardless of total maximum length.** See section 23 3501 - Dryer-Vent Exhaust Collection Systems.
- K. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

**END OF SECTION 23 0553**

**SECTION 23 0593**  
**TESTING, ADJUSTING, AND BALANCING FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Testing, adjustment, and balancing of air systems.
- B. Measurement of final operating condition of HVAC systems.
- C. Sound measurement of equipment operating conditions.
- D. Commissioning activities.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 4000 - Quality Requirements: Employment of testing agency and payment for services.
- B. Section 01 9113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- C. Section 23 0800 - Commissioning of HVAC.
- D. Section 25 0500 - Common Work Results for Integrated Automation.

**1.03 REFERENCE STANDARDS**

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).
- C. NEBB (TAB) - Procedural Standard for Testing, Adjusting and Balancing of Environmental Systems; 2019, with Errata (2022).
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submittal 23 0593.1:
  - 1. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
    - a. Submit to Design Professional.
    - b. Submit to the Commissioning Authority.
    - c. Submit six weeks prior to starting the testing, adjusting, and balancing work.
    - d. Include certification that the plan developer has reviewed Contract Documents, the equipment and systems, and the control system with the Architect and other installers to sufficiently understand the design intent for each system.
    - e. Include at least the following in the plan:
      - 1) List of all air flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      - 2) Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      - 3) Identification and types of measurement instruments to be used and their most recent calibration date.
      - 4) Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      - 5) Final test report forms to be used.
      - 6) Detailed step-by-step procedures for TAB work for each system and issue, including:
        - (a) Terminal flow calibration (for each terminal type).

- (b) Diffuser proportioning.
    - (c) Branch/submain proportioning.
    - (d) Total flow calculations.
    - (e) Rechecking.
    - (f) Diversity issues.
  - 7) Expected problems and solutions, etc.
  - 8) Details of how TOTAL flow will be determined; for example:
    - (a) Air: Sum of terminal flows via control system calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations.
  - 9) Specific procedures that will ensure that systems are operating at the lowest possible pressures and methods to verify this.
  - 10) Confirmation of understanding of the outside air ventilation criteria under all conditions.
  - 11) Method of verifying and setting minimum outside air flow rate will be verified and set and for what level (total building, zone, etc.).
  - 12) Method of checking building static and exhaust fan and/or relief damper capacity.
  - 13) Time schedule for TAB work to be done in phases (by floor, etc.).
  - 14) Time schedule for deferred or seasonal TAB work, if specified.
  - 15) Exhaust fan balancing and capacity verifications, including any required room pressure differentials.
  - 16) Interstitial cavity differential pressure measurements and calculations, if specified.
  - 17) Procedures for field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
  - 18) Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Field Logs: Submit at least twice a week to the Commissioning Authority.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Submittal 23 0593.2:
- 1. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
    - a. Submit to the Design Professional within two weeks after completion of testing, adjusting, and balancing.
    - b. Revise TAB plan to reflect actual procedures and submit as part of final report.
    - c. Submit draft copies of report in PDF form for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
    - d. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
    - e. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
    - f. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.
- F. Submittal 23 0593.3:
- 1. Seasonal Adjustment Statement: Heating Season. See details in Part 3 - Execution: Recording & Adjusting below.
- G. Submittal 23 0593.4:

1. Seasonal Adjustment Statement: Cooling Season. See details in Part 3 - Execution: Recording & Adjusting below.
- H. Include the following on the title page of each report:
  1. Name of Testing, Adjusting, and Balancing Agency.
  2. Address of Testing, Adjusting, and Balancing Agency.
  3. Telephone number of Testing, Adjusting, and Balancing Agency.
  4. Project name.
  5. Project location.
  6. Project Architect.
  7. Project Engineer.
  8. Project Contractor.
  9. Project altitude.
  10. Report date.

## **PART 2 PRODUCTS - NOT USED**

## **PART 3 EXECUTION**

### **3.01 GENERAL REQUIREMENTS**

- A. Perform total system balance in accordance with one of the following:
  1. AABC (NSTSB), AABC National Standards for Total System Balance.
  2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
  3. SMACNA (TAB).
  4. Maintain at least one copy of the standard to be used at project site at all times.
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- D. TAB Agency Qualifications:
  1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
  2. Having minimum of three years documented experience.
  3. Certified by one of the following:
    - a. AABC, Associated Air Balance Council: [www.aabc.com/#sle](http://www.aabc.com/#sle); upon completion submit AABC National Performance Guaranty.
    - b. NEBB, National Environmental Balancing Bureau: [www.nebb.org/#sle](http://www.nebb.org/#sle).
    - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: [www.tabbcertified.org/#sle](http://www.tabbcertified.org/#sle).
- E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

### **3.02 EXAMINATION**

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
  1. Systems are started and operating in a safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fans are rotating correctly.
  7. Fire, smoke, and volume dampers are in place and open.
  8. Air coil fins are cleaned and combed.

- 9. Access doors are closed and duct end caps are in place.
- 10. Air outlets are installed and connected.
- 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
- C. Beginning of work means acceptance of existing conditions.

### **3.03 PREPARATION**

- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
  - 1. Require attendance by all installers whose work will be tested, adjusted, or balanced.
- B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

### **3.04 ADJUSTMENT TOLERANCES**

- A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

### **3.05 RECORDING AND ADJUSTING**

- A. Field Logs: Maintain written logs including:
  - 1. Running log of events and issues.
  - 2. Discrepancies, deficient or uncompleted work by others.
  - 3. Contract interpretation requests.
  - 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- H. **After testing, adjusting and balancing is complete the agency shall visit the job two additional times: once during the heating season, and once during the cooling season, to make adjustments to provide uniform temperatures throughout the building. Schedule the adjustments trips during the months of December through February, when the outdoor temperature is below 40°F, for the heating season, and June through August, when the outdoor temperature is above 85°F for the cooling season. Obtain a signed statement from the Owner acknowledging the trips and subsequent adjustments. Submit a statement to the Architect.**

### **3.06 AIR SYSTEM PROCEDURE**

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.

- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds via Variable Frequency Drive (VFD) or Electronically Commutated Motor (ECM) adjustments. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries. Maintain any and all additional pressure relationships shown on the drawings.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

### **3.07 COMMISSIONING**

- A. See Sections 01 9113 - General Commissioning Requirements and 23 0800 for additional requirements.
- B. Perform prerequisites prior to starting commissioning activities.
- C. Fill out Prefunctional Checklists for:
  - 1. Air side systems.
  - 2. Water side systems.
- D. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.
- E. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 25% percent of the air handlers plus a random sample equivalent to 10% percent of the final TAB report data as directed by Commissioning Authority.
  - 1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
  - 2. Use the same test instruments as used in the original TAB work.
  - 3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
  - 4. For purposes of re-check, failure is defined as follows:
    - a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
    - b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control,

- deviation of more than 30 percent at intermediate supply flow.
- c. Temperatures: Deviation of more than one degree F (0.5 degree C).
- d. Air Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
- e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.
- 5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.
- F. In the presence of the Commissioning Authority, verify that:
  - 1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
  - 2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.

### 3.08 SCOPE

- A. Test, adjust, and balance the following:
  - 1. Air Cooled Refrigerant Condensers.
  - 2. Packaged Heating/Cooling Units
  - 3. Dryer Exhaust Systems.
  - 4. Gas-Fired Infrared Heaters
  - 5. Air Handling Units, including Fan Coil Units.
  - 6. Fans.
  - 7. Air Filters.
  - 8. Air Terminal Units.
  - 9. Air Inlets and Outlets.

### 3.09 MINIMUM DATA TO BE REPORTED

- A. Electric Motors:
  - 1. Manufacturer.
  - 2. Model/Frame.
  - 3. HP/BHP.
  - 4. Phase, voltage, amperage; nameplate, actual, no load.
  - 5. RPM.
  - 6. Service factor.
- B. V-Belt Drives:
  - 1. Identification/location.
  - 2. Required driven RPM.
  - 3. Belt, size and quantity.
  - 4. Motor sheave diameter and RPM.
- C. Combustion Equipment:
  - 1. Manufacturer.
  - 2. Model number.
  - 3. Serial number.
  - 4. Firing rate.
  - 5. Overfire draft.
  - 6. Gas pressure at meter outlet.
  - 7. Gas flow rate.

8. Heat input.
  9. Burner manifold gas pressure.
  10. Percent carbon monoxide (CO).
  11. Percent carbon dioxide (CO<sub>2</sub>).
  12. Percent oxygen (O<sub>2</sub>).
  13. Percent excess air.
  14. Flue gas temperature at outlet.
  15. Ambient temperature.
  16. Net stack temperature.
  17. Percent stack loss.
  18. Percent combustion efficiency.
  19. Heat output.
- D. Air Cooled Condensers:
1. Identification/number.
  2. Location.
  3. Manufacturer.
  4. Model number.
  5. Serial number.
  6. Entering DB air temperature, design and actual.
  7. Leaving DB air temperature, design and actual.
  8. Number of compressors.
- E. Cooling Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.
  6. Entering air DB temperature, design and actual.
  7. Entering air WB temperature, design and actual.
  8. Leaving air DB temperature, design and actual.
  9. Leaving air WB temperature, design and actual.
  10. Saturated suction temperature, design and actual.
  11. Air pressure drop, design and actual.
- F. Heating Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.
  6. Entering air temperature, design and actual.
  7. Leaving air temperature, design and actual.
  8. Air pressure drop, design and actual.
- G. Hot Gas Reheat Coils:
1. Identification/number.
  2. Location.
  3. Service.
  4. Manufacturer.
  5. Air flow, design and actual.
  6. Entering air temperature, design and actual.
  7. Leaving air temperature, design and actual.
  8. Air pressure drop, design and actual.



- H. Electric Duct Heaters:
  - 1. Manufacturer.
  - 2. Identification/number.
  - 3. Location.
  - 4. Model number.
  - 5. Design kW.
  - 6. Number of stages.
  - 7. Phase, voltage, amperage.
  - 8. Test voltage (each phase).
  - 9. Test amperage (each phase).
  - 10. Air flow, specified and actual.
  - 11. Temperature rise, specified and actual.
- I. Air Moving Equipment:
  - 1. Location.
  - 2. Manufacturer.
  - 3. Model number.
  - 4. Serial number.
  - 5. Arrangement/Class/Discharge.
  - 6. Air flow, specified and actual.
  - 7. Return air flow, specified and actual.
  - 8. Outside air flow, specified and actual.
  - 9. Total static pressure (total external), specified and actual.
  - 10. Inlet pressure.
  - 11. Discharge pressure.
  - 12. Sheave Make/Size/Bore.
  - 13. Number of Belts/Make/Size.
  - 14. Fan RPM.
- J. Return Air/Outside Air:
  - 1. Identification/location.
  - 2. Design air flow.
  - 3. Actual air flow.
  - 4. Design return air flow.
  - 5. Actual return air flow.
  - 6. Design outside air flow.
  - 7. Actual outside air flow.
  - 8. Return air temperature.
  - 9. Outside air temperature.
  - 10. Required mixed air temperature.
  - 11. Actual mixed air temperature.
  - 12. Design outside/return air ratio.
  - 13. Actual outside/return air ratio.
- K. Exhaust Fans:
  - 1. Location.
  - 2. Manufacturer.
  - 3. Model number.
  - 4. Serial number.
  - 5. Air flow, specified and actual.
  - 6. Total static pressure (total external), specified and actual.
  - 7. Inlet pressure.
  - 8. Discharge pressure.
  - 9. Sheave Make/Size/Bore.

10. Number of Belts/Make/Size.
11. Fan RPM.
- L. Duct Traverses:
  1. System zone/branch.
  2. Duct size.
  3. Area.
  4. Design velocity.
  5. Design air flow.
  6. Test velocity.
  7. Test air flow.
  8. Duct static pressure.
  9. Air temperature.
  10. Air correction factor.
- M. Duct Leak Tests:
  1. Description of ductwork under test.
  2. Duct design operating pressure.
  3. Duct design test static pressure.
  4. Duct capacity, air flow.
  5. Maximum allowable leakage duct capacity times leak factor.
  6. Test apparatus:
    - a. Blower.
    - b. Calibrated.
  7. Test static pressure.
  8. Test orifice differential pressure.
  9. Leakage.
- N. Terminal Unit Data:
  1. Manufacturer.
  2. Type, constant, variable, single, dual duct.
  3. Identification/number.
  4. Location.
  5. Model number.
  6. Size.
  7. Minimum static pressure.
  8. Minimum design air flow.
  9. Maximum design air flow.
  10. Maximum actual air flow.
  11. Inlet static pressure.
- O. Air Distribution Tests:
  1. Air terminal number.
  2. Room number/location.
  3. Terminal type.
  4. Terminal size.
  5. Area factor.
  6. Design velocity.
  7. Design air flow.
  8. Test (final) velocity.
  9. Test (final) air flow.
  10. Percent of design air flow.
- P. Sound Level Reports:
  1. Location.
  2. Octave bands - equipment off.

3. Octave bands - equipment on.

**END OF SECTION 23 0593**

**SECTION 23 0713  
DUCT INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Duct insulation.
- B. Duct liner.
- C. Jacketing and accessories.

**1.02 SECTION DOES NOT INCLUDE**

- A. Double-walled ducts. See Section 23 3100 - HVAC Ducts and Casings for all double-walled duct construction, lining, and insulation details.

**1.03 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 8400 - Firestopping.
- C. Section 09 9113 - Exterior Painting: Painting insulation jackets.
- D. Section 09 9123 - Interior Painting: Painting insulation jackets.
- E. Section 23 0553 - Identification for HVAC Piping and Equipment.
- F. Section 23 3100 - HVAC Ducts and Casings.

**1.04 REFERENCE STANDARDS**

- A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- D. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- E. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- F. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- G. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- H. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- I. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).
- J. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2017 (Reapproved 2023).
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- M. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

- N. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- O. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 0713.1:
  - 1. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Submittal 23 0713.2:
  - 1. Shop Drawings: Provide shop drawings for all listed and labeled systems (e.g., dryer exhaust, combustion air).

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

#### **1.07 FIELD CONDITIONS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

### **PART 2 PRODUCTS**

#### **2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

#### **2.02 GLASS FIBER, FLEXIBLE**

- A. Manufacturer:
  - 1. CertainTeed Corporation: [www.certainteed.com/](http://www.certainteed.com/).
  - 2. Johns Manville: [www.jm.com/](http://www.jm.com/).
  - 3. JP Lamborn Co: [www.jpflex.com/](http://www.jpflex.com/).
  - 4. Knauf Insulation: [www.knaufinsulation.com/](http://www.knaufinsulation.com/).
  - 5. Owens Corning Corporation: [www.ocbuildingspec.com/](http://www.ocbuildingspec.com/).
  - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. K (Ksi) value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C518.
  - 2. Maximum Service Temperature: 450 degrees F (232 degrees C).
  - 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
- C. Vapor Barrier Jacket:
  - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
  - 2. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
  - 3. Secure with pressure-sensitive tape.
- D. Vapor Barrier Tape:
  - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

- F. Outdoor Vapor Barrier Mastic:
  - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- G. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter (1.29 mm diameter).

## **2.03 JACKETING AND ACCESSORIES**

- A. Aluminum Jacket:
  - 1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch (0.41 mm) with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.
  - 2. Thickness: 0.040 inch (1.00 mm) sheet.
  - 3. Finish: Smooth.
  - 4. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
  - 5. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
  - 6. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.
  - 7. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

## **2.04 DUCT LINER**

- A. Manufacturers:
  - 1. Aeroflex USA: [www.aeroflexusa.com/](http://www.aeroflexusa.com/)
  - 2. Armacell LLC: [www.armacell.us/](http://www.armacell.us/).
  - 3. CertainTeed Corporation: [www.certainteed.com/](http://www.certainteed.com/).
  - 4. Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/](http://www.ductmate.com/).
  - 5. Johns Manville: [www.jm.com/](http://www.jm.com/).
  - 6. Owens Corning Corporation: [www.ocbuildingspec.com/](http://www.ocbuildingspec.com/).
  - 7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Elastomeric Foam Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1, in sheet form.
  - 1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
  - 2. Maximum Service Temperature: 180 degrees F (82 degrees C).
  - 3. Fungal Resistance: No growth when tested according to ASTM G21.
  - 4. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F (0.045 at 24 degrees C).
  - 5. Minimum Noise Reduction Coefficients:
    - a. 1/2 inch (13 mm) Thickness: 0.30.
    - b. 1 inch (25 mm) Thickness: 0.40.
    - c. 1-1/2 inches (40 mm) Thickness: 0.50.
    - d. 2 inch (50 mm) Thickness: 0.60.
  - 6. Connection: Waterproof vapor barrier adhesive.
- C. Glass Fiber Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket, rigid board, and preformed round liner board; impregnated surface and edges coated with poly vinyl acetate polymer, acrylic polymer, or black composite.
  - 1. Fungal Resistance: No growth when tested according to ASTM G21.
  - 2. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F (0.045 at 24 degrees C).
  - 3. Service Temperature: Up to 250 degrees F (121 degrees C).
  - 4. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm (25.4 m/s), minimum.
  - 5. Minimum Noise Reduction Coefficients:
    - a. 1/2 inch (13 mm) Thickness: 0.30.
    - b. 1 inch (25 mm) Thickness: 0.45.
    - c. 1-1/2 inches (40 mm) Thickness: 0.60.
    - d. 2 inch (50 mm) Thickness: 0.70.

- D. Adhesive: Waterproof, fire-retardant type, ASTM C916.
  - 1. Manufacturers:
    - a. Design Polymeric; DP 2502 Water Based, Low VOC, Duct Liner Adhesive: [www.designpoly.com.com/](http://www.designpoly.com.com/).
    - b. Substitutions: See Section 01 6000 - Product Requirements
- E. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

## **2.05 SPECIAL APPLICATIONS**

- A. The following systems are required to use a listed and labeled duct and insulation system designed and manufactured for the specific installation:
  - 1. Type B Gas Vents: See Section 23 5100 - Breechings, Chimneys, and Stacks.
  - 2. Category II, III, and IV Gas Vents: See Section 23 5100 - Breechings, Chimneys, and Stacks.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide minimum R6 insulation for Supply duct, Return duct, and Outside Air duct in all locations unless specifically noted otherwise. Insulate Exhaust duct as indicated in these specifications and on drawings.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
  - 1. Provide insulation with vapor barrier jackets.
  - 2. Finish with tape and vapor barrier jacket.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
  - 1. Provide with or without standard vapor barrier jacket.
  - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Exterior Applications: Minimum R8 insulation. Provide insulation with vapor barrier jacket. Cover with heavy duty all-weather listed and rated aluminum jacketing system (3M VentureClad 1579GCW-E).. Rectangular and Oval Ducts shall have watershed design to prevent ponding on duct surface (flat-surface top installations on exterior are not permitted). See mechanical details on drawings.
- F. Slope exterior ductwork to shed water.
- G. External Duct Insulation Application:
  - 1. Install according to manufacturer's installation instructions for a watertight installation.
  - 2. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- H. Duct and Plenum Liner Application:
  - 1. Adhere insulation with adhesive for 90 percent coverage.
  - 2. Seal and smooth joints. Seal and coat transverse joints.
  - 3. Seal liner surface penetrations with adhesive.
  - 4. **Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.**

### 3.03 SCHEDULES

- A. Combustion Exhaust Duct: Listed and labeled combustion air system only. See Section 23 5100 - Breechings, Chimneys, and Stacks.
- B. Duct Connections to air handling equipment: Provide minimum 1" acoustical lining for at least 15'-0" downstream of the discharge from the air handling unit, and at all locations shown or called out on the drawings.
- C. Exhaust Ducts Within 10 ft (3 m) of Exterior Openings: Insulate
- D. Exhaust Ducts where located outside of building envelope: Insulate
- E. **Supply and Exhaust Ducts Serving Animal Areas:** Insulate externally and additionally provide 1" elastomeric foam rubber acoustical lining in the locations indicated above. **Glass fiber acoustical lining may not be used in Animal Area ductwork.**
- F. Outside Air Ducts: Insulate.
- G. Supply Ducts: Insulate.
- H. Return Ducts: Insulate.
- I. Air Transfer Ducts: Provide 2" acoustical lining for entire length of duct for Air Transfer ducts serving sound-sensitive areas (e.g., Conference rooms, Animal areas, etc.), provide no lining for industrial areas (e.g., Sally Port, Laundry, etc.), and provide 1" acoustical lining for all other areas.
- J. Ducts Exposed to potential damage or high traffic areas: Double-walled Construction.

**END OF SECTION 23 0713**



**SECTION 23 0719  
HVAC PIPING INSULATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Flexible elastomeric cellular insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.
- E. Engineered wall outlet seals and refrigerant piping insulation protection.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 07 8400 - Firestopping.
- C. Section 09 9123 - Interior Painting: Painting insulation jacket.
- D. Section 23 2300 - Refrigerant Piping: Placement of inserts.

**1.03 REFERENCE STANDARDS**

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- D. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- G. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- H. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 0719.1:
  - 1. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
  - 2. Shop Drawings: Provide shop drawings for exterior piping protective cover systems, wall penetration assemblies, and sizes.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

**1.06 FIELD CONDITIONS**

- A. Maintain ambient conditions required by manufacturers of each product.

- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

## **PART 2 PRODUCTS**

### **2.01 REGULATORY REQUIREMENTS**

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

### **2.02 FLEXIBLE ELASTOMERIC CELLULAR INSULATION**

- A. Manufacturers:
1. Aeroflex USA, Inc; AEROFLEX Self-Seal: [www.aeroflexusa.com/](http://www.aeroflexusa.com/)
  2. Armacell LLC; ArmaFlex Ultra with FlameDefense: [www.armacell.us/](http://www.armacell.us/)
  3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation: Preformed flexible elastomeric cellular rubber insulation complying with ASTM C534/C534M Grade 1; use molded tubular material wherever possible.
1. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
  2. Maximum Service Temperature: 180 degrees F (82 degrees C).
  3. Connection: Waterproof vapor barrier adhesive.

### **2.03 WEATHER BARRIER COATINGS**

- A. Weather-Resistive Barrier Coating: Fire-resistive, UV resistant, water-based mastic for use over closed cell polyethylene and polyurethane foam insulation; applied with glass fiber or synthetic reinforcing mesh.
1. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
  2. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.

### **2.04 JACKETING AND ACCESSORIES**

- A. PVC Plastic.
1. Manufacturers:
    - a. Johns Manville Corporation; \_\_\_\_\_: [www.jm.com/](http://www.jm.com/)
  2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
    - a. Minimum Service Temperature: 0 degrees F (minus 18 degrees C).
    - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
    - c. Moisture Vapor Permeability: 0.002 perm inch (0.0029 ng/(Pa s m)), maximum, when tested in accordance with ASTM E96/E96M.
    - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
    - e. Connections: Brush on welding adhesive.

### **2.05 ENGINEERED WALL OUTLET SEALS AND REFRIGERANT PIPING INSULATION PROTECTION**

- A. Manufacturers:
1. Airex Manufacturing, Inc: [www.airexmf.com/](http://www.airexmf.com/)
  2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Pipe Penetration Wall Seal: Seals HVAC piping wall penetrations with compression gasket wall mounted rigid plastic outlet cover.
1. Outlet Cover Color: Coordinate with exterior wall color.
- C. Insulation Protection System: Refrigerant piping insulation PVC protective cover.
1. PVC Insulation Cover Color: Black with full-length velcro fastener.
  2. Weatherization and Ultraviolet Exposure Protection: Comply with ASTM G153.
  3. Water/Vapor Permeability: Comply with ASTM E96/E96M.
  4. Anti-Fungal and Anti-Microbial Resistance: Comply with ASTM G21.
  5. Flame Spread and Smoke Development Rating of 24/450: Comply with ASTM E84 or UL 723.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated Pipes Conveying Fluids Below Ambient Temperature:
  - 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- D. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.
- E. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet (3 meters) above finished floor): Finish with canvas jacket sized for finish painting.
- F. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.

#### **3.03 SCHEDULE**

- A. Cooling Systems:
  - 1. Refrigerant Suction: Insulate with elastomeric closed-cell foam, paint with UV-resistant paint, and install with rigid aluminum or PVC weatherproof jacketing.
  - 2. Refrigerant Hot Gas: Insulate with elastomeric closed-cell foam, paint with UV-resistant paint, and install with rigid aluminum or PVC weatherproof jacketing.

**END OF SECTION 23 0719**

**SECTION 23 0800  
COMMISSIONING OF HVAC**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. See Section 01 9113 - General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 9113.
- B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.
- C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Prefunctional Checklists and Functional Test Procedures for Contractor's use.
- D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
  - 1. Control system.
  - 2. All major and minor equipment items.
  - 3. Ductwork and accessories.
  - 4. Terminal units.
  - 5. Sound control devices (e.g. acoustical packed unit curbs).
  - 6. Variable frequency drives.
  - 7. UL-listed Dryer Exhaust Systems
  - 8. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
- E. The Prefunctional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 7800 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
- B. Section 23 0593 - Testing, Adjusting, and Balancing for HVAC.
- C. Section 23 0923 - Direct-Digital Control System for HVAC.
- D. Section 23 0993 - Sequence of Operations for HVAC Controls.

**1.03 REFERENCE STANDARDS**

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).

**1.04 SUBMITTALS**

- A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup; revise and resubmit when substantial changes are made.
- B. Submittal 23 0800.1:
  - 1. Draft Prefunctional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
    - a. System name.
    - b. List of devices.
    - c. Step-by-step procedures for testing each controller after installation, including:
      - 1) Process of verifying proper hardware and wiring installation.

- 2) Process of downloading programs to local controllers and verifying that they are addressed correctly.
  - 3) Process of performing operational checks of each controlled component.
  - 4) Plan and process for calibrating valve and damper actuators and all sensors.
  - 5) Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
  - d. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during calibration of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
  - e. Description of the instrumentation required for testing.
  - f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
- C. Submittal 23 0800.2:
1. Startup Reports, Prefunctional Checklists, and Trend Logs: Submit for approval of Commissioning Authority.
- D. Submittal 23 0800.3:
1. HVAC Control System O&M Manual Requirements. In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
    - a. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
    - b. Full as-built set of control drawings.
    - c. Full as-built sequence of operations for each piece of equipment.
    - d. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
      - 1) Floor.
      - 2) Room number.
      - 3) Room name.
      - 4) Air handler unit ID.
      - 5) Reference drawing number.
      - 6) Air terminal unit tag ID.
      - 7) Heating and/or cooling valve tag ID.
      - 8) Minimum air flow rate.
      - 9) Maximum air flow rate.
    - e. Full print out of all schedules and set points after testing and acceptance of the system.
    - f. Full as-built print out of software program.
    - g. Electronic copy on disk of the entire program for this facility.
    - h. Marking of all system sensors and thermostats on the as-built floor plan and HVAC drawings with their control system designations.
    - i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
    - j. Control equipment component submittals, parts lists, etc.
    - k. Warranty requirements.
    - l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
    - m. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
      - 1) Sequences of operation.

- 2) Control drawings.
  - 3) Points lists.
  - 4) Controller and/or module data.
  - 5) Thermostats and timers.
  - 6) Sensors and DP switches.
  - 7) Valves and valve actuators.
  - 8) Dampers and damper actuators.
  - 9) Program setups (software program printouts).
- E. Submittal 23 0800.4:
1. Project Record Documents: See Section 01 7800 for additional requirements.
    - a. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
    - b. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and air-flow stations on project record drawings.
- F. Submittal 23 0800.5:
1. Draft Training Plan: In addition to requirements specified in Section 01 7900, include:
    - a. Follow the recommendations of ASHRAE Guideline 1.1.
    - b. Control system manufacturer's recommended training.
    - c. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.
- G. Training Manuals: See Section 01 7900 for additional requirements.
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

## **PART 2 PRODUCTS**

### **2.01 TEST EQUIPMENT**

- A. Provide all standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Cooperate with the Commissioning Authority in development of the Prefunctional Checklists and Functional Test Procedures.
- B. Furnish additional information requested by the Commissioning Authority.
- C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
- D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
- E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.

- F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.
- G. Provide temperature and pressure taps in accordance with Contract Documents.

### **3.02 INSPECTING AND TESTING - GENERAL**

- A. Submit startup plans, startup reports, and Prefunctional Checklists for each item of equipment or other assembly to be commissioned.
- B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.
- C. Provide two-way radios for use during the testing.
- D. Valve/Damper Stroke Setup and Check:
  - 1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
  - 2. Set pump/fan to normal operating mode.
  - 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
  - 4. Command valve/damper open; verify position is full open and adjust output signal as required.
  - 5. Command valve/damper to a few intermediate positions.
  - 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- E. Isolation Valve or System Valve Leak Check: For valves not by coils.
  - 1. With full pressure in the system, command valve closed.
  - 2. Use an ultra-sonic flow meter to detect flow or leakage.
- F. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

### **3.03 TAB COORDINATION**

- A. TAB: Testing, adjusting, and balancing of HVAC.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
- D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.
- E. Have all required Prefunctional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate the controls to assist the TAB technicians or provide sufficient training for the TAB technicians to operate the system without assistance.

### **3.04 CONTROL SYSTEM FUNCTIONAL TESTING**

- A. Prefunctional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of Contract Documents and the detailed Sequences of Operation documentation submittal.
- B. Do not start Functional Testing until all controlled components have themselves been successfully Functionally Tested in accordance with Contract Documents.
- C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.

- D. Functional Testing of the control system constitutes demonstration and trend logging of control points monitored by the control system.
  - 1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
  - 2. Perform all trend logging specified in Prefunctional Checklists and Functional Test procedures.
- E. Functionally Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
- F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
  - 1. Setpoint changing features and functions.
  - 2. Sensor calibrations.
- G. Demonstrate to the Commissioning Authority:
  - 1. That all specified functions and features are set up, debugged and fully operable.
  - 2. That scheduling features are fully functional and setup, including holidays.
  - 3. That all graphic screens and value readouts are completed.
  - 4. Correct date and time setting in central computer.
  - 5. That field panels read the same time as the central computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
  - 6. Functionality of field panels using local operator keypads and local ports (plug-ins) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail, test all remaining units at no extra cost to Owner.
  - 7. Power failure and battery backup and power-up restart functions.
  - 8. Global commands features.
  - 9. Security and access codes.
  - 10. Occupant over-rides (manual, telephone, key, keypad, etc.).
  - 11. O&M schedules and alarms.
  - 12. Occupancy sensors and controls.
  - 13. All control strategies and sequences not tested during controlled equipment testing.
- H. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

### **3.05 OPERATION AND MAINTENANCE MANUALS**

- A. See Section 01 7800 for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

### **3.06 DEMONSTRATION AND TRAINING**

- A. See Section 01 7900 for additional requirements.
- B. Demonstrate operation and maintenance of HVAC system to Owner' personnel; if during any demonstration, the system fails to perform in accordance with the information included in the



O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.

- C. These demonstrations are in addition to, and not a substitute for, Prefunctional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
- D. Provide classroom and hands-on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and all equipment items indicated to be commissioned. Provide the following minimum durations of training:
- E. TAB Review: Instruct Owner's personnel for minimum 2 hours, after completion of TAB, on the following:
  - 1. Review final TAB report, explaining the layout and meanings of each data type.
  - 2. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.
  - 3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
  - 4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
  - 5. Other salient information that may be useful for facility operations, relative to TAB.
- F. HVAC Control System Training: Perform training in at least three phases:
  - 1. Phase 1 - Basic Control System: Provide minimum of 6 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
    - a. This training may be held on-site or at the manufacturer's facility.
    - b. If held off-site, the training may occur prior to final completion of the system installation.
    - c. For off-site training, Contractor shall pay expenses of up to two attendees.
  - 2. Phase 2 - Integrating with HVAC Systems: Provide minimum of 6 hours of on-site, hands-on training after completion of Functional Testing. Include instruction on:
    - a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
    - b. Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
    - c. Trend logging and monitoring features (values, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
    - d. Every display screen, allowing time for questions.
    - e. Point database entry and modifications.
  - 3. Phase 3 - Post-Occupancy: Six months after occupancy conduct minimum of 8 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.
- G. Provide the services of manufacturer representatives to assist instructors where necessary.
- H. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

**END OF SECTION 23 0800**

**SECTION 23 0913  
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Control panels.
- B. Dampers.
- C. Damper Operators:
  - 1. Electric operators.
  - 2. Inlet vane operators.
- D. Humidistats:
  - 1. Room humidistats.
- E. Wall-, Surface-, and Duct-Mounted Sensors:
  - 1. Temperature sensors.
  - 2. Humidity sensors.
  - 3. Room pressure monitors.
  - 4. Static air pressure sensors.
- F. Thermostats:
  - 1. Line voltage thermostats.
  - 2. Room-mount thermostat accessories.
  - 3. Outdoor-reset thermostats.
- G. Time switches.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 3300 - Air Duct Accessories.
- B. Section 25 3513 - Integrated Automation Actuators and Operators.
- C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- D. Section 26 2726 - Wiring Devices: Elevation of exposed components.

**1.03 REFERENCE STANDARDS**

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- C. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- D. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.
- E. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide description and engineering data for each control system component. Include sizing as requested. Provide data for each system component and software module.
- C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Submit schedule of valves indicating size, flow, and pressure drop for each valve. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
- D. Manufacturer's Instructions: Provide for all manufactured components.
- E. Project Record Documents: Record actual location of control components, including panels, thermostats, and sensors.

- F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out 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 documented experience.

## **PART 2 PRODUCTS**

### **2.01 EQUIPMENT - GENERAL**

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

### **2.02 CONTROL PANELS**

- A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face.
- B. NEMA 250, general purpose utility enclosures with enameled finished face panel.
- C. Provide common keying for all panels.

### **2.03 DAMPER OPERATORS**

- A. General:
1. Provide actuators with torque capacity sized for minimum of 20 percent greater than maximum design stream velocity and hold tight seal against maximum system pressures.
  2. Provide spring return for two position control and for fail safe operation.
  3. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
  4. Provide one operator for maximum 36 sq ft (3.34 sq m) damper section.
  5. See Section 25 3513 for field-mount damper actuators and operators.
- B. Electric Operators:
1. Manufacturers:
    - a. Honeywell International, Inc: [buildingcontrols.honeywell.com/](http://buildingcontrols.honeywell.com/)
    - b. Johnson Controls International, PLC: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
    - c. Schneider Electric: [www.schneider-electric.us/](http://www.schneider-electric.us/)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- C. Inlet Vane Operators:
1. High pressure with pilot positioners and sufficient force to move vanes when fan is started with vanes in closed position. Return vane operator to closed position on fan shutdown.

### **2.04 HUMIDISTATS**

- A. Room Humidistats:
1. Manufacturers:
    - a. Honeywell International, Inc; \_\_\_\_\_: [buildingcontrols.honeywell.com/](http://buildingcontrols.honeywell.com/)
    - b. Johnson Controls International, PLC; \_\_\_\_\_: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
    - c. Siemens Industry, Inc: [www.siemens.com/](http://www.siemens.com/)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Wall mounted, proportioning type.
  3. Throttling Range: Adjustable 2 percent relative humidity.
  4. Operating Range: 30 to 80 percent.

### **2.05 WALL-, SURFACE-, AND DUCT-MOUNT SENSORS**

- A. Temperature Sensors:
1. Manufacturers:
    - a. Dwyer Instruments Inc: [www.dwyer-inst.com/](http://www.dwyer-inst.com/)
    - b. Johnson Controls International, PLC: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)

2. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy.
  3. Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F (26 degrees C).
  4. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
  5. Temperature Sensing Device: Compatible with project DDC controllers.
  6. Performance Characteristics:
    - a. RTD:
      - 1) Room Sensor Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
      - 2) Duct Averaging Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
      - 3) Chilled Water Accuracy: Plus/minus 0.50 degrees F (0.28 degrees C) minimum.
      - 4) All Other Accuracy: Plus/minus 0.75 degrees F (0.42 degrees C) minimum.
      - 5) Range: Minus 40 degrees F (Minus 40 degrees C) through 220 degrees F (104.4 degrees C) minimum.
    - b. Room Sensors: Locking cover matching the pneumatic thermostats used.
    - c. Room Temperature Sensors with Integral Digital Display:
      - 1) Provide a physical or touchscreen keypad with the following capabilities:
        - (a) Indication of space and outdoor temperatures.
        - (b) Setpoint adjustment to accommodate room setpoint, DDC Input/Output Points List, and Sequence of Operation.
        - (c) Display fan operation status.
        - (d) Manual occupancy override and indication of occupancy status.
        - (e) Controller mode status.
        - (f) Password enabled setpoint and override modes.
- B. Humidity Sensors, Duct-Mounted:
1. Manufacturers:
    - a. Dwyer Instruments Inc: [www.dwyer-inst.com/](http://www.dwyer-inst.com/)
    - b. Johnson Controls International, PLC: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
    - c. Substitutions: See Section 01 6000 - Product Requirements.
  2. Digitally profiled thin-film capacitive sensor probe extended from die-cast metal, weather-proof plastic or metal housing designed for duct mounting.
  3. Measuring Scale: 0 to 100 percent RH, noncondensing, temperature compensated.
  4. Hardwired Output: Two-wire, 4 to 20 mA, loop powered.
  5. Accuracy: Plus/minus 1 percent between 20 to 40 percent RH linear range, NIST traceable with multi-point calibration.
- C. Humidity Transmitters, Surface-Mounted:
1. Manufacturers:
    - a. Honeywell International, Inc: [buildingcontrols.honeywell.com/](http://buildingcontrols.honeywell.com/)
    - b. Substitutions: See Section 01 6000 - Product Requirements.
  2. Plastic housing encased, wall-mounted, humidity and temperature indicating sensor.
  3. Humidity Sensor Type: Thin-film capacitive.
  4. Accuracy: 1 percent at rated measuring scale and capable of withstanding 95 percent relative humidity without loss of calibration.
  5. Output: Two-wire, 4 to 20 mA, 0 to 5 VDC or 0 to 10 VDC, non-loop powered, selectable.
- D. Room Pressure Monitors:
1. Manufacturers:
    - a. Dwyer Instruments Inc: [www.dwyer-inst.com/](http://www.dwyer-inst.com/)
    - b. Ebtron, Inc: [www.ebtron.com/](http://www.ebtron.com/)
    - c. Setra Systems, Inc: [www.setra.com/](http://www.setra.com/)
    - d. Substitutions: See Section 01 6000 - Product Requirements.

2. Transmitter: Five percent accuracy, adjustable zero and span, 100 to 1 turndown, 0.1 percent of calibrated span linearity, 30 to 50 millisecond response time, minimum overpressure of 150 percent over highest range value, alphanumeric indicating display, wired or wireless connectivity for configuration, and terminal strip within enclosed electronic components.
- E. Static-Air Pressure Sensors:
  1. Manufacturers:
    - a. Johnson Controls International, PLC: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
    - b. Substitutions: See Section 01 6000 - Product Requirements.
  2. Unidirectional with ranges not exceeding 150 percent of maximum expected input.
  3. Temperature compensate with typical thermal error or 0.06 percent of full scale in temperature range of 40 to 100 degrees F (5 to 40 degrees C).
  4. Accuracy: One percent of full scale with repeatability 0.3 percent.
  5. Output: 0 to 5 vdc with power at 12 to 28 vdc.

## 2.06 THERMOSTATS

- A. Line Voltage Thermostats:
  1. Manufacturers:
    - a. Honeywell International, Inc: [buildingcontrols.honeywell.com/](http://buildingcontrols.honeywell.com/)
    - b. Johnson Controls International, PLC: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
    - c. Siemens Industry, Inc: [www.siemens.com/](http://www.siemens.com/)
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  2. Dead Band: Maximum 2 degrees F (one degree C).
  3. Cover: Locking with set point adjustment, with thermometer.
  4. Rating: Motor load.
- B. Room-Mounted Thermostat Accessories:
  1. Insulating Bases: For thermostats located on exterior walls.

## 2.07 TIME SWITCHES

- A. Manufacturers:
  1. Intermatic, Inc: [www.intermatic.com/](http://www.intermatic.com/)
  2. Tork, a division of NSI Industries LLC: [www.nsiindustries.com/](http://www.nsiindustries.com/)
  3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Digital Electronic Time Switches:
  1. Description: Factory-assembled, solid-state programmable controller with LCD display, listed and labeled as complying with UL 916 or UL 917.
  2. Program Capability:
  3. Schedule Capacity: Not less than 16 programmable on/off operations.
  4. Provide automatic daylight savings time and leap year compensation.
  5. Provide power outage backup to retain programming and maintain clock.
  6. Manual Override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.
  7. Input Supply Voltage: As indicated on the drawings.
  8. Provide lockable enclosure; environmental type complying with NEMA 250 as specified for the following installation locations:

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that systems are ready to receive work.
- B. Beginning of installation means installer accepts existing conditions.
- C. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.

- D. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.
- E. Ensure installation of components is complementary to installation of similar components.
- F. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of thermostats with plans and room details before installation. Locate 60 inches (1500 mm) above floor unless specifically indicated otherwise on drawings. Align with lighting switches and humidistats per drawing details; see Section 26 2726.
- C. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- D. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- E. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

**END OF SECTION 23 0913**

**SECTION 23 0923**  
**DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC**

**PART 1 GENERAL**

**1.01 RELATED REQUIREMENTS**

- A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- B. Section 23 0993 - Sequence of Operations for HVAC Controls.
- C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.02 REFERENCE STANDARDS**

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
- B. ASHRAE Std 147 - Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems; 2019, with Addendum (2024).
- C. Bluetooth CS - Bluetooth Core Specification; 2016, Addendum 2017.
- D. CTA-709.1 - Control Network Protocol Specification; 2019.
- E. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2020 (Corrigendum 2022).
- F. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks; 2024.
- G. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2019h.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL (DIR) - Online Certifications Directory; Current Edition.

**1.03 ADMINISTRATIVE REQUIREMENTS**

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

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 0923.1:
  - 1. Product Data: Provide data for each system component and software module.
  - 2. Shop Drawings:
    - a. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
    - b. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
    - c. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
    - d. Indicate description and sequence of operation of operating, user, and application software.
  - 3. Manufacturer's Instructions: Indicate manufacturer's installation instructions for all manufactured components.
  - 4. Designer's Qualification Statement.
  - 5. Manufacturer's Qualification Statement.
  - 6. Installer's Qualification Statement.
- C. Submittal 23 0923.2:

1. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors.
  - a. Revise shop drawings to reflect actual installation and operating sequences.
  - b. Include submittals data in final "Record Documents" form.
  - c. Startup Testing Report (See PART 3 - EXECUTION for startup testing details)
  - d. Performance Verification Testing Report (See PART 3 - EXECUTION for performance verification details)
- D. Submittal 23 0923.3:
  1. Operation and Maintenance Data:
    - a. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
    - b. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
    - c. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
    - d. Include all other information common to the entire system. This shall include, but not be limited to, the following:
      - 1) Product manuals for the key software tasks.
      - 2) Operating the system.
      - 3) Administrating the system.
      - 4) Engineering the operator workstation.
      - 5) Application programming.
      - 6) Engineering the network.
      - 7) Setting up the web server.
      - 8) Report creation.
      - 9) Graphics creation.
      - 10) All other engineering tasks.
      - 11) System Architecture Diagram.
      - 12) List of recommended maintenance tasks associated with the system servers, operator workstations, data servers, web servers and web clients.
      - 13) Define a task.
      - 14) Recommend a frequency for the task.
      - 15) Reference the product manual that includes instructions on executing the task.
      - 16) Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.
      - 17) Licenses, guarantees, and warranty documents for equipment and systems.
    - e. Provide additional information common to the systems in a single building, including, but not limited to, the following:
      - 1) System architecture diagram for components within the building annotated with specific location information.
      - 2) As-built drawing for each control panel.
      - 3) As-built wiring design diagram for all components.
      - 4) Installation design details for each I/O device.
      - 5) As-built system flow diagram for each system.
      - 6) Sequence of control for each system.
      - 7) Binding map for the building.
      - 8) Product data sheet for each component.
      - 9) Installation data sheet for each component.
  2. Software Submittals: All software revisions shall be as installed at the time of the system acceptance. Provide the following software submittals:
    - a. Submit a copy of all software installed on the servers and workstations.
    - b. Submit all licensing information for all software installed on the servers and workstations.



- c. Submit a copy of all software used to execute the project even if the software was not installed on the servers and workstations.
  - d. Submit all licensing information for all of the software used to execute the project.
  - e. All software revisions shall be as installed at the time of the system acceptance.
  - f. Submit a copy of all firmware files that were downloaded to or pre-installed on any devices installed as part of this project. This does not apply to firmware that is permanently burned on a chip at the factory and can only be replaced by replacing the chip.
  - g. Submit a copy of all application files that were created during the execution of the project.
  - h. Submit a copy of all graphic page files created during the execution of the project.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

#### 1.05 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Designer Qualifications: Perform design of system using manufacturer's software under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience and approved by manufacturer.
  - 1. Installer shall have a full service facility within 100 miles of the project that is staffed with engineers trained and certified by the manufacturer in the configuration, programming and service of the automation system. The installer's technicians shall be fully capable of providing instructions and routine emergency maintenance service on all system components.
- E. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

#### 1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Substantial Completion.
- C. Provide five year manufacturer's warranty for field programmable micro-processor based units.

#### 1.07 PROTECTION OF SOFTWARE RIGHTS

- A. The Owner shall retain permanent licenses to software for this project.
- B. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement. Such license shall grant use of all programs and application software to the Owner as defined by the manufacturer's license agreement, but shall protect the manufacturer's rights to disclosure of Trade Secrets contained within such software. **The licensing agreement shall not preclude the use of the software by individuals under contract to the owner for commissioning, servicing or altering the system in the future.** Use of the software by individuals under contract to the owner shall be restricted to use on the owner's computers and only for the purpose of commissioning, servicing, or altering the installed system.
- C. All project developed software, files and documentation shall become the property of the Owner. These include but are not limited to:
  - 1. Server and workstation software
  - 2. Application programming tools
  - 3. Configuration tools
  - 4. Network diagnostic tools

5. Addressing tools
6. Application files
7. Configuration files
8. Graphic files
9. Report files
10. Graphic symbol libraries
11. All documentation

## **PART 2 PRODUCTS**

### **2.01 SYSTEM DESCRIPTION**

- A. The Building Automation System (BAS) shall consist of Network Server/Controllers (NSCs), a family of Standalone Digital Control Units (SDCUs), Administration and Programming Workstations (APWs), and Web-based Operator Workstations (WOWs). The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire facility, and Wide Area Network (WAN) if applicable.
  1. Modbus RTU/ASCII (and J-bus), Modbus TCP, BACnet MS/TP, BACnet IP, LonTalk FTT-10A, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow all three protocols to be natively supported.
  2. A sub-network of SDCUs using the BACnet MS/TP protocol shall connect the local, stand-alone controllers with Ethernet-level Network Server Controllers/IP Routers.
  3. All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of an existing or new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.
- B. System Expansion:
  1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
  2. Web-based operation shall be supported directly by the NSCs and require no additional software.
  3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.
  4. The system shall be able to operate normally and without restriction at multiple software version levels with the only requirement that each element of the hierarchy be at least as new a version as the newest version in the level below it. In other words, Enterprise Servers will be able to manage NSCs of different version provided that the Enterprise Server was the same or more recent version than the most recent NSC version.
- C. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.
- D. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- E. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- F. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.

- G. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- H. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

## **2.02 OPERATOR INTERFACE**

- A. User Access and Permissions:
  - 1. The BMS system shall allow for creation of one account per user.
  - 2. The BMS shall support Groups where User Accounts associated with the group can inherit group permissions.
  - 3. The BMS shall be able to specify each user account / group accessibility to each object in the system.
  - 4. This username/password combination shall be linked to a set of capabilities within the software, set and editable only by user with system administrator privileges. The sets of capabilities shall include: edit or View only, Acknowledge alarms, Enable/disable Program and change values.
  - 5. The system shall allow the above capabilities to be applied independently to each and every class of object in the system.
  - 6. The BMS shall support configurable reminder for "Days until password expires".
  - 7. The BMS shall support configurable password policy across:
    - a. Minimum number of characters
    - b. Minimum number of lowercase characters
    - c. Minimum number of numeric characters
    - d. Minimum number of special characters
    - e. Number of consecutive unique passwords before reuse
    - f. No more than three repeating identical characters
  - 8. The BMS user account management shall support password policy with the following components:
    - a. Mandatory change of password at first logon with default credentials
    - b. Disabling of all imported user accounts by default
    - c. Custom password complexity rules and its enforcement
    - d. Custom password reuse and its enforcement
    - e. Configurable black listing of passwords to limit the use of common known passwords (e.g. password)
    - f. Password aging rules
  - 9. The BMS shall be capable of enabling an anonymous access (guest account) to previously engineered views such as dashboards, graphics, etc. with configurable permissions and without username or password.
  - 10. It shall be possible to configure the BMS system so that the guest account is used by default to simplify presentation of Kiosk Mode across multiple screens
  - 11. The BMS shall provide time configurability to logout the user and to revert to a preconfigured presentation view, such as offered by the Guest account functionality.
  - 12. The BMS shall provide configurability in managing access and permission levels based on location, IP addresses and address ranges, Schedule and Time of day and combination thereof.
- B. System Security
  - 1. The BMS system supplier The BMS vendor shall be certified to Security Development Lifecycle process that is certified to IEC 62443-4-1 by a reputable third party independent lab.
  - 2. The BMS system supplier shall be subjected to regular and verifiable best practice cyber security testing by the system supplier. Results of this testing shall be made available upon request prior to deployment of the system.

3. The BMS system supplier shall provide cyber security service incident escalation through help desk on a 7/24/365 basis.
4. The BMS shall support configuration for inactivity auto log-off of logged clients
5. The BMS system shall support Self-Signed Certificates, Default Certificates and/or Certification Authority (CA) certificates.
6. The BMS client communications (web access or rich client access) shall support TLS 1.2 encryption or higher
7. The BMS shall allow configuration in disabling all devices and software that support HTTP and require access via HTTPS.
8. The BMS must be able to Alarm or generate notification on failed access attempts
9. The BMS Servers shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks
10. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
11. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.
12. The BMS shall have the capability to use blacklisted and whitelisted IPs/MAC addresses to gate access
13. The BMS shall have the capability to differentiate, limit, or enable user access depending on Client's IP address/range (where) and time of day (when) the user is accessing the system.

C. Alarm Management

1. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels.
2. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
3. It shall be possible for the user to sort, filter and search on any available criteria such as priority, category, origin, alarm type, etc.
4. An active alarm viewer shall be included which can be customized for each user or user type to a hide or display any alarm attributes.
5. It shall be possible to present alarms with configurable colors based on priority, category, origin, alarm type, etc.
6. It shall be possible to linking files/documents/hyperlinks/navigation links/graphics link to an alarm for easy access upon occurrence
7. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
8. Alarm notifications must support multiple distribution methods within one notification
9. On alarm, it shall be possible to notify via email to a preconfigured list of recipients . through a Simple Mail Transfer Protocol (SMTP) or secure email using Simple Mail Transfer Protocol Secure (SMTPS). No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
10. On alarm, it shall be possible to notify via SNMP
11. On alarm, it shall be possible to notify via file (on disk) that would be consumable by other alarm management services
12. An operator shall have the capability to assign an alarm to another user of the system.
13. Individual alarms shall be able to be assigned to a user automatically via a preconfigured list of users and date/time. For example, a critical high temp alarm can be configured to be assigned to a Facilities Dept or to a Central Alarming workstation depending on time/date.
14. Playing an audible sound on alarm initiation or return to normal.
15. It shall be possible to assign a custom audio sound to each alarm / alarm-criteria (e.g., priority, category, origin, alarm type, etc.)

16. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.
  17. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
  18. The alarm viewer can be configured to auto hide alarms when triggered.
  19. An operator shall have the capability to save and apply alarm favorites.
  20. Alarms shall be configurable such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
  21. Alarms shall be configurable such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
  22. It shall be possible to configure user-actions via user/group permissions when responding to an alarm
  23. All operator actions responding to an alarm must be audit trailed.
- D. PC Based Work Station:
1. The BAS system supplier shall furnish licenses for web connection to the BAS system. Web-based users shall have access to all system points and graphics, shall be able to receive and acknowledge alarms, and shall be able to control setpoints and other parameters. All engineering work, such as trends, reports, graphics, etc. that are accomplished from the WorkStation shall be available for viewing through the web browser interface without additional changes. The web-based interface must conform to the B-OWS BACnet device profile. There will be no need for any additional computer based hardware to support the web-based user interface.
  2. Resides on high speed network with building controllers.
  3. Connected to server for full access to all system information.
  4. Shall have a graphical, web-based operator interface that allows for instant access to any system through a standard browser.
  5. Allows for future expansion of both input/output points and processing/control functions.
- E. Administration and Programming Workstation(s):
1. The BAS system supplier shall include Operation software and architecture required. These workstations must be running the standard workstation software developed and tested by the manufacturer of the network server controllers and the standalone controllers. No third party front-end workstation software will be acceptable. Workstations must conform to the B-OWS BACnet device profile
- F. Mobile Device Interface:
1. The BAS system supplier shall include Operation software and architecture required to provide a graphical, web-based operator interface that allows for instant access to any system through a a mobile device operating on the most current versions of both Apple iOS or Android.
- G. Workstation, controllers, and control backbone to communicate using BACnet protocol and addressing.
- H. BACnet protocol to comply with ASHRAE Std 135.
- I. Hardware:
1. Desktop:
    - a. Computer(s) and display(s) to be provided by Owner, meeting DDC Control Manufacturer's minimum requirements..
    - b. Quantity: 1.
    - c. Minimum RAM: 8GB.
    - d. Minimum Processing Speed: 3.0 GHz.
    - e. Minimum Hard Drive Memory: 20GB.
    - f. Drives: Solid State recommended..
    - g. Ports: USB 2.0 minimum..

- h. Location(s): As directed by the Owner.
- i. Network Connection:
  - 1) Ethernet interface card.
  - 2) Minimum Speed: 10/100MBPS.
- 2. Hand Held Device:
  - a. Provide remote system access via Smart Phone or Tablet with browser agnostic connectivity, including controller point monitor and control access to the following data:
    - 1) Alarm.
    - 2) Summary.
    - 3) Schedule.
    - 4) Trend.
  - b. Provide the capability to view in text list based format.
  - c. Minimum Functionality:
    - 1) Set point adjustment.
    - 2) Alarm acknowledgement.
    - 3) Scheduling.

### **2.03 ENCLOSURES**

- A. For all I/O requiring field interface devices, these devices where practical will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
- B. FIPs shall contain power supplies for sensors, interface relays and contactors, and safety circuits.
- C. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for twenty percent spare mounting space. All locks will be keyed identically.
- D. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
- E. All outside mounted enclosures shall meet the NEMA-4 rating.
- F. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

### **2.04 POWER SUPPLIES AND LINE FILTERING**

- A. Power Supplies:
  - 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
  - 2. Limit connected loads to 80 percent of rated capacity.
  - 3. Match DC power supply to current output and voltage requirements.
  - 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
  - 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
  - 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
  - 7. Operational Ambient Conditions: 32 to 120 degrees F (0 to 50 degrees C).
  - 8. EM/RF meets FCC Class B and VDE 0871 for Class B and MIL-STD-810 for shock and vibration.
  - 9. Line voltage units UL recognized and CSA approved.
- B. Power Line Filtering:
  - 1. Provide external or internal transient voltage and surge suppression component for all workstations and controllers.

2. Minimum surge protection attributes:
  - a. Dielectric strength of 1000 volts minimum.
  - b. Response time of 10 nanoseconds or less.
  - c. Transverse mode noise attenuation of 65 dB or greater.
  - d. Common mode noise attenuation of 150 dB or greater at 40 to 100 Hz.

## **2.05 CONTROLLER SOFTWARE**

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. Web-based Operator PC Requirements:
  1. Any user on the network can access the system, using the following software:
    - a. Google Chrome 71 or higher
    - b. Mozilla Firefox 64 or higher
    - c. Microsoft Edge (EdgeHTML) 17 or higher
    - d. Safari 11.4 or higher
- C. System Security:
  1. User access secured via user passwords and user names.
  2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
  3. User Log On/Log Off attempts are recorded.
  4. Automatic Log Off occurs following the last keystroke after a user defined delay time.
- D. User Interface:
  1. **FOR NEW SYSTEMS, NOT CONNECTING TO AN EXISTING ENTERPRISE SYSTEM:**  
The following guidelines are used to convey the intent of the user interface. BAS system supplier may furnish an alternate proposed interface, provided that such interface meets or exceeds these guidelines in function and purpose.
  2. The Navigation Pane shall comprise a Navigation Tree which defines a geographic hierarchy of the proposed BAS system. Navigation through the GUI shall be accomplished by clicking on appropriate level of a navigation tree (consisting of expandable and collapsible tree control like Microsoft's Explorer program), and/or by selecting dynamic links to other system graphics. Both the navigation tree and graphic pane defined under "Action Pane" below shall be displayed simultaneously, enabling the operator to select a specific system or equipment, and view the graphic corresponding to the highlighted position in the navigation tree. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
    - a. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment and BACnet objects.
    - b. Network View shall display the hierarchy of the actual BACnet IP Intranet network. This can include: Systems, Site, Networks, Routers, Half-Routers, Devices, Equipment and all the BACnet Objects in a device.
    - c. Groups View shall display Scheduled Groups and custom reports.
    - d. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
  3. Action Pane:
    - a. The Action Pane shall provide several functional views for each HVAC or mechanical/electrical subsystem specified. By clicking on a button, an operator shall be able to select the following system page, corresponding to the highlighted area/equipment in the navigation tree.
      - 1) Graphics: Using animated gifs or other graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floor-plans, equipment drawings of each individual piece of equipment with live variable statuses, active graphic setpoint controls, web content, and other valid HTML elements. The data on each graphic page shall automatically refresh at a rate defined by the operator.

- 2) Properties: Shall include graphic controls and text for the following: Locking or overriding BACnet objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress a 'accept/cancel' button.
  - 3) Schedules: Shall be used to create, modify/edit and view schedules based on the systems geographical hierarchy (using the navigation tree) and in compliance with "Hierarchical Schedules" below.
  - 4) Events: Shall be used to view alarm event information geographically (using the navigation tree), acknowledge events, sort events by category, actions and verify reporting actions.
  - 5) Trends: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling
  - 6) Logic - Live Graphic Programs: Shall be used to display a 'live' graphic program of the control algorithm for the mechanical/electrical system selected in the navigation tree. All control outputs and inputs shall be displayed on the program giving real-time statuses for use in operator troubleshooting.
4. The following actions shall be accomplished by clicking appropriate buttons/menu in the graphic window: Log In/Out, Print and Hide/Show Navigation Pane.
  5. Color Graphics:
    - a. The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to setpoints and comfort. Animated gif's, active setpoint graphic controls and valid web content (like local weather forecast) shall be used to enhance usability:
      - 1) Display Size: The GUI workstation software shall graphically display in at least 1024 by 768 pixels 24 bit True Color.
      - 2) General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
      - 3) Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, which provide a visual display of temperature relative to their respective setpoints (see "Zone Setpoint Adjustments" below). The colors shall be updated dynamically as a zone's actual comfort condition changes in real-time. Locations of space sensors shall also be shown for each zone. The intent of the specification is to enable the operator to readily assess problems at a glance.
      - 4) Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability.
      - 5) Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
        - (a) Each piece of equipment monitored or controlled including each terminal unit
        - (b) Each building
        - (c) Each floor and zone controlled
  6. Zone Setpoint Adjustments: Color floor plans displayed via a web browser shall utilize a contiguous band of colors, each corresponding to actual zone temperatures relative to the desired heating and cooling setpoints. The ideal temperature shall be shown as a green color band. Temperatures slightly warmer than ideal shall be shown in yellow, and even warmer temperature band shall be shown in orange. Temperatures slightly cooler than ideal shall be light blue, and even cooler temperatures shall be shown as dark blue. All alarm colors shall be in red.
  7. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an operator (with password access) shall be able to define a Normal, Holiday or Override



schedule for an individual piece of equipment or room, or choose to apply a hierarchical schedule to the entire system, site or floor area. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph. See "Object or Object Group Scheduling" below.

- E. Object or Object Group Scheduling:
  - 1. Weekly Schedules Based on Separate, Daily Schedules:
    - a. Include start, stop, optimal stop, and night economizer.
    - b. 10 events maximum per schedule.
    - c. Start/stop times adjustable for each group object.
  - 2. Exception Schedules:
    - a. Based on any day of the year.
    - b. Defined up to one year in advance.
    - c. Automatically discarded and replaced with standard schedule for that day of the week upon execution.
  - 3. Holiday or Special Schedules:
    - a. Capability to define up to 99 schedules.
    - b. Repeated annually.
    - c. Length of each period is operator defined.
- F. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- G. Alarms:
  - 1. Binary object is set to alarm based on the operator specified state.
  - 2. Analog object to have high/low alarm limits.
  - 3. All alarming is capable of being automatically and manually disabled.
  - 4. Alarm Reporting:
    - a. Operator determines action to be taken for alarm event.
    - b. Alarms to be routed to appropriate workstation.
    - c. Reporting Options:
      - 1) Start programs.
      - 2) Print.
      - 3) Logged.
      - 4) Custom messaging.
      - 5) Graphical displays.
      - 6) Dial out to workstation receivers via system protocol.
- H. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- I. Sequencing: Application software based upon specified sequences of operation in Section 23 0993.
- J. PID Control Characteristics:
  - 1. Direct or reverse action.
  - 2. Anti-windup.
  - 3. Calculated, time-varying, analog value, positions an output or stages a series of outputs.
  - 4. User selectable controlled variable, set-point, and PED gains.
- K. Staggered Start Application:
  - 1. Prevents all controlled equipment from simultaneously restarting after power outage.
  - 2. Order of equipment startup is user selectable.
- L. Energy Calculations:
  - 1. Accumulated instantaneous power or flow rates are converted to energy use data.
  - 2. Algorithm calculates a rolling average and allows window of time to be user specified in minute intervals.

3. Algorithm calculates a fixed window average with a digital input signal from a utility meter defining the start of the window period that in turn synchronizes the fixed-window average with that used by the power company.
- M. Anti-Short Cycling:
  1. All binary output objects protected from short-cycling.
  2. Allows minimum on-time and off-time to be selected.
- N. On-Off Control with Differential:
  1. Algorithm allows binary output to be cycled based on a controlled variable and set-point.
  2. Algorithm to be direct-acting or reverse-acting incorporating an adjustable differential.
- O. Run-Time Totalization:
  1. Totalize run-times for all binary input objects.
  2. Provides operator with capability to assign high run-time alarm.

## **2.06 HVAC CONTROL PROGRAMS**

- A. General:
  1. Support Inch-pounds and SI (metric) units of measurement.
  2. Identify each HVAC Control system.
- B. Optimal Run Time:
  1. Control start-up and shutdown times of HVAC equipment for both heating and cooling.
  2. Base on occupancy schedules, outside air temperature, seasonal requirements, and interior room mass temperature.
  3. Start-up systems by using outside air temperature, room mass temperatures, and adaptive model prediction for how long building takes to warm up or cool down under different conditions.
  4. Use outside air temperature to determine early shut down with ventilation override.
  5. Analyze multiple building mass sensors to determine seasonal mode and worse case condition for each day.
- C. Supply Air Reset:
  1. Monitor heating and cooling loads in building spaces, terminal reheat systems, both hot deck and cold deck temperatures on dual duct and multizone systems, single zone unit discharge temperatures.
  2. Adjust discharge temperatures to most energy efficient levels satisfying measured load by:
    - a. Raising cooling temperatures to highest possible value.
    - b. Reducing heating temperatures to lowest possible level.
- D. Enthalpy Switchover:
  1. Calculate outside and return air enthalpy using measured temperature and relative humidity; determine energy expended and control outside and return air dampers.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- C. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.

- D. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

### 3.02 DEMOLITION

- A. Remove controls which do not remain as part of the building automation system, all associated abandoned wiring and conduit, and all associated pneumatic tubing. Coordinate with Owner to determine any equipment which is to be removed that will remain the property of the Owner. All other equipment which is removed will be disposed of by .

### 3.03 COORDINATION

- A. **The BAS system supplier shall furnish all Sensor Wells for installation by the Mechanical Installer and/or others.**
- B. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans, furniture, and other room details before installation.
- C. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor Control Centers," "Panel boards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- D. Coordinate with Owner's IT department on locations for NSC's, Ethernet communication cabling and TCP/IP addresses.
- E. The BAS system supplier shall provide field supervision to the designated contractor for the installation of the following:
  - 1. Automatic control dampers
  - 2. Blank-off plates for dampers that are smaller than duct size
  - 3. Sheet metal baffles plates to eliminate stratification
- F. **The BAS system supplier shall furnish smoke detectors and wire to the building fire alarm system.** HVAC Installer to mount devices. BAS system supplier to hardwire to fan shut down.
- G. Coordinate requirements for auxiliary contact (pulse initiator) on the electric meter for central monitoring of kWh and KW with the Electrical Installer. Electrical Installer shall provide the pulse rate for remote readout to the BAS.

### 3.04 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 23 0993.
- C. Provide conduit and electrical wiring in accordance with Section 26 0583. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- D. Hardware and Wiring Installation:
  - 1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
  - 2. The 120VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
  - 3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
  - 4. Wires are to be attached to the building proper at regular intervals such that wiring does not droop (not more than 0.50 inches of droop per 10'-0" length). Wires are not to be affixed to or supported by pipes, conduit, etc.

5. Conduit in finished areas will be concealed in ceiling cavity spaces, plenums, furred spaces and wall construction.
    - a. Exception; metallic surface raceway may be used in finished areas on masonry walls **ONLY WHERE SPECIFICALLY INDICATED ON DRAWINGS OR IN THESE SPECIFICATIONS**. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
  6. Conduit, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
  7. Wires are to be kept a minimum of three (3) inches from hot water, steam, or condensate piping.
  8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.
  9. Wire will not be allowed to run across telephone equipment areas.
  10. Provide fire caulking at all rated penetrations.
- E. Field Device Installation
1. Well-mounted sensors shall include thermal conducting compound within the well to ensure good heat transfer to the sensor.
  2. Actuators shall be firmly mounted to give positive movement and linkage shall be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
  3. Relay outputs shall include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
  4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
  5. For duct static pressure sensors, the high pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low pressure port shall be left open to the plenum area at the point that the high pressure port is tapped into the ductwork.
  6. For building static pressure sensors, the high pressure port shall be inserted into the space via a metal tube. Pipe the low pressure port to the outside of the building.
  7. Space humidity or temperature sensors will be mounted away from machinery generating heat, direct light and diffuser air streams.
  8. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
  9. Field enclosures shall be located immediately adjacent to the controller panel(s) to which they are being interfaced.
- F. Software Installation:
1. The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.

### 3.05 IDENTIFICATION

- A. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with as-built drawings.
- B. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
- C. Junction box covers must be marked to indicate that they are a part of the BAS system.
- D. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with name plates.
- E. All I/O field devices inside FIP's shall be labeled.

### 3.06 TESTING AND STARTUP

- A. Field Checkout:

1. Each I/O device (both field mounted as well as those located in FIPs) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Contractor for submission to Owner or Owner's representative.
  2. For wireless devices, the signal strength recorded during checkout shall also be reported.
  3. A field checkout of all controllers and front end equipment (computers, printers, modems, etc.) shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to Owner or Owner's representative at the completion of the project.
- B. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation.
1. All application software will be verified and compared against the sequences of operation.
  2. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.
  3. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the owner.
  4. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the owner.
  5. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.
- C. The BAS system supplier shall commission and set in operating condition all major equipment and systems, such as the chilled water, hot water and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. If the vendor is providing an AFDD/CC system, use of the analytics shall be used to help commission the system.
- D. Startup Testing shall be performed for each task on the startup test checklist, which shall be initialed by the technician and dated upon test was completion along with any recorded data such as voltages, offsets or tuning parameters. Any deviations from the submitted installation plan shall also be recorded. Required elements of the startup testing include, but are not limited to:
1. Measurement of voltage sources, primary and secondary
  2. Verification of proper controller power wiring.
  3. Verification of component inventory when compared to the submittals.
  4. Verification of labeling on components and wiring.
  5. Verification of connection integrity and quality (loose strands and tight connections).
  6. Verification of bus topology, grounding of shields and installation of termination devices.
  7. Verification of point checkout.
  8. Each I/O device is landed per the submittals and functions per the sequence of control.
  9. Analog sensors are properly scaled and a value is reported.
  10. Binary sensors have the correct normal position and the state is correctly reported.
  11. Analog outputs have the correct normal position and move full stroke when so commanded.
  12. Binary outputs have the correct normal state and respond appropriately to energize/de-energize commands.

13. Documentation of analog sensor calibration (measured value, reported value and calculated offset).
14. Documentation of Loop tuning (sample rate, gain and integral time constant).
- E. A performance verification test shall also be completed for the operator interaction with the system. Test elements shall be written to require the verification of all operator interaction tasks including, but not limited to the following:
  1. Graphics navigation.
  2. Trend data collection and presentation.
  3. Alarm handling, acknowledgement and routing.
  4. Time schedule editing.
  5. Application parameter adjustment.
  6. Manual control.
  7. Report execution.
  8. Automatic backups.
  9. Web Client access.
  10. Mobile Device Client access.

### **3.07 MANUFACTURER'S FIELD SERVICES**

- A. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation. The BAS system supplier shall commission and set in operating condition all major equipment and systems in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives. If the vendor is providing an AFDD/CC system, use of the analytics shall be used to help commission the system.
- B. See 23 0050 - Common Work Results for Mechanical for additional startup and training requirements.

**END OF SECTION 23 0923**

**SECTION 23 0934  
VARIABLE-FREQUENCY MOTOR CONTROLLERS FOR HVAC**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.
- B. Overcurrent protective devices for motor controllers, including overload relays.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 0529 - Hangers and Supports for HVAC Piping and Equipment.
- B. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- C. Section 23 0553 - Identification for HVAC Piping and Equipment: Identification products and requirements.
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- E. Section 26 2813 - Fuses.
- F. Section 28 4600 - Fire Detection and Alarm: For interface with variable-frequency motor controllers.

**1.03 REFERENCE STANDARDS**

- A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 1989 (Corrigendum 2019).
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- D. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
- E. NEMA ICS 7 - Industrial Control and Systems: Adjustable-Speed Drives; 2020.
- F. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems; 2022.
- G. NEMA ICS 7.2 - Application Guide for AC Adjustable Speed Drive Systems; 2021.
- H. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2005.
- I. NEMA MG 1 - Motors and Generators; 2021.
- J. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- M. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy (Ed. 2); Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.
  - 2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.

3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

#### **1.05 QUALITY ASSURANCE**

- A. Comply with requirements of NFPA 70.
- B. Maintain copy of each referenced document that prescribes execution requirements at project site.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
  1. Authorized service facilities located within 200 miles (320 km) of project site.
- D. Installer Qualifications: Company with minimum three years documented experience with variable-frequency motor control systems of similar size, type, and complexity; manufacturer's authorized installer.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

#### **1.07 FIELD CONDITIONS**

- A. Maintain field conditions within required service conditions during and after installation.

#### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Source Limitations: Furnish variable-frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

#### **2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS**

- A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.
- B. Provide products listed, classified, and labeled as suitable for purpose intended.
- C. Controller Assemblies: Comply with NEMA ICS 7, NEMA ICS 7.1, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.
- D. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA ICS 7.2, NEMA MG 1 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
  1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 1 design letter or inverter duty rating for induction motors.
  2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
  3. Motor nameplate data.
  4. Requirements for speed control range, speed regulation, and braking.
  5. Motor suitability for bypass starting method, where applicable.



- E. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.
- F. Operating Requirements:
  - 1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
  - 2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
  - 3. Efficiency: Minimum of 96 percent at full speed and load.
  - 4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
  - 5. Overload Rating:
    - a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
    - b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.
- G. Power Conversion System: Microprocessor-based, pulse width modulation type.
- H. Control System:
  - 1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
  - 2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
  - 3. Control Functions:
    - a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
      - 1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
      - 2) Vector Control: Provide selectable autotuning function.
    - b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
    - c. Selectable braking control; DC injection or flux braking.
    - d. Adjustable minimum/maximum speed limits.
    - e. Adjustable pulse width modulation switching carrier frequency.
    - f. Adjustable motor slip compensation.
    - g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.
    - h. Safety Interlock: Provide permissive run safety interlock capability where indicated or required; upon activation of designated input, stop and prevent operation of motor; operational in both drive and bypass modes where applicable.
  - 4. Status Indications:
    - a. Motor run/stop status.
    - b. Motor forward/reverse status.
    - c. Local/remote control status.
    - d. Output voltage.
    - e. Output current.
    - f. Output frequency.
    - g. DC bus voltage.
    - h. Motor speed.
  - 5. Protective Functions/Alarm Indications:
    - a. Overcurrent.
    - b. Motor overload.
    - c. Undervoltage.
    - d. Overvoltage.
    - e. Controller overtemperature.
    - f. Input/output phase loss.

- g. Output short circuit protection.
    - h. Output ground fault protection.
  - 6. Inputs:
    - a. Digital Input(s): Three.
    - b. Analog Input(s): Two.
  - 7. Outputs:
    - a. Analog Output(s): One.
    - b. Relay Output(s): Two.
  - 8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
    - a. Remote Monitoring Capabilities:
      - 1) Motor run/stop status.
      - 2) Hand-off-auto status.
      - 3) Fault information.
      - 4) Discrete input/output status.
      - 5) Analog input/output values.
    - b. Remote Control Capabilities:
      - 1) Motor run/stop command.
      - 2) Hand-off-auto selection.
      - 3) Speed adjustment.
      - 4) Fault reset.
  - 9. Features:
    - a. Password-protected security access.
    - b. Event log.
- I. Power Conditioning/Filtering:
  - 1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
  - 2. Reactor Impedance: 3 percent, unless otherwise indicated or required.
- J. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
  - 1. Disconnects: Circuit breaker or disconnect switch type.
    - a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
    - b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
    - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
  - 2. Provide door-mounted remote operator interface.
- K. Service Conditions:
  - 1. Provide controllers and associated components suitable for operation under following service conditions without derating:
    - a. Altitude: Less than 3,300 feet (1,000 m).
    - b. Ambient Temperature: Between 32 degrees F (0 degrees C) and 104 degrees F (40 degrees C).
  - 2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.
- L. Short Circuit Current Rating:
  - 1. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
- M. Conductor Terminations: Suitable for use with conductors to be installed.
- N. Enclosures:

1. Comply with NEMA ICS 6.
  2. NEMA 250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
  3. Finish: Manufacturer's standard unless otherwise indicated.
  4. Cooling: Forced air or natural convection as determined by manufacturer.
- O. Interface with Other Work:
1. Provide products compatible with other systems requiring interface with controllers.
  2. Interface with building automation system.
    - a. Capable of remote monitoring and control of controllers.

### **2.03 OVERCURRENT PROTECTIVE DEVICES**

- A. Overload Relays:
1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
  2. Comply with NEMA ICS 2.
  3. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
  4. Trip-free operation.
  5. Visible trip indication.
  6. Resettable:
    - a. Employ manual reset unless otherwise indicated.
    - b. Do not employ automatic reset with two-wire control.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of controllers are consistent with indicated requirements.
- C. Verify that mounting surfaces are ready to accept controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

### **3.02 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.
- C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 23 0529.
- F. Install controllers plumb and level.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Install field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

### **3.03 FIELD QUALITY CONTROL**

- A. Provide services of manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective controllers or associated components.

**3.04 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
  - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
  - 2. Provide minimum of two hours of training.
  - 3. Instructor: Manufacturer's authorized representative.
  - 4. Location: At project site.

**3.05 PROTECTION**

- A. Protect installed controllers from subsequent construction operations.

**END OF SECTION 23 0934**

**SECTION 23 0993**  
**SEQUENCE OF OPERATIONS FOR HVAC CONTROLS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 9113 - General Commissioning Requirements: Commissioning requirements that apply to all types of work.
- B. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- C. Section 23 0923 - Direct-Digital Control System for HVAC.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 0993.1:
  - 1. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
    - a. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
    - b. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in Contract Documents.
  - 2. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
    - a. Label with settings, adjustable range of control and limits.
    - b. Include flow diagrams for each control system, graphically depicting control logic.
    - c. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
    - d. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
    - e. Include all monitoring, control and virtual points specified in elsewhere.
    - f. Include a key to all abbreviations.
  - 3. Points List: Submit list of all control points indicating at least the following for each point.
    - a. Name of controlled system.
    - b. Point abbreviation.
    - c. Point description; such as dry bulb temperature, airflow, etc.
    - d. Display unit.
    - e. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
    - f. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
    - g. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
    - h. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.
  - 4. Designer's Qualification Statement.
- C. Submittal 23 0993.2:

1. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

**1.04 QUALITY ASSURANCE**

- A. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION**

**3.01 SEQUENCES OF OPERATIONS**

- A. See mechanical drawings for individual unit control diagrams and sequences of operations.

**END OF SECTION 23 0993**

**SECTION 23 1123  
FACILITY NATURAL-GAS PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 09 9113 - Exterior Painting.
- D. Section 09 9123 - Interior Painting.
- E. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.
- F. Section 23 0548 - Vibration and Seismic Controls for HVAC: Seismic support and restraint requirements.
- G. Section 23 0553 - Identification for HVAC Piping and Equipment.
- H. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- I. Section 31 2316 - Excavation.
- J. Section 31 2316.13 - Trenching.
- K. Section 31 2323 - Fill.

**1.03 REFERENCE STANDARDS**

- A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2019.
- B. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- C. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.
- D. ANSI Z223.1 - National Fuel Gas Code; 2024.
- E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- F. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- G. ASME B31.1 - Power Piping; 2022.
- H. ASME B31.9 - Building Services Piping; 2020.
- I. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
- J. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- K. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- L. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- M. ASTM D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings; 2020.
- N. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

- P. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- R. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- S. AWWA C606 - Grooved and Shouldered Joints; 2022.
- T. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- U. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- V. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- W. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- X. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- Y. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

#### **1.04 QUALITY ASSURANCE**

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- D. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- E. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.
- C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

### **PART 2 PRODUCTS**

#### **2.01 NATURAL GAS PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING**

- A. Medium Density Polyethylene (MDPE) Pipe: ASTM D2513, SDR 11.
  - 1. Fittings: ASTM D2683 or ASTM D2513 socket type.
  - 2. Joints: Fusion welded.
- B. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
  - 1. Fittings: ASTM A234/A234M, wrought steel welding type.
  - 2. Joints: ANSI Z223.1, welded.
  - 3. Jacket: AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

#### **2.02 NATURAL GAS PIPING, ABOVE GRADE**

- A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
  - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
  - 2. Joints: Threaded or welded to ASME B31.1.
- B. Flexible Gas Piping:



1. Corrugated Stainless Steel Tubing: Comply with ANSI LC 1/CSA 6.26.
2. Comply with ASTM E84.
3. Fittings: Provided by piping system manufacturer.
4. Provide piping with integral lightning protection.
5. Manufacturers:
  - a. Omega Flex, Inc; TracPipe CounterStrike: [www.omegaflex.com/](http://www.omegaflex.com/)
  - b. Substitutions: See Section 01 6000 - Product Requirements.

## **2.03 FLANGES, UNIONS, AND COUPLINGS**

- A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:
  1. Ferrous Pipe: Class 150 malleable iron threaded unions.
- B. Flanges for Pipe Size Over 1 Inch (25 mm):
  1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

## **2.04 PIPE HANGERS AND SUPPORTS**

- A. Provide hangers and supports that comply with MSS SP-58.
  1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
  2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
  3. Trapeze Hangers: Welded steel channel frames attached to structure.
  4. Vertical Pipe Support: Steel riser clamp.
  5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
- B. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:
  1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
  2. Masonry Wedge Expansion Anchors: Complying with ICC-ES AC01.
  3. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
  4. Masonry Screw Type Anchors: Complying with ICC-ES AC106.
  5. Other Types: As required.
  6. Manufacturers:
    - a. Powers Fasteners, Inc: [www.powers.com/](http://www.powers.com/)
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## **2.05 BALL VALVES**

- A. Manufacturers:
  1. Apollo Valves: [www.apollovalves.com/](http://www.apollovalves.com/)
  2. Grinnell Products: [www.grinnell.com/](http://www.grinnell.com/)
  3. Milwaukee Valve Company: [www.milwaukeevalve.com/](http://www.milwaukeevalve.com/)
  4. Nibco, Inc: [www.nibco.com/](http://www.nibco.com/)
  5. Viega LLC: [www.viega.us/](http://www.viega.us/)
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi (2760 kPa) CWP, bronze body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder, threaded, or grooved ends with union.

## **2.06 STRAINERS**

- A. Manufacturers:
  1. Armstrong International, Inc: [www.armstronginternational.com/](http://www.armstronginternational.com/)
  2. Green Country Filter Manufacturing: [www.greencountryfilter.com/](http://www.greencountryfilter.com/)
  3. WEAMCO: [www.weamco.com/](http://www.weamco.com/)
  4. Substitutions: See Section 01 6000 - Product Requirements.

- B. Size 2 inch (50 mm) and Under:
  - 1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
  - 2. Class 150, threaded bronze body 300 psi (2070 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.
- C. Size 1-1/2 inch (40 mm) to 4 inch (100 mm):
  - 1. Class 125, flanged iron body, Y pattern with 1/16 inch (1.6 mm) stainless steel perforated screen.

## **2.07 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS**

- A. Manufacturers:
  - 1. Actaris Metering Systems (A brand of ITT Controls): [www.actaris-metering-systems.com/](http://www.actaris-metering-systems.com/)
  - 2. Dungs Combustion Controls: [www.dungs.com/](http://www.dungs.com/)
  - 3. Maxitrol Company: [www.maxitrol.com/](http://www.maxitrol.com/)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Compliance Requirements:
  - 1. Appliance Regulator: ANSI Z21.18/CSA 6.3.
  - 2. Line Pressure Regulator: ANSI Z21.80/CSA 6.22.
- C. Materials in Contact With Gas:
  - 1. Housing: Aluminum, steel (free of non-ferrous metals).
  - 2. Seals and Diaphragms: NBR-based rubber.
- D. Type: Vent-free with manufacturer's matching vent limiter.
  - 1. Indoors: Vent-free with manufacturer's matching vent limiter.
  - 2. Outdoors: Vented or Vent-free with manufacturer's matching vent limiter.
  - 3. Substitutions: If Vented type is used, furnish bug screen provided or approved by manufacturer at termination point.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that excavations are to required grade, dry, and not over-excavated.

### **3.02 PREPARATION**

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom, conserve space, and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Provide support for utility meters in accordance with requirements of utility companies.
- I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
  - 1. Painting of interior piping systems and components is specified in Section 09 9123.

2. Painting of exterior piping systems and components is specified in Section 09 9113.
- J. Install valves with stems upright or horizontal, not inverted.
- K. Gas Regulator Venting:
  1. Wherever possible, appliance gas pressure regulators installed indoors shall be non-venting type with manufacturer's matching vent limiter. Regardless of application or location, vent limiters must be installed in accordance with the manufacturer's instructions.
  2. When vented gas regulators are used, pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood. Coordinate with architectural drawings to ensure vent termination location is not exposed to view from any vantage point of normal building occupants.
    - a. The vent line must discharge away from where people might walk or work, such as pedestrians, roofers and other maintenance professionals.
    - b. The vent line must discharge away from fresh air intakes and from windows in accordance with code requirements.
    - c. If a vent line runs through a roof, verify that the vent line terminates above the point where water and snow accumulation on the roof does not cover or isolate the termination point from the atmosphere. The end shall be goose-necked downwards.
    - d. Bug Screens:
      - 1) Some bugs are attracted to the smell of the natural/LP gas odorant and could nest in the vent line, which could seal the termination point. Install manufacturer's provided/approved bug screen on the termination point to deter insects from nesting in the line.
      - 2) Do not paint the bug screen.
- L. Sleeve pipes passing through partitions, walls and floors.
- M. Pipe Hangers and Supports:
  1. Install in accordance with ASME B31.9.
  2. Support horizontal piping as indicated.
  3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
  4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
  6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
  7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
    - a. Painting of interior piping systems and components is specified in Section 09 9123.
    - b. Painting of exterior piping systems and components is specified in Section 09 9113.
  9. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 23 0548.

### **3.04 APPLICATION**

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install ball valves for shut-off and to isolate equipment, part of systems, and vertical risers.

### **3.05 SERVICE CONNECTIONS**

- A. Provide new gas service complete with gas meter and regulators in accordance with Section 33 5216. Gas service distribution piping to have initial minimum pressure as indicated on drawings.

### **3.06 SCHEDULES**

- A. Pipe Hanger Spacing:

1. Metal Piping:
  - a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
    - 1) Maximum Hanger Spacing: 6.5 ft (2 m).
    - 2) Hanger Rod Diameter: 3/8 inches (9 mm).
  - b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
    - 1) Maximum Hanger Spacing: 10 ft (3 m).
    - 2) Hanger Rod Diameter: 3/8 inch (9 mm).
  - c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
    - 1) Maximum Hanger Spacing: 10 ft (3 m).
    - 2) Hanger Rod Diameter: 1/2 inch (13 mm).
  - d. Pipe Size: 4 inches (100 mm) to 6 inches (150 mm):
    - 1) Maximum Hanger Spacing: 10 ft (3 m).
    - 2) Hanger Rod Diameter: 5/8 inch (15 mm).

**END OF SECTION 23 1123**

**SECTION 23 2300  
REFRIGERANT PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Piping.
- B. Refrigerant.
- C. Moisture and liquid indicators.
- D. Valves.
- E. Strainers.
- F. Filter-driers.
- G. Solenoid valves.
- H. Flexible connections.
- I. Engineered wall seals and insulation protection.
- J. Engineered roof penetration protection.
- K. Exterior penetration accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 08 3100 - Access Doors and Panels.
- C. Section 09 9123 - Interior Painting.
- D. Section 23 0719 - HVAC Piping Insulation: Refrigerant Piping Insulation Requirements
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants; 2014.
- B. AHRI 761 (SI) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants; 2014.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Errata (2023).
- D. ASHRAE Std 34 - Designation and Safety Classification of Refrigerants; 2024.
- E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2023.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- G. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- H. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2022.
- I. ASME B31.9 - Building Services Piping; 2020.
- J. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- K. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.
- L. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- M. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

- O. ICC (IMC)-2018 - International Mechanical Code; 2018.
- P. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- Q. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.
- R. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

#### 1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide general assembly of specialties, including manufacturer's catalogue information. Provide manufacturer's catalog data including load capacity.

#### 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum 5 years of documented experience.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store piping and specialties in shipping containers with labeling in place.
- B. Protect piping and specialties from entry of contaminating material by **leaving end caps and plugs in place until installation. The use of adhesive tape to cap piping is PROHIBITED, and use of this or other similar methods that do not use plugs or end caps specifically designed for pipe capping duty shall constitute grounds for requiring cleaning of all piping connected to the improperly capped pipe or joint at Contractor's expense.**
- C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

### PART 2 PRODUCTS

#### 2.01 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified ensure system components are compatible and joined to ensure integrity of system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- B. Provide pipe hangers and supports in accordance with ASME B31.5 unless indicated otherwise.
- C. Liquid Indicators:
  - 1. Use line size liquid indicators in main liquid line leaving condenser.
  - 2. If receiver is provided, install in liquid line leaving receiver.
  - 3. Use line size on leaving side of liquid solenoid valves.
- D. Valves:
  - 1. Use service valves on suction and discharge of compressors.
  - 2. Use gauge taps at compressor inlet and outlet.
  - 3. Use gauge taps at hot gas bypass regulators, inlet and outlet.
  - 4. Use check valves on compressor discharge.
  - 5. Use check valves on condenser liquid lines on multiple condenser systems.
- E. Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- F. Strainers:
  - 1. Use line size strainer upstream of each automatic valve.
  - 2. Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
  - 3. On steel piping systems, use strainer in suction line.
  - 4. Use shut-off valve on each side of strainer.

- G. Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- H. Filter-Driers:
  - 1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.
  - 2. Use a filter-drier on suction line just ahead of compressor.
  - 3. Use sealed filter-driers in lines smaller than 1/2 inch (13 mm) outside diameter.
  - 4. Use sealed filter-driers in systems utilizing hermetic compressors.
  - 5. Use replaceable core filter-driers in lines of 1/2 inch (13 mm) outside diameter or greater.
  - 6. Use replaceable core liquid-line filter-driers in systems utilizing receivers.
  - 7. Use filter-driers for each solenoid valve.
- I. Solenoid Valves:
  - 1. Use in liquid line of systems operating with single pump-out or pump-down compressor control.
  - 2. Use in liquid line of single or multiple evaporator systems.
  - 3. Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- J. Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb vibration.

## **2.02 REGULATORY REQUIREMENTS**

- A. Comply with ASME B31.9 for installation of piping system.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.
- C. Welders Certification: In accordance with ASME BPVC-IX.

## **2.03 PIPING**

- A. Copper Tube: ASTM B280, H58 hard drawn.
  - 1. Fittings: ASME B16.22 wrought copper.
  - 2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.
- B. Pipe Supports and Anchors:
  - 1. Provide hangers and supports that comply with MSS SP-58. See Section 23 0529 - Hangers and Supports for HVAC Piping and Equipment for additional requirements.
  - 2. Rooftop Supports for Low-Slope Roofs: Steel pedestals with bases that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified; and as follows:
    - a. Bases: High density, UV tolerant, polypropylene or reinforced PVC.
    - b. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
    - c. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
    - d. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
    - e. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.
    - f. Manufacturers:
      - 1) PHP Systems/Design: [www.phpsd.com/](http://www.phpsd.com/).
      - 2) Miro Industries, Inc.; : <https://www.miroind.com/>
      - 3) Substitutions: See Section 01 6000 - Product Requirements.

## **2.04 MOISTURE AND LIQUID INDICATORS**

- A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F (93 degrees C) and maximum working pressure of

500 psi (3450 kPa).

## 2.05 VALVES

- A. Manufacturers:
  - 1. Hansen Technologies Corporation: [www.hantech.com/](http://www.hantech.com/).
  - 2. Henry Technologies: [www.henrytech.com/](http://www.henrytech.com/).
  - 3. Flomatic Valves: [www.flomatic.com/](http://www.flomatic.com/).
  - 4. Parker Hannifin - Sporlan Division: [www.parker.com/](http://www.parker.com/).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Ball Valves:
  - 1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300 degrees F (149 degrees C).
- C. Service Valves:
  - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi (3450 kPa).

## 2.06 STRAINERS

- A. Manufacturers:
  - 1. Hansen Technologies Corporation: [www.hantech.com/](http://www.hantech.com/).
  - 2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com/](http://www.parker.com/).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Straight Line or Angle Line Type:
  - 1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa).

## 2.07 FILTER-DRIERS

- A. Manufacturers:
  - 1. Flow Controls Division of Emerson Electric: [www.emersonflowcontrols.com/](http://www.emersonflowcontrols.com/).
  - 2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com/](http://www.parker.com/).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
- C. Construction: UL listed.
  - 1. Replaceable Core Type: Steel shell with removable cap.
  - 2. Sealed Type: Copper shell.
  - 3. Connections: As specified for applicable pipe type.

## 2.08 SOLENOID VALVES

- A. Manufacturers:
  - 1. Flow Controls Division of Emerson Electric: [www.emersonflowcontrols.com/](http://www.emersonflowcontrols.com/).
  - 2. Parker Hannifin/Refrigeration and Air Conditioning: [www.parker.com/](http://www.parker.com/).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi (3450 kPa).
- C. Coil Assembly: UL 429 UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.



## 2.09 FLEXIBLE CONNECTORS

- A. Manufacturers:
  - 1. Circuit Hydraulics, Ltd: [www.circuit-hydraulics.co.uk/](http://www.circuit-hydraulics.co.uk/).
  - 2. Flexicraft Industries: [www.flexicraft.com/](http://www.flexicraft.com/).
  - 3. Penflex: [www.penflex.com/](http://www.penflex.com/).
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Corrugated stainless steel hose with single layer of stainless steel exterior braiding and dielectric connection fittings compatible with refrigerant type or listed and rated for use with other materials in system, minimum 9 inches (230 mm) long with copper tube ends; for maximum working pressure of 500 psi (3450 kPa).

## 2.10 ENGINEERED WALL SEALS AND INSULATION PROTECTION

- A. Manufacturers:
  - 1. Airex Manufacturing, Inc; Titan: [www.airexmfg.com/](http://www.airexmfg.com/).
  - 2. Rooftop Penetration Housings LLC; Wall Vault: <https://roofpenetrationhousings.com/>
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation Protection System: Mechanical line insulation and PVC cover.
  - 1. PVC Insulation Cover Color: Black with full-length velcro fastener.

## 2.11 ENGINEERED ROOF PENETRATION PROTECTION

- A. Manufacturers:
  - 1. Rooftop Penetration Housings LLC; : <https://roofpenetrationhousings.com/>
  - 2. SBC Flashings; : <https://sbcflashings.com/product/ac-line-shack/>
  - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Basis of Design: Rooftop Penetration Housings LLC
  - 1. Rooftop penetration housing: Roof Vault

## 2.12 EXTERIOR PENETRATION ACCESSORIES

- 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.
  - 1. Products:
    - a. Quickflash Weatherproofing Products, Inc: [www.quickflashproducts.com/](http://www.quickflashproducts.com/).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain-end ferrous pipe.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.02 INSTALLATION

- A. Install refrigeration systems and specialties in accordance with manufacturer's instructions. Where these specifications and the manufacturer's instructions differ, use the more stringent method, except where doing so would negatively affect system operation.
- B. **BRAZING ACTIVITIES: Flood refrigerant piping systems with nitrogen for the duration of all brazing activities.** Cut sample joints selected by the Engineer and/or the Contracting Officer of Record to inspect for carbon buildup or improper brazing techniques. **Piping found**

**to have excessive scale or carbon buildup due to neglecting nitrogen purge must be replaced in its entirety.** Provide sample cuts for not less than three (3) locations, and not more than 2% of the fittings in the system, as directed.

1. **Mechanical Press-Sealed Fittings installed in accordance with the manufacturer's instructions are exempt from this requirement.** Only brazed/welded piping and fittings require sample cuts.
- C. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and avoid interference with use of space.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Inserts:
  1. Provide inserts for placement in concrete formwork.
  2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
  3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
  4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
  5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.
- G. Pipe Hangers and Supports:
  1. Install in accordance with ASME B31.5.
  2. Support horizontal piping as indicated.
  3. Install hangers to provide minimum 1/2 inch (13 mm) space between finished covering and adjacent work.
  4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
  5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
  6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
  7. Provide copper plated hangers and supports for copper piping.
- H. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- I. Provide clearance for installation of insulation and access to valves and fittings.
- J. Provide access to concealed valves and fittings.
- K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.
- L. Prepare unfinished pipe, fittings, supports, and accessories for finish painting. See Section 09 9123.
- M. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
- N. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- O. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- P. Fully charge completed system with refrigerant after testing.
- Q. Provide electrical connection to solenoid valves. See Section 26 0583.

### 3.03 SYSTEM PRESSURE TEST

- A. Provide system pressure testing in accordance with manufacturer's instructions. Pressure test shall be documented and shall be both witnessed and approved by the manufacturer's

representative in writing. **For all tests, gauges must read the same pressure both before and after the time periods indicated unless equipment manufacturer specifically directs otherwise.** The pressure tests shall include the following, at a minimum:

1. Pressurization Procedure:
    - a. Step 1: 150 psi dry nitrogen held for 3 minutes. Two (2) time stamps: Start and Finish.
    - b. Step 2: 325 psi dry nitrogen held for 5 minutes. Two (2) time stamps: Start and Finish.
    - c. Step 3: 550 psi dry nitrogen held for 24 hours. Two (2) time stamps: Start and Finish.
  2. Evacuation Procedure:
    - a. Step 1: Evacuate to 4,000 microns and wait 30 seconds; if measured pressure remains at or below 4,000 microns, hold for 15 minutes - else restart vacuum pump and bring below 4,000 microns and repeat 30 second wait. Break vacuum with dry nitrogen at 2-3 psig. Three (3) time stamps: Start and Finish, and Positive Pressure.
    - b. Step 2: Evacuate to 1,500 microns and wait 30 seconds; if measured pressure remains at or below 1,500 microns, hold for 15 minutes - else restart vacuum pump and bring below 1,500 microns and repeat 30 second wait. Three (3) time stamps: Start and Finish, and Positive Pressure.
    - c. Step 3: Evacuate to 475 microns and wait 30 seconds; if measured pressure remains at or below 475 microns, hold for 60 minutes - else restart vacuum pump and bring below 475 microns and repeat 30 second wait. Two (2) time stamps: Start and Finish.
    - d. If vacuum level remains below 500 microns after the 60 minute period, system is ready for charging.
- B. Documentation:
1. Documentation of pressure test shall include the following, at a minimum:
    - a. Time stamps recording the beginning and end of each pressure test
    - b. The total time length of each test in hours, minutes, and seconds
    - c. Recorded pressures at beginning and end of each pressure test
    - d. Photographs of the gauge readings at each time stamp.

### 3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Test refrigeration system in accordance with ASME B31.5, and in accordance with manufacturer's instructions.

### 3.05 SCHEDULES

- A. Hanger Spacing for Copper Tubing.
  1. 1/2 inch (13 mm), 5/8 inch (16 mm), and 7/8 inch (22 mm) OD: Maximum span, 5 feet (1500 mm); minimum rod size, 1/4 inch (6.3 mm).
  2. 1-1/8 inch (29 mm) OD: Maximum span, 6 feet (1800 mm); minimum rod size, 1/4 inch (6.3 mm).
  3. 1-3/8 inch (35 mm) OD: Maximum span, 7 feet (2100 mm); minimum rod size, 3/8 inch (9.5 mm).
  4. 1-5/8 inch (41 mm) OD: Maximum span, 8 feet (2400 mm); minimum rod size, 3/8 inch (9.5 mm).

**END OF SECTION 23 2300**

**SECTION 23 3100  
HVAC DUCTS AND CASINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal ducts.
- B. Flexible ducts.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 09 9113 - Exterior Painting: Weld priming, weather resistant, paint or coating.
- C. Section 09 9123 - Interior Painting: Weld priming, paint or coating.
- D. Section 23 0130.51 - HVAC Air-Distribution System Cleaning: Post install duct cleaning.
- E. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- F. Section 23 0713 - Duct Insulation: External insulation and duct liner.
- G. Section 23 3300 - Air Duct Accessories.
- H. Section 23 3700 - Air Outlets and Inlets: Fabric air distribution devices.

**1.03 REFERENCE STANDARDS**

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASHRAE Std 126 - Method of Testing HVAC Air Ducts; 2020.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 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; 2021a.
- 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; 2023.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- L. ICC (IMC) - International Mechanical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2018, with Editorial Revision (2020).
- N. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).

- O. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- P. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- Q. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- R. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- S. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- T. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2021.
- U. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; 2012.
- V. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- W. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

#### **1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 3100.1:
  - 1. Product Data: Provide data for duct materials.
- C. Submittal 23 3100.2: Shop Drawings:
  - 1. Submittal 23 3100.2: Shop Drawings: Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work for medium pressure class systems, Animal Area systems, and hazardous exhaust systems (e.g., Isolation Areas, etc.)

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer. See Owner
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum three years of documented experience.

#### **1.06 FIELD CONDITIONS**

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.
- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

### **PART 2 PRODUCTS**

#### **2.01 GENERAL REQUIREMENTS**

- A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.
- B. Provide metal duct unless otherwise indicated.
- C. Seismic Restraint: Fabricate in compliance with ICC (IMC) requirements; see Section 23 0548.
- D. Duct Shape and Material in accordance with Allowed Static Pressure Range:
  - 1. Round: Plus or minus 2 in-wc (500 Pa) of galvanized steel.
  - 2. Rectangular: Plus or minus 2 in-wc (500 Pa) of galvanized steel.
  - 3. Flat Oval: Plus 2 in-wc (500 Pa) of galvanized steel.
  - 4. Flexible Duct (Fabric and wire): Plus or minus 1/2 in-wc (125 Pa); see Section 23 3700.
- E. Duct Sealing and Leakage in accordance with Static Pressure Class:
  - 1. Duct Pressure Class and Material for Common Mechanical Ventilation Applications:
    - a. Supply Air: 1 in-wc (250 Pa) pressure class, galvanized steel.

- b. Outside Air Intake and Supply: 3 in-wc (\_\_\_ Pa) pressure class, galvanized steel.
  - c. Return and Relief Air: 1 in-wc (250 Pa) pressure class, galvanized steel.
  - d. Contaminated or Hazardous Exhaust Air: By Duct Class. See section below.
  - e. General Exhaust Air: 1 in-wc (250 Pa) pressure class, galvanized steel.
  - f. Transfer-air and Sound Boots: 1/2 in-wc (125 Pa) pressure class, fibrous glass.
- 2. Less than 3 in-wc (750 Pa):
  - a. Seal: Class B, apply sealing of transverse joints and longitudinal seams.
  - b. Leakage:
    - 1) Rectangular: Class 12 or 12 cfm/100 sq ft (340 Lpm/9.3 sq m).
    - 2) Round: Class 6 or 6 cfm/100 sq ft (170 Lpm/9.3 sq m).
- 3. 3 in-wc (750 Pa) and above:
  - a. Seal: Class A, apply sealing of transverse joints, longitudinal seams, and duct wall penetrations.
  - b. Leakage:
    - 1) Rectangular: Class 6 or 6 cfm/100 sq ft (170 Lpm/9.3 sq m).
    - 2) Round: Class 3 or 3 cfm/100 sq ft (85 Lpm/9.3 sq m).
- F. Duct Fabrication Requirements:
  - 1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.
  - 2. Variation of duct configuration or size must be reflected in the shop drawings. Size round duct installed in place of rectangular ducts in accordance with ASHRAE (FUND) Handbook - Fundamentals.
  - 3. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.
  - 4. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.
  - 5. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
  - 6. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
  - 7. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.
  - 8. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide duct transitions sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.
- G. Bath/Shower Exhaust: 1/2 inch w.g. (125 Pa) pressure class, stainless steel or aluminum.
  - 1. Construct of 18 gage, 0.0500 inch (1.27 mm) stainless steel using continuous external welded joints in rectangular sections.

## 2.02 METAL DUCTS

- A. Material Requirements:
  - 1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
  - 2. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.
  - 3. Stainless Steel: ASTM A666, Type 304.
- B. Flat-Oval Metal Ducts:
  - 1. Flat-Oval Single Wall Duct: Machine made from a round spiral lock seam duct.
    - a. Fittings: Manufacture at least two gauges heavier metal than the duct.
    - b. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- C. Round Metal Ducts:

1. Round Single Wall Duct: Round lock seam duct with galvanized steel outer wall.
2. Round Connection System: Interlocking duct connection system in accordance with SMACNA (DCS).
- D. Round Spiral Duct:
  1. Round spiral lock seam duct with galvanized steel outer wall.
- E. Connectors, Fittings, Sealants, and Miscellaneous:
  1. Fittings: Manufacture with solid inner wall of perforated galvanized steel.
  2. Transverse Duct Connection System: SMACNA "E" rated rigid class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).
  3. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
    - a. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
    - b. VOC Content: Not more than 250 g/L, excluding water.
    - c. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
    - d. For Use with Flexible Ducts: UL labeled.
  4. Gasket Tape:
    - a. Provide butyl rubber gasket tape for a flexible seal between transfer duct connector (TDC), transverse duct flange (TDF), applied flange connections, and angle ring connections.
  5. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.
  6. Hanger Fasteners: Attach hangers to structure using appropriate fasteners as follows:
    - a. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.
    - b. Concrete Screw Type Anchors: Complying with ICC-ES AC193.
    - c. Concrete Adhesive Type Anchors: Complying with ICC-ES AC308.

## **2.03 FLEXIBLE DUCTS**

- A. Flexible Air Ducts:
  1. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
  2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
  3. Pressure Rating: From 10 in-wc (2.5 kPa) to 1 in-wc (250 Pa) negative.
  4. Maximum Velocity: 4,000 fpm (20.3 m/s).
  5. Temperature Range: Minus 20 to 210 degrees F (Minus 28 to 99 degrees C).

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install products following the manufacturer's instructions.
- C. Comply with safety standards NFPA 90A and NFPA 90B.
- D. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.
- E. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- F. Flexible Ducts: Connect to metal ducts with adhesive, draw bands, and foil tape.
- G. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

- H. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.
- I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with a crimp in the direction of airflow.
- K. Use double nuts and lock washers on threaded rod supports.
- L. Connect terminal units to supply ducts directly or with one foot (300 mm) maximum length of flexible neoprene glass fabric duct. Do not use flexible duct to change direction.
- M. Connect diffusers to low pressure ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp.
- N. Fire Partitions: Provide firestopping sealing. See Section 07 8400.
- O. Duct Insulation: Provide duct insulation. See Section 23 0713.
- P. Painting: Provide surface finish as indicated on drawings. See Sections 09 9113 and 09 9123.

### **3.02 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. If duct opening and cleanliness procedures have not been observed during construction, and such conditions have been identified or reported by the Owner, Design Professional, or the Authorities Having Jurisdiction, clean thoroughly each existing duct system indicated as having not complied with duct opening and cleanliness procedures in accordance with the requirements in Section 23 0130.51 - HVAC Air-Distribution System Cleaning. Otherwise, use the duct cleaning procedures indicated below.
- C. Clean new duct systems by forcing air at high velocity through duct to remove accumulated dust. Clean half the system at a time to obtain sufficient air. Protect equipment that could be harmed by excessive dirt with temporary filters or bypass during cleaning.

**END OF SECTION 23 3100**



**SECTION 23 3300  
AIR DUCT ACCESSORIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air turning devices/extractors.
- B. Backdraft dampers - metal.
- C. Duct access doors.
- D. Duct test holes.
- E. Fire dampers.
- F. Flexible duct connectors.
- G. Volume control dampers.
- H. Low leakage (Class 1A) control dampers.
- I. Miscellaneous Products:
  - 1. Internal strut end plugs.
  - 2. Duct opening closure film.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 23 3100 - HVAC Ducts and Casings.
- C. Section 25 3513 - Integrated Automation Actuators and Operators: Damper operators.
- D. Section 25 3516 - Integrated Automation Sensors and Transmitters: Damper position switch.
- E. Section 25 3523 - Integrated Automation Control Dampers: Product furnishing.
- F. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- D. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- E. UL 33 - Safety Heat Responsive Links for Fire-Protection Service; Current Edition, Including All Revisions.
- F. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.
- G. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.
- H. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- I. UL 2043 - Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide for shop fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Provide instructions for fire dampers.
- D. Project Record Drawings: Record actual locations of access doors and test holes.

### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect dampers from damage to operating linkages and blades.

## **PART 2 PRODUCTS**

### **2.01 APPROVED MANUFACTURERS**

- A. AireTechnologies, Inc, a DMI Company: [www.airetechnologies.com/](http://www.airetechnologies.com/)
- B. Carlisle HVAC Products: [www.carlislehvac.com/](http://www.carlislehvac.com/)
- C. Crown Products Company, Inc.: [www.crownproductsco.com/](http://www.crownproductsco.com/)
- D. Ductmate Industries, Inc, a DMI Company: [www.ductmate.com/](http://www.ductmate.com/)
- E. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/](http://www.elgenmfg.com/)
- F. Greenheck Fan Corporation: [www.greenheck.com/](http://www.greenheck.com/)
- G. Krueger-HVAC, Division of Air System Components: [www.krueger-hvac.com/](http://www.krueger-hvac.com/)
- H. Nailor Industries, Inc: [www.nailor.com/](http://www.nailor.com/)
- I. Pottorff: [www.pottorff.com/](http://www.pottorff.com/)
- J. Ruskin Company: [www.ruskin.com/](http://www.ruskin.com/)
- K. Titus HVAC, a brand of Johnson Controls: [www.titus-hvac.com/](http://www.titus-hvac.com/)
- L. United Enertech: [www.unitedenertech.com/](http://www.unitedenertech.com/)

### **2.02 AIR TURNING DEVICES/EXTRACTORS**

- A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

### **2.03 BACKDRAFT DAMPERS - METAL**

- A. Multi-Blade, Parallel Action Gravity Balanced Backdraft Dampers: Galvanized steel, with center pivoted blades of maximum 6 inch (150 mm) width, with felt or flexible vinyl sealed edges, linked together in rattle-free manner with 90 degree stop, steel ball bearings, and plated steel pivot pin; adjustment device with gravity counterbalance to permit setting for varying differential static pressure.

### **2.04 DUCT ACCESS DOORS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.

### **2.05 DUCT TEST HOLES**

- A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

### **2.06 FIRE DAMPERS**

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated.
- B. Horizontal Dampers: Galvanized steel, 22-gauge, 0.0299-inch (0.76 mm) frame, stainless steel closure spring, and lightweight, heat-retardant, non-asbestos fabric blanket.
- C. Curtain Type Dampers: Galvanized steel with interlocking blades. Provide stainless steel closure springs and latches for horizontal installations. Configure with blades out of air stream except for 1-inch (250 Pa) pressure-class ducts up to 12 inches (300 mm) in height.

- D. Fusible Links: UL 33, separate at 160 degrees F (71 degrees C) with adjustable link straps for combination fire/balancing dampers.

## **2.07 FLEXIBLE DUCT CONNECTORS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Flexible Duct Connections: Fabric crimped into metal edging strip.
  - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz/sq yd (1.0 kg/sq m).
    - a. Net Fabric Width: Approximately 2 inches (50 mm) wide.
    - b. Metal: 3 inches (75 mm) wide, metal thickness and type to match connecting duct material.
- C. Maximum Installed Length: 14 inch (356 mm).

## **2.08 VOLUME CONTROL DAMPERS**

- A. Fabricate in accordance with SMACNA (DCS) and as indicated.
- B. Splitter Dampers:
  - 1. Material: Same gauge as duct to 24 inches (600 mm) size in either direction, and two gauges heavier for sizes over 24 inches (600 mm).
  - 2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
  - 3. Operator: Minimum 1/4 inch (6 mm) diameter rod in self aligning, universal joint action, flanged bushing with set screw.
- C. Single Blade Dampers:
  - 1. Fabricate for duct sizes up to 6 by 30 inch (150 by 760 mm).
  - 2. Blade: 24 gauge, 0.0239 inch (0.61 mm), minimum.
- D. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inches (200 by 1825 mm). Assemble center- and edge-crimped blades in prime-coated or galvanized-channel frame with suitable hardware.
  - 1. Blade: 18 gauge, 0.0478 inch (1.21 mm), minimum.
- E. End Bearings: Except in round ducts 12 inches (300 mm) and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.
  - 1. Manufacturers:
    - a. Carlisle HVAC Products; Dynair End Bearing Leak Resistant Sets: [www.carlislehvac.com/](http://www.carlislehvac.com/)
    - b. Elgen Manufacturing Company, Inc: [www.elgenmfg.com/](http://www.elgenmfg.com/)
    - c. Substitutions: See Section 01 6000 - Product Requirements.
- F. Quadrants:
  - 1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
  - 2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
  - 3. Where rod lengths exceed 30 inches (750 mm) provide regulator at both ends.
  - 4. Manufacturers:
    - a. Carlisle HVAC Products; Dynair Double Shear Rattle Free Quadrants 1/2 inch: [www.carlislehvac.com/](http://www.carlislehvac.com/)
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## **2.09 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS**

- A. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc (15.2 L/sec/sq m at 0.25 kPa).
- B. Frame:
  - 1. Material: 20-gauge galvanized steel.
  - 2. Free-area: Single cross section.

3. Blanked-off: Split frame into two free-area sections to allow a smaller free-area to be used for a minimum airflow intake or exhaust application and secondary free-area fully blanked-off.
- C. Blade:
  1. Type: Single-blade rectangle shape.
  2. Operation: Opposed type.
  3. Maximum Individual Blade Height: 8 inches (203 mm).
  4. Material: 12-gauge galvanized steel.
  5. Authority: Opposed type, 5 to 50 percent (typically 10 percent).
- D. Insulation: Water-resistant sound absorbing material.
- E. Temperature Service Range: Minus 25 to 185 degrees F (Minus 32 to 85 degrees C).

## **2.10 MISCELLANEOUS PRODUCTS**

- A. Internal Strut End Plugs: Combination end-mounting and sealing plugs for metal conduit used as internal reinforcement struts for metal ducts; plug crimped inside conduit with outside gasketed washer seal.
  1. Manufacturers:
    - a. Carlisle HVAC Products; Dynair Internal Duct Reinforcement - Conduplugs: [www.carlislehvac.com/](http://www.carlislehvac.com/)
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
  1. Thickness: 2 mils (0.6 mm).
  2. High tack water based adhesive.
  3. UV stable light blue color.
  4. Elongation Before Break: 325 percent, minimum.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Verify that electric power is available and of the correct characteristics.

### **3.02 INSTALLATION**

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.
- B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.
- C. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch (200 by 200 mm) size access door for hand and shoulder access, or as indicated on drawings. Provide minimum 4 by 4 inch (100 by 100 mm) size access door for balancing dampers only. Review locations prior to fabrication.
- D. Provide duct test holes where indicated and required for testing and balancing purposes.
- E. Provide fire dampers at locations indicated, where ducts and outlets pass through fire-rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- F. Demonstrate re-setting of fire dampers to Owner's representative.
- G. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.
- H. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

- I. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.
- J. Use splitter dampers only where indicated.
- K. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly or shown on the drawings.

**END OF SECTION 23 3300**

**SECTION 23 3439**  
**HIGH-VOLUME, LOW-SPEED PROPELLER FANS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. High-volume, low-speed propeller fans.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connection.

**1.03 REFERENCE STANDARDS**

- A. AMCA 99 - Standards Handbook; 2016.
- B. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- C. NEMA MG 1 - Motors and Generators; 2021.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. UL 507 - Electric Fans; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

**1.05 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for parts and labor.

**PART 2 PRODUCTS**

**2.01 GENERAL REQUIREMENTS**

- A. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 507.
- B. Static and Dynamically Balanced: Comply with AMCA 204.
- C. Fabrication: Comply with AMCA 99.
- D. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**2.02 HIGH-VOLUME, LOW-SPEED PROPELLER FANS**

- A. Manufacturers:
  - 1. Big Ass Fans; <https://bigassfans.com/>
  - 2. Greenheck Fan Corporation; <https://www.greenheck.com/>
  - 3. Macroair; <https://macroairfans.com/>
  - 4. Hunter Fan International: [www.hunterfan.com/](http://www.hunterfan.com/)
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Direct Drive Fan:
  - 1. Statically and dynamically balanced.
  - 2. Motors:
    - a. Totally enclosed fan cooled (TEFC).
    - b. Heavy duty ball bearing type.

- c. Mount on vibration isolators or resilient cradle mounts, out-of-airstream.
  - d. Fully accessible for maintenance.
- C. Shafts and Bearings:
  - 1. Fan Shaft:
    - a. Ground and polished steel with anti-corrosive coating.
    - b. First critical speed at least 25 percent over maximum cataloged operating speed.
  - 2. Bearings:
    - a. Permanently sealed or pillow block type.
    - b. Minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
    - c. 100 percent factory tested.
- D. Disconnect Switches:
  - 1. Factory mounted and wired.
  - 2. Environment Type per NEMA 250: As indicated on the drawings.
  - 3. Finish for Painted Steel Enclosures: Provide manufacturer's standard unless otherwise indicated.
  - 4. Positive electrical shutoff.
  - 5. Wired from fan motor to junction box installed within motor compartment.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Secure fan with stainless steel lag screws to structure.
- C. Ceiling-mounted Fans:
  - 1. Install fans with resilient mountings and flexible electrical leads. See Section 23 0548.

**END OF SECTION 23 3439**

**SECTION 23 3416  
CENTRIFUGAL HVAC FANS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Backward inclined centrifugal fans.
- B. Airfoil wheel centrifugal fans.
- C. Bearings and drives.
- D. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 3300 - Air Duct Accessories: Backdraft dampers.
- C. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015 (Reaffirmed 2020).
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings; 2014 (Reaffirmed 2020).
- C. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- D. AMCA 99 - Standards Handbook; 2016.
- E. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.
- F. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.
- G. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- H. NEMA MG 1 - Motors and Generators; 2021.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on centrifugal fans and accessories including fan curves with specified operating point plotted, power, rpm, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect motors, shafts, and bearings from weather and construction dust.

**1.07 FIELD CONDITIONS**

- A. Permanent fans may not be used for ventilation during construction.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Loren Cook Company: [www.lorencook.com/](http://www.lorencook.com/)
- B. Greenheck Fan Corporation; <https://www.greenheck.com/>



- C. PennBarry, Division of Air System Components: [www.pennbarry.com/](http://www.pennbarry.com/)
- D. Twin City Fan & Blower: [www.tcf.com/](http://www.tcf.com/)
- E. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 PERFORMANCE REQUIREMENTS**

- A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. Fabrication: Comply with AMCA 99.
- D. Performance Base: Project-Specific elevation conditions.

## **2.03 WHEEL AND INLET**

- A. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and backplate; cast iron hub riveted to back plate and keyed to shaft with set screws.
- B. Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy backplate die-formed hollow airfoil shaped blades continuously welded at tip flange, and backplate; cast iron or cast steel hub riveted to backplate and keyed to shaft with set screws.

## **2.04 HOUSING**

- A. Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.

## **2.05 BEARINGS AND DRIVES**

- A. Bearings: Heavy duty pillow block type, selfgreasing ball bearings, with ABMA STD 9 life at 50,000 hours.
- B. Drives: As specified in the fan schedule drawings. If no drive is specified, provide Variable Frequency Drive (VFD) or Electronically-Commutated Motor (ECM) to effectuate speed control for the fan motor. **Do not use belt drives unless specifically called out on the drawings.**

## **2.06 ACCESSORIES**

- A. Inlet/Outlet Screens: Galvanized steel welded grid.
- B. Access Doors: Shaped to fit scroll, with quick opening latches and gaskets.
- C. Scroll Drain: 1/2 inch (13 mm) steel pipe coupling welded to low point of fan scroll.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install flexible connections between fan inlet and discharge ductwork; see Section 23 3300. Ensure metal bands of connectors are parallel with minimum one inch (25 mm) flex between ductwork and fan while running.
- C. Provide backdraft dampers on exhaust fans located at discharge side; see Section 23 3300.

**END OF SECTION 23 3416**

**SECTION 23 3501**  
**DRYER-VENT EXHAUST COLLECTION SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Laundry exhaust systems.
- B. Accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 0716 - HVAC Equipment Insulation.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AMCA 99 - Standards Handbook; 2016.
- B. ANSI Z223.1 - National Fuel Gas Code; 2024.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2024.
- E. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- F. UL 378 - Standard for Draft Equipment; Current Edition, Including All Revisions.
- G. UL 705 - Power Ventilators; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 3501.1:
  - 1. Product Data: Provide data indicating system components such as clothes dryer boosters, supply fans, dampers, controls, and factory-built chimneys. Also **include dimensional details of components** and flue caps, dimensions, weights, electrical characteristics, and connection requirements.
- C. Submittal 23 3501.2:
  - 1. Shop Drawings: Provide sealed engineered drawings that indicate general construction, dimensions, weights, support, and layout of breechings and ductwork. Also include the following, at minimum:
    - a. Layout drawings indicating plan view and elevations.
    - b. Calculations showing that the dryer exhaust system meets the specific needs of the manufacturer's installation requirements for each connected appliance.
    - c. ASHRAE Chimney Equation design calculations.

**1.05 QUALITY ASSURANCE**

- A. Designer Qualifications: Design laundry exhaust systems under direct supervision of a Professional Engineer experienced in design of the type of work specified and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

**1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide limited lifetime manufacturer warranty for functional failure. Complete forms in Owner's name and register with manufacturer.

- C. Special Warranty: Provide five-year warranty for installation failure commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.

## **PART 2 PRODUCTS**

### **2.01 GENERAL REQUIREMENTS**

- A. Regulatory Requirements:
1. Comply with ANSI Z223.1.
  2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### **2.02 LAUNDRY EXHAUST SYSTEMS**

- A. Manufacturers:
1. LFSystems, a Division of RM Manifold Group; LES: [www.lfsystems.net/](http://www.lfsystems.net/)
- B. Fabrication: Direct-drive, backward-curved fan enclosed in galvanized steel housing.
- C. Comply with AMCA 99, UL 378, and UL 705.
- D. Maximum Fan Temperature Rating: 480 degrees F (248 degrees C) of exhaust gas.
- E. Electrical Characteristics:
1. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.

### **2.03 ACCESSORIES**

- A. Inline Lint Collector:
1. Construction: Stainless steel housing with access panel and replaceable filter.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Use fittings, accessories, and ductwork that are UL-listed for use in dryer duct systems.
- C. Install dryer exhaust duct stacks, breechings, and ductwork with minimum of joints. Align accurately at connections with smooth internal surfaces.
- D. Rigidly support shafts, stacks, and ductwork from building structure with suitable ties, braces, hangers, and anchors to hold shape and prevent buckling. Support vertical breechings, chimneys, and stacks at 4 foot (4 m) intervals, to adjacent structural surfaces, and at floor penetrations. Refer to SMACNA (DCS) for equivalent duct support configuration and size. Provide each vertical riser with a means for cleanout (such as access to readily disassemble and reassemble ductwork). Do not provide tees in exhaust ductwork unless specifically noted otherwise.
- E. Install only UL-listed smooth long-radius ells in ducts for dryer exhaust ducts with minimum radius equal to 1.5 times the diameter of the exhaust duct, that are labeled and rated for zero reduction in total length. Do not use standard ells, or ells that are not listed for zero reduction in length.
- F. Install straight lengths of dryer exhaust ducts using rated fittings installed in accordance with fitting manufacturer's instructions. Insert ends of ducts shall extend into adjoining ducts or fittings in the direction of airflow.
- G. Do not manifold dryer exhaust ducts together unless specifically noted on drawings. When manifolding stand-alone dryer exhaust ducts together, provide delegated design with UL-listed and labeled system consisting of components designed and rated for the specific appliances to be exhausted, and complying with the appliance manufacturer's instructions. Field-fabricated manifold systems for dryer exhaust appliances are not permitted.
- H. Do not join ducts with fasteners that extend more than 1/8" (3.2mm) into the inside of the ducts.

- I. Seal all joints and seams in dryer exhaust ducts airtight using high-temperature aluminum foil tape rated to at least 600 degrees F and UL-listed for heat shielding applications. The use of duct tape as a means of fastening is not permitted.
- J. PROTECTION:
  - 1. Ducts installed within wall or ceiling cavities shall have sufficient space to be installed without deformation of ductwork.
  - 2. Provide minimum 0.062-inch (1.5mm) thick protective galvanized steel shield plates for all ducts in walls where penetration by screws or fasteners are a risk, including, but not limited to, any place where distance between duct and finished face of the framing member is less than 1-1/4". Shield plates shall extend not less than 2" above sole plates and below top plates.
- K. The total equivalent length of **each dryer exhaust duct system (regardless of total equivalent length)** shall be identified on a permanent label or tag placed on the duct in a visible location within 6'-0" of the exhaust duct connection to the appliance. See section 23 0553 - Identification for HVAC Piping and Equipment for dryer exhaust duct label details.
- L. Coordinate installation of dampers and induced draft fans; see Section 26 0583.
- M. Insulate breechings; see Section 23 0716.
- N. Maintain UL listed minimum clearances from combustibles. Assemble pipe and accessories as required for complete installation. Roof and wall penetrations shall be factory insulated and UL listed as not to require air ventilation for safe installation around combustible materials.
- O. Assemble and install stack sections in accordance with NFPA 82, industry practices, and complying with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- P. Level and plumb stacks.
- Q. Clean breechings, chimneys, and stacks during installation, removing dust and debris.
- R. At appliances, provide slip joints permitting removal of appliances without removing or dismantling breechings, breeching insulation, chimneys, or stacks.
- S. Provide an appliance exhaust wall receptacle sized to fit the maximum stud depth to connect to each stand-alone appliances.
- T. Provide a UL-listed transition duct accessory to connect each appliance to its associated dryer exhaust system. Do not install any portion of transition ducts within concealed construction. Cut transition duct to length to ensure system has only the minimum slack required for maintenance and access for the appliance served.

**END OF SECTION 23 3501**

**SECTION 23 3600  
AIR TERMINAL UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single-duct terminal units.

**1.02 RELATED REQUIREMENTS**

- A. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- B. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats and actuators.
- C. Section 23 0993 - Sequence of Operations for HVAC Controls.
- D. Section 23 3100 - HVAC Ducts and Casings.
- E. Section 23 3300 - Air Duct Accessories.
- F. Section 23 3700 - Air Outlets and Inlets.
- G. Section 25 1400 - Integrated Automation Local Control Units: HVAC controllers.

**1.03 REFERENCE STANDARDS**

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
- B. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- D. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- J. UL 94 - Tests for Flammability of Plastic Materials for Parts in Devices and Appliances; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

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

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 3600.1:
  - 1. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate air flow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

**PART 2 PRODUCTS**

**2.01 SINGLE-DUCT TERMINAL UNITS**

- A. Manufacturers:
  - 1. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp.; \_\_\_\_\_: [www.commercial.carrier.com/](http://www.commercial.carrier.com/)

2. Johnson Controls, Inc; \_\_\_\_\_: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
  3. Metalaire, a brand of Metal Industries Inc; \_\_\_\_\_: [www.metalair.com/](http://www.metalair.com/)
  4. Price Industries, Inc: [www.priceindustries.com/](http://www.priceindustries.com/)
  5. Trane, a brand of Ingersoll Rand: [www.trane.com/](http://www.trane.com/)
  6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Basis of Design: As scheduled on drawings.
- C. General:
1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
  2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.
- D. Unit Casing:
1. Minimum 22 gauge, 0.0299 inch (0.76 mm) galvanized steel.
  2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
  3. Unit Discharge: Rectangular, with slip-and-drive connections.
  4. Acceptable Liners:
    - a. 3/4 inch (19 mm) thick polyurethane foam adhesive complying with UL 181 erosion requirements in accordance with ASHRAE Std 62.1, and having a maximum smoke developed index of 50 for both insulation and adhesive, when tested in accordance with ASTM E84.
    - b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.
- E. Sound Attenuator:
1. Provide if required to meet scheduled acoustical performance requirements.
  2. Construction to consist of a continuous extension of the casing and liner as required to achieve required attenuation.
  3. At 2000 fpm (10.16 m/s) inlet velocity, the minimum operating pressure with attenuator added not to exceed 0.14 inch wg (34.84 Pa).
- F. Damper Assembly:
1. Heavy-gauge, galvanized steel or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
  2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
  3. Incorporate low leak damper blades for tight airflow shutoff.
- G. Electric Heating Coil:
1. Listed and provided by the terminal unit manufacturer.
  2. Coil Casing: 20 gauge, 0.0359 inch (0.92 mm) galvanized steel.
  3. Heating Elements: Nickel chrome, supported by ceramic insulators.
  4. Integral Control Panel: NEMA 250, Type 2 enclosure with hinged access door for access to all controls and safety devices.
  5. Furnish a primary automatic reset thermal cutout and differential pressure airflow switch for proof of airflow.
  6. Provide the following additional components, mounted and/or wired within the control enclosure:
    - a. Fused or non-fused door interlocking disconnect switch.
    - b. Mercury contactors.
    - c. Fuse block.
  7. Factory wired, including all limit switches and steps of control as indicated on the equipment schedule, with the SSR (solid-state relay) proportional heat control.

8. Provide SCR (Silicon Controlled Rectifier) controller, regardless of staging or control levels indicated on drawings.
- H. Electrical Requirements:
  1. Single-point power connection.
  2. Equipment wiring to comply with requirements of NFPA 70.
- I. Controls:
  1. DDC (Direct-Digital Controls):
    - a. Basis of Design: as scheduled on drawings.
      - 1) The unit level controller to include the following:
        - (a) 24 VAC power terminal or RJ-12 Power connection.
        - (b) T-Stat Port for thermostat connection.
        - (c) Service Port for Price Linker diagnostic equipment.
        - (d) Damper actuator.
        - (e) Fan output connection.
        - (f) LED indication for troubleshooting.
        - (g) Three binary staged heating outputs.
        - (h) Binary cooling output.
        - (i) S.A.T. sensor input.
        - (j) Contact closure input.
        - (k) Four analog outputs.
    - b. Include a factory-installed, unit-mounted, direct-digital controller.
    - c. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
    - d. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFM's.
      - 1) Occupied and unoccupied operating mode.
      - 2) Remote reset of temperature or CFM set points.
      - 3) Proportional, plus integral control of room temperature.
      - 4) Monitoring and adjusting with portable terminal.
    - e. Room Sensor:
      - 1) Compatible with temperature controls specified.
      - 2) Wall-mounted, system powered, with temperature set-point adjustment including connection access for portable operator terminal.
    - f. See Section 25 1400.
  2. Airflow Sensor: Differential pressure airflow device measuring total, static, and wake pressures.
    - a. Sensor Construction:
      - 1) Plastic parts are fire-resistant, complying with UL 94.
      - 2) Provides accuracy within 5 percent with a 90 degree sheet metal elbow directly at the inlet of the assembly.
      - 3) Control tubing is protected by grommets at the wall of the air flow sensor's housing.
      - 4) Furnished with twelve total pressure sensing ports and a center averaging chamber that amplifies the sensed air flow signal.
      - 5) Provide sensor with a pressure transducer to interface with a DDC system.
      - 6) Provide velocity pressure sensor with a removable access section for maintenance.
    - b. Signal accuracy: Plus/minus five percent throughout terminal operating range.
  3. Control Sequence:
    - a. Suitable for operation with duct pressures between 0.25 and 3.0 inch wg (60 and 750 Pa) inlet static pressure.
    - b. Include factory-mounted and piped, 5-micron filter; and adjustable, velocity-resetting, high-limit control with amplifying relay.
    - c. See Section 23 0993.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

#### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.
- C. Provide ceiling access doors or locate units above easily removable ceiling components.
- D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 23 0548.
- E. Do not support from ductwork.
- F. Connect to ductwork in accordance with Section 23 3100.
- G. Provide minimum of 10 ft (\_\_\_ m) of 1 inch (25 mm) thick lined ductwork downstream of units. See Section 23 0713 - Duct Insulation for lining details.
- H. Verify that electric power is available and of the correct characteristics.

#### **3.03 ADJUSTING**

- A. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to zero percent full flow. Set units with heating coils for minimum 50 percent full flow.

#### **3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, instruct, and observe field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.
  - 1. Operational Test:
    - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
    - b. Test and adjust controls and safeties.
    - c. Replace damaged and malfunctioning controls and other equipment.
    - d. Remove and replace malfunctioning units and retest as specified above.

#### **3.05 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

#### **3.06 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

**END OF SECTION 23 3600**



**SECTION 23 3700  
AIR OUTLETS AND INLETS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Diffusers:
  - 1. Critical environment diffusers.
  - 2. Perforated ceiling diffusers.
  - 3. Rectangular ceiling diffusers.
  - 4. Round ceiling diffusers.
  - 5. Slot ceiling diffusers.
- B. Registers/grilles:
  - 1. Ceiling-mounted, egg crate exhaust and return register/grilles.
  - 2. Ceiling-mounted, exhaust and return register/grilles.
  - 3. Ceiling-mounted, linear exhaust and return register/grilles.
  - 4. Ceiling-mounted, supply register/grilles.
  - 5. Wall-mounted, supply register/grilles.
  - 6. Wall-mounted, exhaust and return register/grilles.
- C. Door grilles.
- D. Louvers:
  - 1. Combination louvers.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

**1.03 REFERENCE STANDARDS**

- A. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
- B. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2012, with Editorial Revision (2015).
- C. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- D. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.
- E. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- H. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- I. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.
- L. UL 2518 - Standard for Safety Air Dispersion Systems; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 3700.1:
  - 1. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Krueger-HVAC: [www.krueger-hvac.com/](http://www.krueger-hvac.com/)
- B. Metalaire, a brand of Metal Industries Inc: [www.metalaire.com/](http://www.metalaire.com/)
- C. Price Industries: [www.price-hvac.com/](http://www.price-hvac.com/)
- D. Ruskin Company: [www.ruskin.com/](http://www.ruskin.com/)
- E. Titus, a brand of Air Distribution Technologies: [www.titus-hvac.com/](http://www.titus-hvac.com/)
- F. Nailor Industries, Inc: [www.nailor.com/](http://www.nailor.com/)
- G. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 RECTANGULAR CEILING DIFFUSERS**

- A. Type: Provide drawing-scheduled diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated.
- B. Connections: Round.
- C. Frame: Provide snap-in type.
- D. Fabrication: Steel or Aluminum with baked enamel finish.
- E. Color: As selected by Architect from manufacturer's full range.

### **2.03 PERFORATED FACE CEILING DIFFUSERS**

- A. Type: Perforated face with fully adjustable pattern and removable face.
- B. Frame: Snap-in type.
- C. Fabrication: Steel or aluminum with matching frame and baked enamel finish.
- D. Color: As selected by Architect from manufacturer's full range.

### **2.04 CEILING EGG CRATE EXHAUST AND RETURN GRILLES**

- A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch (13 by 13 by 13 mm), 1/2 by 1/2 by 1 inch (13 by 13 by 25 mm), and 1 by 1 by 1 inch (25 by 25 by 25 mm) grid core.
- B. Fabrication: Grid core consists of aluminum or steel with baked enamel finish.
- C. Color: To be selected by Architect from manufacturer's full range.
- D. Frame: Channel lay-in frame for suspended grid ceilings.
- E. Accessories: Provide 45 degree angled eggcrate or other similar provisions for visual blocking such as angled louver, 90 degree duct elbow, etc. where scheduled on drawings. Inside of visual blocking device should be painted flat black.

### **2.05 WALL SUPPLY REGISTERS/GRILLES**

- A. Type: Streamlined and individually adjustable blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing with spring or other device to set blades, vertical face, single deflection.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- C. Fabrication: Steel with 20 gauge, 0.0359 inch (0.91 mm) minimum frames and 22 gauge, 0.0299 inch (0.76 mm) minimum blades, steel and aluminum with 20 gauge, 0.0359 inch (0.91 mm) minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's full range.

### **2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Type: Streamlined blades, 3/4 inch (19 mm) minimum depth, 3/4 inch (19 mm) maximum spacing, with spring or other device to set blades, vertical face.
- B. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting.

- C. Fabrication: Steel frames and blades, with factory baked enamel finish.
- D. Color: To be selected by Architect from manufacturer's full range.

## **2.07 CRITICAL ENVIRONMENTS DIFFUSERS**

- A. General Requirements:
  - 1. Diffuser material to comply with ASTM E84, UL 723, UL 2518, NFPA 90A, and NFPA 90B.
- B. Laminar Flow Diffusers:
  - 1. Construction: Stainless steel.
  - 2. Frame: Provide framing per manufacturer's recommendations.
  - 3. Dimensions: As indicated on the drawings.

## **2.08 LOUVERS**

- A. Manufacturers:
  - 1. NCA, a brand of Metal Industries Inc: [www.ncamfg.com/](http://www.ncamfg.com/)
  - 2. Ruskin Company: [www.ruskin.com/](http://www.ruskin.com/)
  - 3. Greenheck Fan Corporation: <https://www.greenheck.com/sle#>
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type: 6 inch (150 mm) deep frame with drainable blades on 45 degree slope with center baffle and return bend, heavy channel frame, with factory furnished integral 1/2 inch (13 mm) square pvc-coated stainless steel mesh screen.
- C. Fabrication: Aluminum assembly, with factory Kynar 500 prime coat finish.
- D. Color: To be selected by Architect from manufacturer's full range.

## **2.09 COMBINATION LOUVERS**

- A. Damper-combined, drainable louver:
- B. Size: As indicated on the drawings.
- C. Material: Extruded galvanized steel.
- D. Linkage: Concealed in frame.
- E. Custom Features: Include architectural finish.
- F. Insulation: Water-resistant sound absorbing material.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 9123.

### **3.02 PROTECTION**

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

**END OF SECTION 23 3700**

**SECTION 23 4000  
HVAC AIR CLEANING DEVICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Disposable panel filters.
- B. High-efficiency particulate (HEPA) air filters.
- C. Washable permanent panel filters.
- D. Filter frames and housings.
- E. Filter gauges.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 5000 - Temporary Facilities and Controls: Filters for temporary heating and ventilating.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 850 (I-P) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).
- B. AHRI 851 (SI) - Performance Rating of Commercial and Industrial Air Filter Equipment; 2013 (Reaffirmed 2023).
- C. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
- D. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; 2015b.
- E. UL 586 - High Efficiency, Particulate, Air Filter Units; Current Edition, Including All Revisions.
- F. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.

**1.05 QUALITY ASSURANCE**

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**PART 2 PRODUCTS**

**2.01 FILTER MANUFACTURERS**

- A. AAF International/American Air Filter: [www.aafintl.com/](http://www.aafintl.com/)
- B. The Camfil Group: [www.camfilfarr.com/](http://www.camfilfarr.com/)
- C. Basis of Design: Filters For Industry; <https://filtersforindustry.com/>
- D. Substitutions: See Section 01 6000 - Product Requirements.

**2.02 PERFORMANCE REQUIREMENTS**

- A. Comply with the rating requirements in AHRI 851 (SI).

**2.03 DISPOSABLE PANEL FILTERS**

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
  - 1. Thickness: 1 inch (25 mm).

- B. Performance Rating:
  - 1. Face Velocity: 500 fpm (2.54 m/s).
  - 2. Initial Resistance: 0.15 in-wc (37 Pa).
  - 3. Recommended Final Resistance: 0.50 inches WG (125 Pa).
  - 4. Minimum Efficiency Reporting Value (MERV) Rating: 13, unless scheduled otherwise on drawings.
- C. Holding Frames: 20 gauge, 0.0359 inch (0.91 mm) minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

#### **2.04 HIGH EFFICIENCY PARTICULATE (HEPA) AIR FILTERS**

- A. Media: UL 586, pleated, water-resistant glass fiber with aluminum separators:
  - 1. Face Gasket: Neoprene expanded rubber.
- B. Performance Rating:
  - 1. Efficiency: 99.97 percent at 0.3 micro-meter and higher when tested in accordance with the DOP-smoke (Dioctyl Phthalate) Penetration Test on MIL-STD-282.
  - 2. Leakage Scan Tested: Certified as pinhole-free at:
    - a. Air velocity capacity of 500 fps (152.4 m/s).
    - b. Resistance from 0.5 in-wc (124.3 Pa) to 2.0 in-wc (497.9 Pa).

#### **2.05 WASHABLE PERMANENT PANEL FILTERS**

- A. As furnished by equipment manufacturer only.

#### **2.06 FILTER FRAMES AND HOUSINGS**

- A. General: Fabricate filter frames and supporting structures of 16 gauge, 0.0598 inch (1.52 mm) galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.
- B. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gauge, 0.0598 inch (1.52 mm) galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for primary secondary filters with positive sealing gaskets. Access panels to have thumb-actuated cam latches.

#### **2.07 FILTER GAUGES**

- A. Manufacturers:
  - 1. Dwyer Instruments, Inc: [www.dwyer-inst.com/](http://www.dwyer-inst.com/)
  - 2. H.O. Trerice Co: [www.trerice.com/](http://www.trerice.com/)
  - 3. Weiss Instruments: [www.weissinstruments.com/](http://www.weissinstruments.com/)
  - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Direct Reading Dial: 3-1/2 inch (90 mm) diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0 to 0.5 in-wc (0 to 125 Pa), 2 percent of full scale accuracy.
- C. Accessories: Static pressure tips with integral compression fittings, 1/4 inch (6 mm) aluminum tubing, 2-way or 3-way vent valves.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Install filter gauge static pressure tips upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing, with clean set.

- E. Provide filter gauges on filter banks, installed with separate static pressure tips upstream and downstream of filters.

**END OF SECTION 23 4000**

**SECTION 23 5100  
BREECHINGS, CHIMNEYS, AND STACKS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Double wall metal stacks.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z21.66 - American National Standard for Automatic Damper Devices for Use with Gas-Fired Appliances; 2015 (Reaffirmed 2020).
- B. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- C. ASME B31.9 - Building Services Piping; 2020.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- E. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2023.
- F. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2023.
- G. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2023.
- H. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- L. NFPA 54 - National Fuel Gas Code; 2021.
- M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. NFPA 82 - Standard on Incinerators and Waste and Linen Handling Systems and Equipment; 2024.
- O. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.
- P. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- Q. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances; Current Edition, Including All Revisions.
- R. UL 127 - Standard for Factory-Built Fireplaces; Current Edition, Including All Revisions.
- S. UL 378 - Standard for Draft Equipment; Current Edition, Including All Revisions.
- T. UL 441 - Standard for Gas Vents; Current Edition, Including All Revisions.
- U. UL 641 - Type L Low Temperature Venting Systems; Current Edition, Including All Revisions.

- V. UL 959 - Medium Heat Appliance Factory Built Chimneys; Current Edition, Including All Revisions.
- W. UL-1738 - Standard for Venting Systems for Gas-Burning Appliances, Categories II, III, and IV; Current Edition.

#### **1.04 DEFINITIONS**

- A. Breeching: Vent connector.
- B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.
- C. Smoke Pipe: Round, single wall vent connector.
- D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.
- E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

#### **1.05 ADMINISTRATIVE REQUIREMENTS**

- A. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

#### **1.06 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

#### **1.07 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years documented experience, and approved by manufacturer.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Centrotherm North America; : <https://www.centrotherm.us.com/Home.aspx/>
- B. DuraVent; : [www.duravent.com/](http://www.duravent.com/)
- C. Enervex, Inc; : [www.enervex.com/](http://www.enervex.com/)
- D. Heatfab; : <http://www.heatfab.com/>
- E. Jeremias Exhaust Systems; : <https://jeremiasinc.com/>
- F. Security Chimneys International; : [www.securitychimneys.com/](http://www.securitychimneys.com/)
- G. Selkirk Corporation; Model IPS: [www.selkirkcommercial.com/](http://www.selkirkcommercial.com/)
- H. US Draft Co, a division of RM Manifold Group, Inc; : [www.usdraftco.com/](http://www.usdraftco.com/)
- I. Van-Packer; : <https://vpstack.com/>
- J. Z-Flex U.S. Inc: [www.z-flex.com/](http://www.z-flex.com/)
- K. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS**

- A. Regulatory Requirements:
  - 1. Comply with applicable codes for installation of natural gas burning appliances and equipment.



2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### **2.03 CATEGORY IV PLASTIC GAS VENTS**

- A. Provide prefabricated single-wall system listed to UL-1738 Gas Vent for Category II and IV Appliances. Complete vent system from appliance outlet to termination point, including accessories, shall be provided by one manufacturer, except where noted.
- B. Accessories, UL Labeled:
  1. Appliance flue connector
  2. Boot tees
  3. Drain caps or inline drains
  4. Stack Supports
  5. Roof flashings
  6. Termination.

### **2.04 DOUBLE WALL METAL STACKS**

- A. Provide double wall metal stacks, tested to UL-1738 and UL listed with positive pressure rating, for use with building heating equipment, in compliance with NFPA 54.
- B. Fabricate with 1 inch (25 mm) minimum air space between walls and construct outer jacket of 304 stainless steel and inner liner of AL29-4C stainless steel, or UL-1738/Code-Approved Stainless Steel.
  1. Protect aluminized steel surfaces exposed to elements with minimum of one base coat of primer and one finish coat of corrosion-resistant paint suitable for outer jacket skin temperatures of application.
  2. For corrosive environments, fabricate both inner lining and outer jacket of AL29-4C stainless steel or UL-1738/Code-Approved Stainless Steel.
- C. Design, fabricate, and install gastight to prevent products of combustion from leaking into building.
  1. Securely connect inner joints, and seal with factory-supplied overlapping V-bands and appropriate sealant in accordance with manufacturer's instructions.
  2. Design system to compensate for flue-gas-induced thermal expansion.
- D. Accessories, UL Labeled:
  1. Ventilated Roof Thimble: Consists of roof penetration, vent flashing with spacers, and storm collar.
  2. Rain/Stack Cap: Consists of conical rainshield with inverted cone for partial rain protection with low flow resistance.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. **Install in accordance with manufacturer's instructions and NFPA 54. Where these standards differ, use the more stringent requirement.**
- B. Install concrete inserts for support of venting system in coordination with formwork.
- C. Assemble and install stack sections in accordance with NFPA 82, UL Listings, and industry practices. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.
- D. Level and plumb chimney and stacks.

**END OF SECTION 23 5100**

**SECTION 23 7413**  
**PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Packaged roof top unit.
- B. Unit controls.
- C. Remote panel.
- D. Roof mounting curb and base.
- E. Maintenance service.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 6200 - Sheet Metal Flashing and Trim.
- B. Section 07 7200 - Roof Accessories: Placement and installation of factory fabricated roof mounting curbs.
- C. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- D. Section 23 0913 - Instrumentation and Control Devices for HVAC: Installation of thermostats and other controls components.
- E. Section 23 4000 - HVAC Air Cleaning Devices.
- F. Section 26 0583 - Wiring Connections: Installation and wiring of thermostats and other controls components; wiring from unit terminal strip to remote panel.
- G. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015, with Addendum (2016).
- C. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.
- D. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Submittal 23 7413.1:
  - 1. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
  - 2. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
  - 3. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.
- C. Submittal 23 7413.2:
  - 1. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

- D. Submittal 23 7413.3: Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    - a. See Section 01 6000 - Product Requirements for additional provisions.
    - b. Extra Filters: One set for each unit.

### **1.05 QUALITY ASSURANCE**

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Greenheck;: [www.greenheck.com/](http://www.greenheck.com/)
- B. Daikin Applied; <https://www.daikinapplied.com/>
- C. Valent Air Management Systems; <http://www.valentair.com/>
- D. Aaon Heating & Cooling; <https://aaon.com/>
- E. Addison HVAC; : <https://www.addison-hvac.com/>
- F. Carrier, a part of UTC Building and Industrial Systems, a unit of United Technologies Corp: [www.carrier.com/](http://www.carrier.com/)
- G. Trane Technologies: [www.trane.com/](http://www.trane.com/)
- H. York International Corporation/Johnson Controls Inc: [www.johnsoncontrols.com/](http://www.johnsoncontrols.com/)
- I. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 MANUFACTURED UNITS**

- A. General: Roof mounted units having gas burner and electric refrigeration.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner, heat recovery coil, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan, unless otherwise noted.
- C. Performance Ratings: Energy Efficiency Rating (EER)/Coefficient of Performance (COP) not less than requirements of ASHRAE Std 90.1, and not less than 97.5% of ALL scheduled performance metrics on the drawings.
- D. Scheduled Performance: AHRI 210/240 test conditions.
- E. Accessories:
  - 1. As listed on the drawings.
- F. Electrical Characteristics:
  - 1. Refer to Section 26 0583 - Wiring Connections.
  - 2. See electrical drawings for voltage, phase, and overcurrent protection requirements.
  - 3. Unit shall have single-point electrical connection unless specifically noted otherwise.
  - 4. Accessories:
    - a. Include unit-mounted factory-furnished integral disconnect unless specifically noted otherwise.
    - b. Include unit-mounted factory-furnished integral 120V service receptacle. Receptacle shall be configured to remain energized when unit-only disconnect is deactivated. Receptacle shall be energized through the unit single-point connection unless specifically noted otherwise.

- G. Disconnect Switch: Factory mount disconnect switch in control panel.

## **2.03 FABRICATION**

- A. Cabinet: G90 galvanized or G60 galvaneal Steel with baked enamel finish, including access doors with locking handle. Structural members shall be minimum 18 gauge, 0.0478 inch (1.21 mm), with access doors or panels of minimum 20 gauge, 0.0359 inch (0.91 mm).
- B. Insulation: 1/2 inch (13 mm) thick neoprene coated glass fiber with edges protected from erosion.
- C. Heat Exchangers: Aluminized steel, of welded construction.
- D. Fans: Resiliently mounted with electric direct drive, and having neoprene vibration isolated high efficiency motor or direct drive as indicated. Motors larger than 3/4 hp shall be "NEMA Premium" efficiency. Refer to Section 23 0513 - Common Motor Requirements for HVAC Equipment and 23 0548 - Vibration and Seismic Controls for HVAC.
1. Motor Drive: Direct drive motors serving fans with airflows less than 2,500 CFM shall be equipped with speed control for High/Low operation at a minimum, unless specifically noted otherwise on the drawing schedules.
  2. Motors serving fans with airflows above 2,500 CFM shall be equipped with Variable Frequency Drive (VFD) controllers or shall be Electronically Commutated Motor (ECM) type unless specifically noted otherwise.
- E. Air Filters:
1. As scheduled on drawings.
- F. Mounting Curb: Factory-provided insulated 14 inches (350 mm) high galvanized steel assembly; channel frame with gaskets, nailer strips, and vibration isolation rail, designed specifically for the unit served. See drawings for additional configuration details (e.g., side discharge vs. vertical discharge, etc.).
1. Furnish units with sound-attenuating curbs meeting the seismic and wind design requirements of the project, and designed and sealed by a licensed professional engineer licensed in the state in which the project is constructed. See section 23 0548 - Vibration and Seismic Controls for HVAC for sound curb details.

## **2.04 BURNER**

- A. Gas Burner: Modulating Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut-off pilot.
- B. Stages as indicated on the drawing schedules.
- C. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

## **2.05 ENERGY RECOVERY UNITS**

- A. Energy Recovery Units: Where scheduled on drawings, provide sensible only stationary core air-to-air exchanger; prefabricated packaged system designed by manufacturer.
1. Provide unit with a AHRI 1060 (I-P) compliant air-to-air exchanger.
  2. Access: Hinged and/or screwed access panels on front.

## **2.06 EVAPORATOR COIL**

- A. Condensate drain pan: Welded austenitic stainless sheet steel, positively drain configuration, with drain connector sealed at penetration through cabinet wall.

## **2.07 COMPRESSOR**

- A. As scheduled on drawings.

**2.08 CONDENSER COIL**

- A. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.

**2.09 OPERATING CONTROLS**

- A. The unit shall be constructed so that it can function as a stand-alone heating and cooling system controlled by factory-supplied controllers, thermostats and sensors, or it can be operated as a heating and cooling system controlled by a Building Management System (BMS). This unit shall be controlled by a factory-installed microprocessor programmable controller (DDC) that is connected to various optional sensors.
- B. Unit shall incorporate a DDC controller with integral LCD screen that provides text readouts of status. DDC controller shall have a built-in keypad to permit operator to access read-out screens without the use of ancillary equipment, devices or software. DDC controllers that require the use of equipment or software that is not factory-installed in the unit are not acceptable. Alarm readouts consisting of flashing light codes are not acceptable. Owner-specified ventilating conditions can be input by means of pushbuttons.
- C. Unit controls must include all indicated points on drawing control points list and must be able to meet all requirements in Section 23 0913 - Instrumentation and Control Devices for HVAC, 23 0923 - Direct-Digital Control System for HVAC, and 23 0993 - Sequence of Operations for HVAC Controls. Verify compatibility of operating protocol with control system(s) indicated.
- D. Controls: Pre-wire unit for connection of power supply. Field wiring from unit to remote control panel makes unit operative.
- E. Provide terminal strip on unit for connection of operating controls to remote panel. Control shall allow for two stages of heating and two stages cooling.
- F. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135 BACnet MS/TP.

**2.10 HEAT RECOVERY COIL**

- A. Hot Gas Reheat:
  - 1. Provide copper tube aluminum fin coil assembly with multiple circuits arranged to provide heat recovery.
  - 2. Provide reheat coil with factory-installed modulating hot gas reheat valve.

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. Verify that roof or equipment pad (as indicated on drawings) is ready to receive work and opening dimensions are as indicated on shop drawings.
- B. Verify that proper power supply is available.
- C. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance.
- D. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements.
- E. Proceed with installation only after all unsatisfactory conditions have been corrected.
- F. Coordinate all items above with unit installation and operations manual.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- C. Acoustical Dampening (for units that are NOT specified to have listed and rated acoustical dampening curbs):

1. Install unit on curb with vibration isolators (if internal mechanical components are not fully isolated); refer to Sections 07 7200 - Roof Accessories and 23 0548 - Vibration and Seismic Controls for HVAC for details.
  2. Pack voids in roof curb using two layers of 5/8" thick mold-resistant gypsum board and four inches of mineral fiber wool insulation. Gypsum board layers should go beneath each layer of insulation. See mechanical drawings for details.
  3. Provide flexible duct connections on inlet and outlet from unit; refer to Section 23 3300 - Air Duct Accessories.
  4. Line ducts using minimum 1" acoustical lining (unless specifically noted otherwise on drawings) for minimum of 15'-0" downstream of the supply fan discharge and 15'-0" upstream of the return/exhaust fan intake connections. See Section 23 0713 - Duct Insulation.
- D. Condensate drain piping shall be insulated Copper Type L tubing or Schedule 40 UV-resistant Chlorinated Polyvinyl Chloride (CPVC) tubing. Provide a P-trap at the condensate drain connection. Trap shall be connected using threaded unions immediately upstream and downstream of the P-trap to allow for easy service and cleaning of trap. See Section 22 1005 - Plumbing Piping for details.

### 3.03 SYSTEM STARTUP

- A. Manufacturer's Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation, to include electrical and piping connections.

### 3.04 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training for additional requirements.

### 3.05 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements relating to maintenance service.
- B. Provide service and maintenance of packaged roof top units for one year year from Date of Substantial Completion.
- C. Provide routine maintenance service with a two month interval as maximum time period between calls.
- D. Include maintenance items as outlined in manufacturer's operating and maintenance data, including minimum of six filter replacements, minimum of one fan belt replacement, and controls check-out, adjustments, and recalibration.
- E. Provide 24-hour emergency service on breakdowns and malfunctions.
- F. After each service call, submit copy of service call work order or report that includes description of work performed.

**END OF SECTION 23 7413**

**SECTION 23 7416**  
**PACKAGED ROOFTOP AIR-CONDITIONING UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Packaged, intermediate-capacity, rooftop air-conditioning units.

**1.02 RELATED REQUIREMENTS**

- A. Section 06 1000 - Rough Carpentry: Materials and installation of field fabricated roof mounting curbs.
- B. Section 07 6200 - Sheet Metal Flashing and Trim.
- C. Section 07 7200 - Roof Accessories: Placement and installation of factory fabricated roof mounting curbs.
- D. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- E. Section 23 0913 - Instrumentation and Control Devices for HVAC: Control components, time clocks.
- F. Section 26 0583 - Wiring Connections: Installation and wiring of thermostats and other control components; wiring from unit terminal strip to remote panel.
- G. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

**1.03 REFERENCE STANDARDS**

- A. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015, with Addendum (2016).
- B. AMCA 611 - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations; 2015.
- C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).
- E. Bluetooth CS - Bluetooth Core Specification; 2016, Addendum 2017.
- F. IEEE 802.11 - IEEE Standard for Information Technology--Telecommunications and Information Exchange between Systems - Local and Metropolitan Area Networks--Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications; 2020 (Corrigendum 2022).
- G. IEEE 802.15.4 - IEEE Standard for Low-Rate Wireless Networks; 2024.
- H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- I. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.
- C. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

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

### **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide a five year warranty to include coverage for refrigeration compressors.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. AAON heating and cooling; \_\_\_\_\_: <https://aaon.com/>.
- B. Johnson Controls International, PLC; \_\_\_\_\_: [www.johnsoncontrols.com/#sle](http://www.johnsoncontrols.com/#sle).
- C. Greenheck; \_\_\_\_\_: [www.greenheck.com/](http://www.greenheck.com/).
- D. Trane Technologies, PLC; \_\_\_\_\_: [www.trane.com/#sle](http://www.trane.com/#sle).
- E. Daikin Applied; <https://daikinapplied.com/>\_\_\_\_\_.

### **2.02 PACKAGED, INTERMEDIATE-CAPACITY, ROOFTOP AIR-CONDITIONING UNITS**

- A. General: Roof mounted units having gas burner and electric refrigeration that are 7.5 tons to 25 tons in capacity.
- B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, return fan, heat exchanger and burner, heat recovery coil, controls, air filters, refrigerant cooling coil and compressor, condenser coil and condenser fan.
- C. Refrigerant: Use only refrigerants that have ozone depletion potential (ODP) of zero and global warming potential (GWP) of less than 50.
- D. Disconnect Switch: Factory mount disconnect switch in control panel.

### **2.03 CASING**

- A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver-operated flush, cam type fasteners. Structural members to be minimum 18 gauge, 0.0478 inch (1.21 mm), with access doors or panels of minimum 20 gauge, 0.0359 inch (0.91 mm).

### **2.04 FANS**

- A. Supply and Return Fan: Forward curved centrifugal type, resiliently mounted with V-belt drive, adjustable variable pitch pulley, and rubber isolated hinge mounted. Provide with high efficiency motor or direct drive as indicated. Isolate complete fan assembly. See Section 23 0548.

### **2.05 BURNERS**

- A. Gas Burner: Atmospheric type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut-off, intermittent spark or glow coil ignition, flame-sensing device, and automatic 100 percent shutoff pilot.
- B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after airflow proven and slight delay, allow gas valve to open.

### **2.06 EVAPORATOR COIL**

- A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
- B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons (21 kw) capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons (26 kw) cooling capacity and larger.

### **2.07 CONDENSER COIL**

- A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
- B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor. Provide high efficiency fan motors.
- C. Provide refrigerant pressure switches to cycle condenser fans.



**2.08 HEAT RECOVERY COIL**

- A. Provide copper tube aluminum fin coil assembly with multiple circuits arranged to provide heat recovery.

**2.09 COMPRESSORS**

- A. Provide hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gauge ports, and filter drier.

**2.10 AIR FILTERS:**

- A. As noted on the drawings.

**2.11 ROOF CURBS**

- A. Roof Mounting Curb: 14 inches (350 mm) high, galvanized steel, channel frame with gaskets, nailer strips.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that roof is ready to receive work and opening dimensions are as required by manufacturer.
- B. Verify that proper power supply is available.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NFPA 90A.
- C. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level.
- D. Locate remote panels where indicated on drawings.

**3.03 SYSTEM STARTUP**

- A. Prepare and start equipment. Adjust for proper operation.

**3.04 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals for additional submittals.
- B. See Section 01 7900 - Demonstration and Training for additional requirements.

**END OF SECTION 23 7416**

**SECTION 23 8126.13**  
**SMALL-CAPACITY SPLIT-SYSTEM AIR CONDITIONERS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Air cooled condensing units.
- B. Indoor air handling (fan and coil) units for ductless systems.
- C. Controls.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Mounting pad for outdoor unit.
- B. Section 22 1005 - Plumbing Piping: Includes indoor coil condensate drain.
- C. Section 22 3000 - Plumbing Equipment: Cooling condensate removal pumps.
- D. Section 23 0719 - HVAC Piping Insulation: Refrigerant piping insulation, protective covers, and exterior penetration assemblies.
- E. Section 23 0913 - Instrumentation and Control Devices for HVAC: Thermostats, humidistats, time clocks.
- F. Section 23 2300 - Refrigerant Piping: Refrigerant Piping

**1.03 REFERENCE STANDARDS**

- A. AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2023.
- B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.
- C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems; 2022, with Errata (2023).
- D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submittal 23 8126.13.1:
  - 1. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
  - 2. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- C. Submittal 23 8126.13.2:
  - 1. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- D. Submittal 23 8126.13.3:
  - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    - a. See Section 01 6000 - Product Requirements, for additional provisions.
    - b. Extra Filters: One for each unit.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Carrier Corporation: [www.carrier.com/](http://www.carrier.com/)

- B. Gree Commercial; : [www.greecommercial.com/](http://www.greecommercial.com/)
- C. LG Air Conditioning Technologies; <https://www.lghvac.com/>
- D. Daikin Applied; <https://www.daikinapplied.com/>
- E. Mitsubishi Electric; <https://www.mitsubishicomfort.com/>
- F. Rheem; <https://www.rheem.com/>
- G. Samsung HVAC; <https://www.samsunghvac.com/>
- H. Trane Inc: [www.trane.com/](http://www.trane.com/)
- I. Substitutions: See Section 01 6000 - Product Requirements.

## **2.02 SYSTEM DESIGN**

- A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.
  - 1. Heating: As scheduled on drawings.
  - 2. Cooling: Outdoor electric condensing unit with evaporator coil in central ducted indoor unit.
  - 3. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.
- B. Performance Requirements: See Drawings for additional requirements.

## **2.03 INDOOR AIR HANDLING UNITS**

- A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.
- B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.
  - 1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.
  - 2. Manufacturer: System manufacturer.
- C. Condensate Pump: Integral factory-installed or field-supplied factory-furnished self-priming condensate pump, minimum 50 ft. hd.

## **2.04 OUTDOOR UNITS**

- A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.
  - 1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.
- B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.
- C. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).
  - 1. Provide thermostatic expansion valves.
  - 2. Provide factory-furnished condenser hail guards.
- D. Operating Controls:
  - 1. Control by room thermostat to maintain room temperature setting.
  - 2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig (1965 kPa) and off when pressure drops below 140 psig (965 kPa) for operation to 0 degrees F (-18 degrees C).

## **2.05 ACCESSORY EQUIPMENT**

- A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage; with following features:

1. Capable of integration with Building Management System. See Section 23 0923 - Direct-Digital Control System for HVAC for details.
2. Automatic switching from heating to cooling.
3. Preferential rate control to minimize overshoot and deviation from setpoint.
4. Thermostat Display:
  - a. Actual room temperature.
  - b. System Mode Indication: Heating, Cooling, Fan Auto, Off, and On, Auto or On, Off.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install in accordance with NFPA 90A and NFPA 90B.
- B. Install refrigeration systems in accordance with ASHRAE Std 15 and Section 23 2300 - Refrigerant Piping.

**END OF SECTION 23 8126.13**

**SECTION 23 8200**  
**CONVECTION HEATING AND COOLING UNITS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electric unit heaters.
- B. Electric cabinet unit heaters.
- C. Thermostatic controls.

**1.02 RELATED REQUIREMENTS**

- A. Section 25 1400 - Integrated Automation Local Control Units: Smart sensors and thermostats.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections. Installation of room thermostats. Electrical supply to units.

**1.03 REFERENCE STANDARDS**

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. 23 8200.1:
  - 1. Product Data: Provide typical catalog of information including arrangements.
  - 2. Shop Drawings:
    - a. Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.
    - b. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
    - c. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
    - d. Indicate mechanical and electrical service locations and requirements.
- C. Submittal 23 8200.2:
  - 1. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- D. Submittal 23 8200.3:
  - 1. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    - a. See Section 01 6000 - Product Requirements for additional provisions.
    - b. Extra Filters: One set of each type and size.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

**1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

**PART 2 PRODUCTS**

**2.01 ELECTRIC UNIT HEATERS**

- A. Manufacturers:
  - 1. INDEECO (Industrial Engineering and Equipment Company): [www.indeeco.com/](http://www.indeeco.com/)
  - 2. Marley Engineered Products: <https://www.marleymep.com/>
  - 3. Modine Manufacturing Company: [www.modineHVAC.com/](http://www.modineHVAC.com/)

4. QMark Engineered Products: <http://www.qmarkea.com/>
  5. Reznor HVAC: <https://www.reznorhvac.com/>
  6. Stelpro Design Inc: [www.stelpro.com/](http://www.stelpro.com/)
  7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- C. Heating Element Assembly:
1. Thermal safety cut-out within electric terminal box with automatically reset switch located near electric terminal box.
- D. Housing:
1. Suitable for ceiling or high altitude mount using provided hardware appendages.
- E. Air Inlets and Outlets:
1. Inlets: Provide stamped louvers or protective grilles with fan blade guard.
  2. Outlets: Provide diffuser cones, directional louvers, or radial diffusers.
- F. Fan: Factory balanced, direct drive, axial type with fan guard.
- G. Motor: Totally enclosed, thermally protected, and provided with permanently lubricated bearings.
- H. Controls:
1. Remote digital thermostat unless indicated otherwise on drawings.
- I. Electrical Characteristics: As indicated on drawings.
1. Disconnect Switch: Factory mount disconnect switch.

## **2.02 ELECTRIC CABINET UNIT HEATERS**

- A. Manufacturers:
1. INDEECO (Industrial Engineering and Equipment Company): [www.indeeco.com/](http://www.indeeco.com/)
  2. Marley Engineered Products: [www.marleymep.com/](http://www.marleymep.com/)
  3. QMark Engineered Products: <http://www.qmarkea.com/>
  4. Reznor HVAC: <https://www.reznorhvac.com/>
  5. Stelpro Design Inc: [www.stelpro.com/](http://www.stelpro.com/)
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.
- C. Heating Elements: Provide open-wire, finned tubular, or resistance wire enclosed in steel sheath.
- D. Cabinet:
1. Minimum 18 gauge, 0.0478 inch (1.21 mm) thick steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet, and inlet grilles.
  2. Provide required hardware accessories for ceiling, duct, recessed, semi-recessed, surface, or wall mounting.
- E. Finish:
1. Factory applied, baked enamel finish.
  2. Color: As indicated on drawings.
- F. Controls:
1. Built-in line-voltage thermostat.
- G. Filter: Easily removed, 1 inch (25 mm) thick glass fiber throw-away type, located to filter air before coil.
- H. Electrical Characteristics: As indicated on drawings.

### **2.03 THERMOSTATIC CONTROLS**

- A. Smart Sensor, Thermostats:
  - 1. BAS or BMS linked programmable thermostat; see Section 23 0923 - Direct-Digital Control System for HVAC.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

### **3.02 INSTALLATION**

- A. Install in accordance with manufacturer's recommendations.
- B. Do not damage equipment or finishes.
- C. Unit Heaters:
  - 1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.
  - 2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.
- D. Cabinet Unit Heaters:
  - 1. Install as indicated.
  - 2. Coordinate to ensure correct recess size for recessed units.
- E. Units with Electric Heating Elements:
  - 1. Install as indicated including electrical devices furnished by manufacturer but not factory installed.
  - 2. Install wiring in accordance with the manufacturer's wiring diagram submittal and Section 26 0583.

### **3.03 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. After construction and painting is completed, clean exposed surfaces of units.
- C. Vacuum clean coils and inside of units.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

### **3.04 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training for additional requirements.

### **3.05 PROTECTION**

- A. Provide finished cabinet units with protective covers during the balance of construction.

**END OF SECTION 23 8200**

**SECTION 23 8300  
RADIANT HEATING AND COOLING UNITS**

**PART 1 GENERAL**

**1.01 RELATED REQUIREMENTS**

- A. Section 23 0913 - Instrumentation and Control Devices for HVAC.
- B. Section 23 0993 - Sequence of Operations for HVAC Controls.
- C. Section 23 0548 - Vibration and Seismic Controls for HVAC: Seismic and wind restraint and controls for ceiling-mounted and suspended equipment.
- D. Section 23 1123 - Facility Natural-Gas Piping: Gas-fired radiant heater fuel supply piping and accessories.
- E. Section 23 5100 - Breechings, Chimneys, and Stacks: Gas-fired radiant heater combustion air and exhaust systems.

**1.02 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Submittal 23 8300.1:
  - 1. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and gas and duct connections for combustion air and exhaust.
  - 2. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.
- C. Submittal 23 8300.2:
  - 1. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, installation instructions, maintenance and repair data, and parts listings.
- D. Submittal 23 8300.3:
  - 1. Maintenance Data:
    - a. Include repair methods and parts list of components.
    - b. See Section 01 6000 - Product Requirements, for additional provisions.

**PART 2 PRODUCTS**

**2.01 GAS-FIRED INFRARED RADIANT HEATERS**

- A. Manufacturers:
  - 1. INDEECO (Industrial Engineering and Equipment Company); \_\_\_\_\_: [www.indeeco.com/](http://www.indeeco.com/)
  - 2. Marley Engineered Products: [www.marleymep.com/](http://www.marleymep.com/)
  - 3. Modine: <https://modinehvac.com>
  - 4. Radiant Electric Heat, Inc: [www.electrichheat.com/](http://www.electrichheat.com/)
  - 5. Schwank: <https://www.schwankgroup.com/>
  - 6. Spaceray: <https://spaceray.com>
  - 7. Stelpro Design Inc: [www.stelpro.com/](http://www.stelpro.com/)
- B. Basis of Design: As indicated on drawings.
- C. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL) as suitable for the purpose indicated.
- D. Factory assembled including heating element, reflector, heater housing, mounting brackets, element holders, wire guards, and high temperature internal wiring for commercial use only.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Infrared Radiant Heaters: Verify and maintain minimum distances from combustibles. Verify heater installation is not in a hazardous location. Provide and install reflectors to protect



adjacent items or equipment that may be damaged by close proximity to standard reflector radiant heat paths.

**3.02 INSTALLATION**

- A. Install in accordance with manufacturer's recommendations.
- B. Provide vibration and seismic control protection as specified under Section 23 0548 - Vibration and Seismic Controls for HVAC.

**3.03 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, instruct, and observe.

**3.04 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

**3.05 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.
- B. Outdoor Equipment: Touch-up, repair, or replace damaged products before Date of Substantial Completion.

**END OF SECTION 23 8300**

**SECTION 26 0500  
COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 GENERAL**

**1.01 DESCRIPTION AND DEFINITIONS**

- A. This division of the Specifications covers the complete electrical systems as indicated on the drawings or as specified herein. Provide all equipment, materials, labor, and supervision to install electrical systems. The requirements of this Section apply to all electrical work hereinafter described. The General and Special Conditions are considered a part of this Division of the Specifications and all provisions contained therein which affect this work are as binding as though incorporated herein.
1. The following words and phrases shall be interpreted as indicated:
- a. "approved": approved or accepted by Governing Officials or Authorities Having jurisdiction
  - b. "materials": equipment and/or materials
  - c. "or equal/or equivalent": an equivalent with respect to appearance or function as determined by the Architect/Engineer; submittal approval may be required - refer to individual specification sections
  - d. "provide": furnish, install, connect, and test the operation thereof
  - e. "work": materials provided - see above definitions
  - f. "wiring": conductors/cabling and raceway system, including fittings, boxes, connectors, supports, hardware, labeling, and related accessories

**1.02 QUALITY ASSURANCE**

- A. All electrical work shall be in accordance with the latest locally adopted edition of the following codes and agency standards:
- 1. The National Electrical Code, 2020 Edition.
  - 2. The Life Safety Code (NFPA 101), 2018 Edition.
  - 3. Occupation Safety and Health Administration (OSHA) regulations.
  - 4. Regulations of the local serving utility company regarding metering and service entrance.
  - 5. Accessibility Codes: Americans with Disabilities Act Guidelines (ADA), ANSI A117.1, and 2010 ADA Standards for Accessibility Design.
  - 6. International Building Code 2018.
  - 7. International Energy Conservation Code, 2018 Edition.
  - 8. International Fire Code, 2018 Edition.
  - 9. Municipal or other locally enforced ordinances governing electrical work.
- B. Material Standards: All material shall conform to the standards where such standards have been established for the particular material indicated. Publications and standards of the organizations listed below are applicable to materials specified herein.
- 1. American National Standards Institute (ANSI)
  - 2. Insulated Cable Engineers Association (ICEA)
  - 3. Institute of Electrical and Electronic Engineers (IEEE)
  - 4. National Electrical Manufacturers Association (NEMA)
  - 5. National Fire Protection Association (NFPA)
  - 6. Underwriters' Laboratories, Inc. (UL)
- C. Listing and Labeling: Provide equipment assemblies that are listed and labeled.
- 1. The terms "listed" and "labeled": As defined in the National Electrical Code, Article 100.
  - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

**1.03 PERMITS**

- A. Obtain all permits and inspections for the installation of this work and pay all charges incident thereto. Deliver to the Owner all certificates of said inspection issued by authorities having jurisdiction.

#### **1.04 WARRANTY**

- A. The Contractor warrants to the Owner and Architect that materials and equipment furnished under this Contract will be of good quality and new unless otherwise required or permitted by the Contract Documents, that the Work will be free from defects not inherent in the quality required or permitted, and that the Work will conform with the requirements of the Contract Documents. Work not conforming to these requirements, including substitutions not properly approved and authorized, will be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by modifications not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear under normal usage. If required by the Design-Builder, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. Refer to Division 1 for other warranty requirements.

#### **1.05 PROJECT DOCUMENTS**

- A. Keep on hand at the project site a complete set of all project drawings and specifications, including, but not limited to, all architectural and engineering drawings. Refer to these documents, coordinate and install all work accordingly so that all electrical equipment will be properly located and accessible.
- B. The drawings are diagrammatic and are intended to indicate the arrangements of electrical equipment. Do not scale drawings. Obtain dimensions for layout of equipment from drawings of other trades unless indicated on Electrical plans. Review drawings of other trades for door swings, cabinets, counters, and built-in equipment; conditions indicated on Architectural plans shall govern. Coordinate installation of electrical equipment with structural system and mechanical equipment and access thereto. Coordinate installation of electrical equipment with ductwork and piping, and wall thickness. Verify construction dimensions at the site and make changes to conform to the building as constructed. Work improperly installed due to lack of construction verification shall be corrected at no additional cost to the Owner.
- C. Equipment layout is based on one manufacturer's product. Where equipment selected by the Contractor for use on the project differs from layout indicated, the Contractor shall be responsible for coordinating space requirements and connection arrangements.
- D. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Architect.

#### **1.06 SUBMITTALS**

- A. Shop Drawings and Product Data:
  - 1. **IMPORTANT:** Refer to Section 01 3000 - Administrative Requirements for submittal format! Submittals that do not conform with the requirements of this section will be returned without review.
  - 2. Submit data for materials and equipment to be used on the project to the Architect for review. Submittals shall be supported by descriptive material, catalog cuts, diagrams, and performance charts published by the manufacturer to show conformance to specification and drawing requirements. Model numbers alone will not be acceptable. Provide documentation of complete electrical characteristics for all equipment.
  - 3. Provide equipment layout plans, drawn to  $\frac{1}{4}"=1'-0"$ , showing the space arrangement of electrical spaces such as main service equipment area, electrical closets, and each area where electrical distribution equipment is to be installed. Base layout on dimensions of the equipment submitted for use on the project. Submit plans for review with shop drawings.
  - 4. Refer to the individual sections for indication of equipment for which submittals are required.
- B. Record Documents: Refer to Section 01 3000 - Administrative Requirements for requirements for record documents, as-built drawings, and related submittals.

- C. **MECHANICAL/PLUMBING COORDINATION STATEMENT:** Submit a written statement confirming coordination of voltage and power connection requirements for all Mechanical and Plumbing equipment and controls requiring electrical connection. Statement shall bear the names and signatures of the Mechanical and Plumbing subcontractors.

#### **1.07 EQUIPMENT REQUIRING ELECTRICAL SERVICE**

- A. Review all specification sections and drawings for equipment requiring electrical service. Provide service to and make connections to all equipment requiring electrical service.
- B. Drawings indicate equipment with loads, horsepower ratings, voltages, and corresponding control equipment, feeders, and overcurrent devices which were used as a basis for design. If equipment actually furnished have loads other than those indicated on the drawings or specified herein, control equipment, feeders, and overcurrent devices shall be adjusted in size accordingly at no additional cost to the Owner. Such adjustment shall be subject to the review of the .
- C. Incidental items not indicated on the drawings or mentioned in the specifications but that can legitimately and reasonably be inferred to belong to the work and in good practice to provide a complete system, shall be furnished and installed as though itemized here in detail.

#### **1.08 MECHANICAL SYSTEMS INTERFACE**

- A. See Divisions 21, 22 and 23 for all low-voltage (<120V) control wiring for mechanical systems, unless otherwise indicated on the Electrical drawings. See Division 26 for associated raceway systems specifications. Coordinate with all divisions to determine location and quantity of control conduits.
- B. Unless otherwise indicated, motor controllers (starters) shall be specified under Division 21, 22 and 23 as an integral component of Division 21, 22 and 23 equipment.
- C. Power wiring and associated raceway systems to all motors and controllers and between motors and controllers shall be as specified under Division 26.
- D. Power to low-voltage (<120V) controllers shall be as specified under Division 26. Power downstream of low-voltage controllers shall be as specified under Divisions 21, 22, and 23.

#### **1.09 QUALITY ASSURANCE**

- A. **NOTICE: Manufacturer's Startup Representative Qualifications:** Unless specifically noted otherwise in the specifications or drawings, when the project documents specify startup services by a manufacturer's factory technician or representative, those services may not be delegated to the contractor or subcontractor who performed the installation, but must be provided directly by the manufacturer's personnel or by the manufacturer's contracted independent third party representative.

#### **1.10 SITE INVESTIGATION**

- A. Prior to submitting bids for the project, visit the site of the work to become aware of existing conditions.

### **PART 2 PRODUCTS**

#### **2.01 MATERIALS**

- A. Furnish all materials specified herein or indicated on the drawings. All materials shall be new, unless otherwise indicated.
- B. Where Underwriters' Laboratories (UL) testing standards and listings exist for an item of material or equipment, the listed material shall bear the UL label.

### **PART 3 - EXECUTION**

#### **3.01 PRODUCT DELIVERY, STORAGE, HANDLING, AND PROTECTION**

- A. Inspect materials upon arrival at site and verify conformance with project requirements. Prevent unloading of unsatisfactory material. Handle materials in accordance with applicable standards and recommendations, and in a manner to prevent damage to materials. Store

packaged materials in original undamaged condition with manufacturer's labels and seals intact. Containers which are broken, opened, damaged, or watermarked are unacceptable and shall be removed from the premises and replaced.

- B. All material, except items specifically designed to be installed outdoors, shall be stored in an enclosed, dry building or trailer. Areas for general storage shall be provided. Provide temperature and/or humidity control where needed. All material for interior installation, including conductors, shall be stored in an enclosed weathertight structure and shall be protected from water, direct sunlight, cold or heat. Equipment stored other than as specified above shall be removed from the premises and replaced.
- C. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed.

### **3.02 SEISMIC AND WIND DESIGN**

- A. Install hangers and supports to allow controlled thermal and seismic movement of wiring, conduit, raceways, lighting, electrical fixtures, and equipment, to permit freedom of movement between anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units, and to protect similar exterior-mounted equipment and components against the effects of high velocity winds. See Structural drawings for project Seismic Design Classification and for Wind Design Classification.
- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

### **3.03 CLEANING, PAINTING AND IDENTIFICATION**

- A. Remove oil, dirt, grease and foreign materials from all raceways, boxes, panelboard trims and cabinets to provide a clean surface for painting. Touch-up scratched or marred surfaces of lighting fixtures, panelboard and cabinet trims, or other equipment enclosures with paint furnished by the equipment manufacturer specifically for that purpose.
- B. Where painting of trim covers for flush mounted panelboards, communication equipment cabinets, pull boxes, junction boxes, and control cabinets is part of this or any other Division of these specifications, remove trim covers before painting. Do not paint locks, latches, hinges, or exposed trim clamps.
- C. Where plywood backboards are used to mount equipment provided under Divisions 26, 27, or 28, paint backboards with two coats of light gray paint. Provide fire-retardant plywood, 3/4" thick minimum.
- D. Identify electrical components in the individual specification sections.
  - 1. Nameplates for equipment shall be installed on the exterior with epoxy cement adhesive.

### **3.04 EXCAVATION, TRENCHING AND BACKFILLING**

- A. Verify existing underground utility locations before excavation is to begin. Perform all excavation to install underground circuiting and raceway systems indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent cave-ins. Provide shoring per OSHA Standards. Remove and dispose of all excavated materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping.
- B. Grade the bottom of trenches to provide uniform bearing and support for underground circuiting and raceway systems on undisturbed soil at every point along entire length. Tamp over depths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12" below invert of equipment or installation.

- C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, or sand and gravel, free from large clods of earth and stones, deposited in 6" layers and tamped until the installation has a cover of not less than the adjacent ground but not greater than 2" above existing ground. Backfill simultaneously on both sides of the trench. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface, mounded over and smoothed off.

### **3.05 COORDINATION AND COOPERATION**

- A. Schedule the work, coordinate, and cooperate with all trades to avoid interferences, delays, and unnecessary work. If any conflicts occur which, in the installer's opinion, necessitate departures from the drawings and specifications, details of departures and reasons therefore shall be submitted in writing for the Architect's consideration.
- B. Notify other trades of dedicated electrical space to ensure those spaces stay clear of pipes, duct work and other foreign systems.

### **3.06 OPERATION AND MAINTENANCE MANUALS AND INSTRUCTIONS**

- A. Provide printed material for binding in operation and maintenance manuals. Include electrical equipment shop drawings as a minimum, and additional shop and product drawings as required by individual specification sections. Refer to Section 01 3000 - Administrative Requirements for additional information on submittal requirements.
- B. Instructions of Owner Personnel:
  - 1. Before final project review, as designated by the Design Professional, provide a competent representative to instruct Owner's designated personnel in systems indicated.
  - 2. Use Operation and Maintenance Manuals as basis of instruction. Review contents with personnel in detail to explain all aspects of operation and maintenance.
  - 3. Prepare and insert additional data in Operation and Maintenance Manuals when the need for such data becomes apparent during instruction.

### **3.07 ELECTRICAL ACCEPTANCE TESTS AND MANUFACTURERS CERTIFICATION**

- A. Refer to the individual specification sections and the Electrical Acceptance Testing section for equipment or system test requirements. Testing documentation shall be provided for reference at the time of final project review.
- B. Where specified under the individual system specification sections, the systems shall be reviewed for compliance with these specifications, installation in accordance with the manufacturer's recommendations, and system operation by a representative of the manufacturer.

### **3.08 CONSTRUCTION OBSERVATION ASSISTANCE**

- A. Provide personnel to assist the Architect or their representative during all construction observation visits. Provide tools and equipment to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, etc.
- B. Remove panelboard trims, motor control covers, device plates, junction box covers, etc. as directed for inspection of internal wiring. Turn over to the Owner one set of keys for all lockable electrical equipment on the project. Accessible ceilings shall be removed as directed for inspection of equipment installed above ceilings.
- C. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment and systems as directed.
- D. Provide authorized representatives of the manufacturers to demonstrate to the Architect compliance with the Contract Documents at a time designated by the Architect.

### 3.09 LOW VOLTAGE CABLE ROUTING

- A. All low voltage and fire alarm cabling shall be run tight to structure, regardless of whether cables are above or below structural elements. Free-standing cables, conduits, or cable trays spanning open spaces or voids is prohibited. All cabling to be routed in areas with exposed ceilings, cloud ceilings, or any other areas where cabling will be visible to building occupants shall be routed inside conduit or cable trays and shall maintain a low-profile installation or be hidden from view. Coordinate electrical, low voltage, building controls, and fire alarm to maintain uniform installation approach.
  - 1. If any of these conditions are identified in the field, remove and reinstall cabling in accordance with these directions at no additional cost to the Owner.
  - 2. If there are areas where cable routing cannot comply with these instructions, furnish a sketch identifying such areas, how the routing in indicated areas will differ from these instructions and obtain written approval from the Architect prior to installation.
- B. Furnish and install conduit and/or cable trays in areas as described above for low voltage, building control, and fire alarm cabling.
- C. Coordination drawings
  - 1. Submit low voltage cabling pathway plan drawing for review by Architect prior to beginning work. Plan shall detail major elements, components, and systems of electrical, low voltage, building control, and fire alarm equipment and materials in relation to other systems, installations, and building components. Show detailed space requirements for installation and maintenance access after installation is complete. Identify areas where conduit and cable tray will be used. Indicate if sequence and coordination of installations are important to efficient flow of the work. Include the following, at a minimum:
    - a. Main cabling pathway, including areas where conduit and cable trays will be used.
    - b. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly for periodic maintenance.
    - c. Equipment and accessory service connections and support details.
    - d. Exterior wall and foundation penetrations.
    - e. Rated wall and floor penetrations (fire, smoke, etc.)
  - 2. Cabling pathway plan shall bear the signatures of the electrical, low voltage, building control, and fire alarm subcontractors.
- D. Cabling and associated equipment, accessories, and specialties shall not be installed without first coordinating the installation of same with other trades. All uncoordinated cabling and other equipment installed that is determined by the Architect, the Owner, or the Authority Having Jurisdiction to interfere with the proper installation and mounting of fire protection equipment, plumbing equipment, HVAC equipment, ceilings, or other architectural or structural systems or finishes shall be relocated at the Contractor's expense.
- E. Stacking of cabling where it would cause an obstruction or restricted access path for egress or serviceability of equipment is prohibited.

### 3.10 RESTRICTIONS ON SURFACE MOUNTED CONDUIT AND DEVICES

- A. New Construction: Unless otherwise noted on the drawings or specifications, all conduit shall be concealed and wall mounted devices recessed flush within walls. Surface mounted conduit and devices are prohibited.
- B. Renovations: Unless otherwise noted on the drawings or specifications, all conduit shall be concealed and wall mounted devices recessed within existing walls. Contractors pricing to include cutting existing walls to install concealed conduit and flush wall mounted devices. Price to also include patching existing walls back to original condition. Surface mounted conduit and devices are prohibited.

**END OF SECTION 26 0500**

**SECTION 26 0519**  
**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Wire pulling lubricant.
- F. Cable ties.
- G. Firestop sleeves.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2023.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2017.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- J. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor



sizes increased for voltage drop.

2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

### 1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

## PART 2 PRODUCTS

### 2.01 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated or permitted.
- C. Metal-clad cable is permitted only as follows:
  1. Where not otherwise restricted, can use:
    - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
      - 1) Maximum Length: 6 feet (1.8 m).
    - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.
    - c. From the last junction box to the device being fed.
  2. In addition to other applicable restrictions, do not use:
    - a. Where exposed to damage.
    - b. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.
    - c. To feed panelboards.
    - d. Routing from junction box to junction box.
    - e. Areas with exposed ceilings, cloud ceilings or exposed walls.

### 2.02 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all conduit, boxes, wiring, connectors, etc. for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- H. Conductor Material:
  1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
  2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
  3. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size:
  1. Branch Circuits: 12 AWG.
    - a. Exceptions:
      - 1) 20 A, 120 V circuits longer than 75 feet (23 m): 10 AWG, for voltage drop.

- 2) 20 A, 120 V circuits longer than 150 feet (46 m): 8 AWG, for voltage drop.
- J. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- K. Conductor Color Coding:
  1. Color code conductors as indicated. Maintain consistent color coding throughout project.
  2. Color Coding Method: Integrally colored insulation.
  3. Color Code:
    - a. 480Y/277 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Brown.
      - 2) Phase B: Orange.
      - 3) Phase C: Yellow.
      - 4) Neutral/Grounded: Gray.
    - b. 208Y/120 V, 3 Phase, 4 Wire System:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral/Grounded: White.
    - c. Equipment Ground, All Systems: Green.
    - d. Travelers for 3-Way and 4-Way Switching: Pink.
    - e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
    - f. For control circuits, comply with manufacturer's recommended color code.

### 2.03 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
  1. Feeders and Branch Circuits:
    - a. Size 10 AWG and Smaller: Solid.
    - b. Size 8 AWG and Larger: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
  1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

### 2.04 METAL-CLAD CABLE

### 2.05 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Wiring Connectors for Splices and Taps:
  1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.
  2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- C. Wiring Connectors for Terminations:
  1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
  2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
  3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

- D. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- E. Mechanical Connectors: Provide bolted type or set-screw type.
- F. Compression Connectors: Provide circumferential type or hex type crimp configuration.

## **2.06 ACCESSORIES**

- A. Electrical Tape:
  - 1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
- B. Wire Pulling Lubricant:
  - 1. Listed and labeled as complying with UL 267.
  - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
  - 3. Suitable for use at installation temperature.
- C. Cable Ties: Material and tensile strength rating suitable for application.
- D. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for cables and roofing system to be installed; designed to accommodate existing penetrations where applicable.
- E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Circuiting Requirements:
  - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
  - 2. When circuit destination is indicated without specific routing, determine exact routing required.
  - 3. Arrange circuiting to minimize splices.
  - 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
  - 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
  - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
  - 2. Pull all conductors and cables together into raceway at same time.
  - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
  - 4. Use suitable wire pulling lubricant, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- G. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- H. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- I. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- J. Make wiring connections using specified wiring connectors.
  1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
  2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
  3. Do not remove conductor strands to facilitate insertion into connector.
  4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
  5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- K. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- L. Insulate ends of spare conductors using vinyl insulating electrical tape.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- N. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

**END OF SECTION 26 0519**

**SECTION 26 0526**  
**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2022.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

**PART 2 PRODUCTS**

**2.01 GROUNDING AND BONDING REQUIREMENTS**

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Grounding Electrode System:
  - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
    - a. Provide continuous grounding electrode conductors without splice or joint.
    - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
  - 2. Ground Rod Electrode(s):
    - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
    - b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
  - 3. Ground Bar: Provide ground bar, separate from service equipment enclosure, for common connection point of grounding electrode system bonding jumpers as permitted in NFPA 70. Connect grounding electrode conductor provided for service-supplied system grounding to this ground bar.
    - a. Ground Bar Size: 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
- E. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
  2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
  3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
  4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
  5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
  6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
- F. Communications Systems Grounding and Bonding:
1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.

## **2.02 GROUNDING AND BONDING COMPONENTS**

- A. General Requirements:
1. Provide products listed, classified, and labeled as suitable for the purpose intended.
  2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:
1. Use insulated copper conductors unless otherwise indicated.
    - a. Exceptions:
      - 1) Use bare copper conductors where installed underground in direct contact with earth.
- C. Connectors for Grounding and Bonding:
1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
  2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
  3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
- D. Ground Bars:
1. Description: Copper rectangular ground bars with mounting brackets and insulators.
  2. Size: As indicated.
  3. Holes for Connections: As indicated or as required for connections to be made.
- E. Ground Rod Electrodes:
1. Comply with NEMA GR 1.
  2. Material: Copper-bonded (copper-clad) steel.
  3. Size: 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide

ground plates.

- D. Make grounding and bonding connections using specified connectors.
  - 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
  - 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
  - 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
  - 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
  - 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 0553.

**END OF SECTION 26 0526**

**SECTION 26 0529**  
**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- B. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**PART 2 PRODUCTS**

**2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
  - 1. Comply with the following. Where requirements differ, comply with most stringent.
    - a. NFPA 70.
    - b. Requirements of authorities having jurisdiction.
  - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
  - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
  - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
  - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
    - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
    - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.



- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
  - 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
  - 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
  - 1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  - 2. Comply with MFMA-4.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
  - 1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
  - 1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
  - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Secure fasteners in accordance with manufacturer's recommended torque settings.
- I. Remove temporary supports.

**END OF SECTION 26 0529**

**SECTION 26 0533.13  
CONDUIT FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Galvanized steel electrical metallic tubing (EMT).
- C. Rigid polyvinyl chloride (PVC) conduit.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- G. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- H. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- K. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- L. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- M. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
  - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.
  - 4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
  - 5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**PART 2 PRODUCTS**

**2.01 CONDUIT APPLICATIONS**

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  - 1. Exterior, Direct-Buried: Use rigid PVC conduit.
  - 2. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to Galvanized steel rigid metal conduit (RMC) where emerging from underground.
- D. Concealed Within Masonry Walls: Use electrical metallic tubing (EMT).
- E. Concealed Within Hollow Stud Walls: Use electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- G. Exposed, Interior, Not Subject to Physical Damage: Use electrical metallic tubing (EMT).
- H. Exposed, Exterior: Use galvanized steel rigid metal conduit (RMC).

## **2.02 CONDUIT - GENERAL REQUIREMENTS**

- A. Comply with NFPA 70.
- B. Provide conduit, fittings, supports, and accessories required for complete raceway system.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

## **2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)**

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
  - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
  - 2. Material: Use steel or malleable iron.
  - 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

## **2.04 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)**

- A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
  - 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
  - 2. Material: Use steel or malleable iron.
  - 3. Connectors and Couplings: Use compression/gland or set-screw type.
    - a. Do not use indenter type connectors and couplings.

## **2.05 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- B. Fittings:
  - 1. Manufacturer: Same as manufacturer of conduit to be connected.
  - 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- E. Conduit Support:
  - 1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.
  - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  - 3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
- F. Connections and Terminations:
  - 1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  - 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  - 3. Use suitable adapters where required to transition from one type of conduit to another.
  - 4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
  - 5. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
  - 6. Secure joints and connections to provide mechanical strength and electrical continuity.
- G. Penetrations:
  - 1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  - 2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  - 3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
  - 4. Conceal bends for conduit risers emerging above ground.
  - 5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  - 6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
  - 7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.
- H. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
- I. Conduit Sealing:
  - 1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:
    - a. Where conduits enter building from outside.
    - b. Where service conduits enter building from underground distribution system.
    - c. Where conduits enter building from underground.
    - d. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:
  - a. Where conduits pass from outdoors into conditioned interior spaces.
  - b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- J. Provide grounding and bonding; see Section 26 0526.

**END OF SECTION 26 0533.13**

**SECTION 26 0533.16**  
**BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.13 - Conduit for Electrical Systems:
  - 1. Conduit bodies and other fittings.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013 (Reaffirmed 2020).
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
  - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
  - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
  - 6. Coordinate the work with other trades to preserve insulation integrity.
  - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
  - 8. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

## **PART 2 PRODUCTS**

### **2.01 BOXES**

- A. General Requirements:
  - 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
  - 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
  - 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
  - 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
  - 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes:
  - 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
  - 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
  - 3. Use suitable concrete type boxes where flush-mounted in concrete.
  - 4. Use suitable masonry type boxes where flush-mounted in masonry walls.
  - 5. Use raised covers suitable for the type of wall construction and device configuration where required.
  - 6. Use shallow boxes where required by the type of wall construction.
  - 7. Do not use "through-wall" boxes designed for access from both sides of wall.
  - 8. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
  - 9. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
  - 10. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
  - 11. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
  - 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
  - 2. NEMA 250 Environment Type, Unless Otherwise Indicated.
  - 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
    - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
  2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
- G. Install boxes plumb and level.
- H. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
  2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
  3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- I. Install boxes as required to preserve insulation integrity.
- J. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- K. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- L. Close unused box openings.
- M. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- N. Provide grounding and bonding in accordance with Section 26 0526.

**END OF SECTION 26 0533.16**



**SECTION 26 0536  
CABLE TRAYS FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Metal cable tray systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA VE 1 - Metal Cable Tray Systems; 2017.
- C. NEMA VE 2 - Cable Tray Installation Guidelines; 2018.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cable tray system components and accessories. Include dimensions, materials, fabrication details, finishes, and span/load ratings.

**PART 2 PRODUCTS**

**2.01 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS**

- A. Provide new cable tray system consisting of all required components, fittings, supports, accessories, etc. as necessary for a complete system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Do not use cable tray for applications other than as permitted by NFPA 70 and product listing/classification.
- D. Provide cable tray system and associated components suitable for use at indicated span/load ratings under the service conditions at the installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA VE 1.
- F. Unless otherwise indicated, specified load/fill depths and inside widths are nominal values, with values for metal cable tray systems in accordance with NEMA VE 1 including applicable allowable tolerances.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install cable tray in accordance with NECA 1 (general workmanship), and NEMA VE 2.
- C. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- D. Arrange cable tray to provide required clearances and maintain cable access.

- E. Install cable tray plumb and level, with sections aligned and with horizontal runs at the proper elevation.
- F. Cable Tray Movement Provisions:
  - 1. Provide suitable expansion fittings where cable tray is subject to movement, including but not limited to:
    - a. Where cable tray crosses structural joints intended for expansion.
    - b. Long straight cable tray runs in accordance with NEMA VE 2.
  - 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA VE 2.
  - 3. Set gaps for expansion fittings in accordance with NEMA VE 2.
- G. Cable Provisions:
  - 1. Use suitable fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
  - 2. Use suitable drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
  - 3. Use suitable cable support fittings for long vertical cable tray runs with heavy cables.
- H. Provide end closures at unconnected ends of cable tray runs.
- I. Cable Tray Support:
  - 1. Use manufacturer's recommended hangers and supports, located in accordance with NEMA VE 2 and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment in accordance with Section 26 0529, where not furnished by cable tray manufacturer.
  - 2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- J. Grounding and Bonding Requirements, in Addition to Requirements of Section 26 0526:
  - 1. Comply with grounding and bonding requirements of NEMA VE 2.
- K. Penetrations: Install firestopping to preserve fire resistance rating of building elements, using materials and methods specified in Section 07 8400.
- L. Identification Requirements, in Addition to Those Specified in Section 26 0553.
- M. Install cable tray covers where indicated and as follows:

**END OF SECTION 26 0536**

**SECTION 26 0544****SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING****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 for raceway and cable penetration of non-fire-rated construction walls and floors.
  - 2. Sleeve-seal systems.
  - 3. Sleeve-seal fittings.
  - 4. Grout.
  - 5. 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.

**PART 2 PRODUCTS****2.01 SLEEVES**

- A. Wall Sleeves:
  - 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
  - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized sheet steel.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

**2.02 SLEEVE-SEAL SYSTEMS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or 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: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

**2.03 SLEEVE-SEAL FITTINGS**

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

**2.04 GROUT**

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

**2.05 SILICONE SEALANTS**

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: 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 FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS**

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. 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 annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 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 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.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between

pipe and sleeve for installing mechanical sleeve seals.

- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### **3.02 SLEEVE-SEAL-SYSTEM INSTALLATION**

- 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.

### **3.03 SLEEVE-SEAL-FITTING INSTALLATION**

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

**END OF SECTION 26 0544**

**SECTION 26 0548**  
**VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Vibration isolation requirements.
- B. Seismic control requirements.
  - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- C. Vibration-isolated equipment support bases.
- D. Vibration isolators.
- E. External seismic snubber assemblies.
- F. Seismic restraint systems.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 4533 - Code-Required Special Inspections and Procedures.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.

**1.03 DEFINITIONS**

- A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g., conduit, cable tray).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

**1.04 REFERENCE STANDARDS**

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings; 2016.
- C. ASHRAE (HVAC) - ASHRAE Handbook - HVAC Applications; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.
- G. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. ICC-ES AC156 - Acceptance Criteria for Seismic Certification by Shake-Table Testing of Nonstructural Components; 2010, with Editorial Revision (2020).
- I. MFMA-4 - Metal Framing Standards Publication; 2004.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

- B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.
  - 1. Vibration Isolators: Include rated load capacities and deflections; include information on color coding or other identification methods for spring element load capacities.
  - 2. Seismic Controls: Include seismic load capacities.
- D. Seismic Design Data:
  - 1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
    - a. Component operating weight and center of gravity.
    - b. Component elevation in the building in relation to the roof elevation (z/h).
    - c. Component importance factor ( $I_p$ ).
    - d. For distributed systems, component materials and connection methods.
    - e. Component amplification factor ( $a_p$ ) and component response modification factor ( $R_p$ ), determined in accordance with ASCE 7 tables.
    - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
  - 2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.
- E. Certification for seismically qualified equipment; identify basis for certification.
- F. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.
- G. Manufacturer's detailed field testing and inspection procedures.
- H. Field quality control test reports.

## **1.06 QUALITY ASSURANCE**

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Seismic Controls Designer Qualifications: Registered professional engineer licensed in the State in which the Project is located and with minimum five years experience designing seismic restraints for nonstructural components.
  - 1. Designer may be employed by the manufacturer of the seismic restraint products.

## **PART 2 PRODUCTS**

### **2.01 VIBRATION ISOLATION REQUIREMENTS**

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing electrical equipment and/or electrical connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
  - 1. Select vibration isolators to provide required static deflection.
  - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
  - 3. Select seismic type vibration isolators to comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
  - 4. Select vibration isolators for outdoor equipment to comply with wind design requirements.
  - 5. Select vibration-isolated equipment support bases and associated vibration isolators to provide minimum 2-inch (50 mm) operating clearance beneath base unless otherwise

indicated.

D. Equipment Isolation:

1. Transformers:

- a. Specified vibration isolators are in addition to any factory-installed internal core and coil assembly vibration isolators unless otherwise indicated.
- b. Floor-Mounted Transformers, Nonseismic Applications: Use resilient material isolator pads, resilient material isolator mounts, or open (unhoused) spring isolators.
- c. Floor-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts or seismic type restrained spring isolators.
- d. Suspended Transformers, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
- e. Suspended Transformers, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
- f. Wall-Mounted Transformers, Nonseismic Applications: Use resilient material isolator mounts.
- g. Wall-Mounted Transformers, Seismic Applications: Use seismic type resilient material isolator mounts.
- h. Minimum Static Deflection:
  - 1) Transformers Mounted on Grade-Level Slabs: 0.25 inch (6 mm) deflection unless otherwise indicated.
  - 2) Transformers Mounted at Above-Grade Levels: 0.5 inch (12 mm) deflection unless otherwise indicated.

2. Engine Generators:

- a. Specified vibration isolators are in addition to any factory-installed internal vibration isolators between generator set and integral base unless otherwise indicated; obtain generator set manufacturer approval of applied vibration isolation.
- b. Nonseismic Applications, Isolators Not Located Below Sub-Base Fuel Tank: Use housed spring isolators or restrained spring isolators.
- c. Nonseismic Applications, Isolators Located Below Sub-Base Fuel Tank: Use restrained spring isolators.
- d. Seismic Applications: Use seismic type restrained spring isolators.
- e. Provide vibration-isolated concrete inertia bases where equipment is not designed to be point loaded.
- f. Minimum Static Deflection:
  - 1) Generators Mounted on Grade-Level Slabs: 1 inch (25 mm) deflection unless otherwise indicated.
  - 2) Generators Mounted at Above-Grade Levels: 2 inch (50 mm) deflection unless otherwise indicated.

E. Conduit Isolation:

1. Use flexible conduit or cable for electrical connections to vibration-isolated equipment, including equipment installed under other sections or by others.
  - a. Minimum Length: 3 feet (0.9 m) unless otherwise indicated.
2. Vibration Isolators:
  - a. Provide vibration isolators for conduit supports:
    - 1) Located within 50 feet (15.2 m) of connected vibration-isolated equipment where flexible connection to equipment is not possible.
  - b. Minimum Static Deflection:
    - 1) First Three Supports Closest to Isolated Equipment: Same as static deflection of equipment; maximum of 2 inch (50 mm) deflection required.
    - 2) Remainder of Supports: 0.75 inch (19 mm) deflection unless otherwise indicated.



- c. Suspended Conduits, Nonseismic Applications: Use resilient material isolator hangers, spring isolator hangers, or combination resilient material/spring isolator hangers.
- d. Suspended Conduits, Seismic Applications: Use seismic type resilient material isolator hangers, seismic type spring isolator hangers, or seismic type combination resilient material/spring isolator hangers.
- e. Use modular seal or approved resilient material where vibration-isolated conduits penetrate building elements (e.g., walls, floors) arranged to prevent vibration transmission to structure.

## 2.02 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
- B. Seismic Design Criteria: As indicated on drawings.
- C. Component Importance Factor (Ip): Electrical components to be assigned a component importance factor (Ip) of 1.5 unless otherwise indicated.
- D. Seismic Qualification of Equipment:
  - 1. Provide special certification for electrical equipment furnished under other sections and assigned a component importance factor (Ip) of 1.5, certifying that equipment will remain operable following a design level earthquake.
  - 2. Seismic qualification to be by shake table testing in accordance with recognized testing standard procedure, such as ICC-ES AC156, acceptable to authorities having jurisdiction.
  - 3. Notify Architect and obtain direction where mounting restrictions required by conditions of seismic certification conflict with specified requirements.
  - 4. Seismically qualified equipment to be furnished with factory-installed labels referencing certificate of compliance and associated mounting restrictions.
- E. Seismic Restraints:
  - 1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
  - 2. Seismic Restraint Exemptions:
    - a. Exemptions for Seismic Design Category D, E, and F:
      - 1) Discrete electrical components that are positively attached to the structure where either of the following apply:
        - (a) The component weighs 400 pounds (1,780 N) or less, has a center of mass located 4 feet (1.22 m) or less above the adjacent floor level, flexible connections are provided between the component and associated ductwork, piping, and conduit, and the component importance factor (Ip) is 1.0.
        - (b) The component weighs 20 pounds (89 N) or less or, in the case of a distributed system, 5 pounds per foot (73 N/m) or less.
    - b. Conduit, Cable Tray, and Raceway Exemptions, All Seismic Design Categories:
      - 1) Raceways with component importance factor (Ip) of 1.0 where flexible connections are provided between cable tray or raceway and associated components, where cable tray or raceway is positively attached to the structure, and where one of the following apply:
        - (a) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 3/8 inch (10 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.

- (b) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 200 pounds (890 N) or less.
    - (c) Trapeze supported conduits, cable trays, or raceways with trapeze assemblies using 1/2 inch (13 mm) diameter rod hangers not exceeding 24 inches (610 mm) in length from support point connection to the supporting structure, and the total weight supported by any single trapeze is 100 pounds (445 N) or less.
    - (d) Hanger supported conduits, cable trays, or raceways with individual rod hangers 3/8 inch (10 mm) or 1/2 inch (13 mm) in diameter not exceeding 12 inches (305 mm) in length from support point connection to the supporting structure, and the total weight supported by any single rod is 50 pounds (220 N) or less.
  - 2) Conduits less than 2-1/2 inch (64 mm) trade size.
- c. Lighting Exemptions, All Seismic Design Categories:
  - 1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the structure or other nonstructural components.
  - 2) Lay-in luminaires weighing less than 56 pounds (25 kg) secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
- 3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
  - a. ASHRAE (HVACA).
  - b. FEMA 413.
  - c. FEMA E-74.
  - d. SMACNA (SRM).
- 4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third-party registered professional engineer acceptable to authorities having jurisdiction.
- 5. Seismic Type Vibration Isolators:
  - a. Comply with seismic design requirements, including conditions of equipment seismic certification where applicable.
- 6. External Seismic Snubber Assemblies:
  - a. Provide quantity and arrangement of external seismic snubber assemblies as required to restrain equipment in all directions (both lateral and vertical).
  - b. Do not use external seismic snubber assemblies that restrain equipment only in one or more lateral directions (but not vertical) except where uplift forces are zero or are addressed by other restraints.
- 7. Seismic Restraint Systems:
  - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
  - b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
  - c. Use only one restraint system type for a given electrical component or distributed system (e.g., conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
  - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
  - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid

restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.

- f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
- g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
- h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.
- i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams, or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

F. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
  - a. Increase size of pad as required to comply with anchor requirements.
  - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

G. Seismic Interactions:

1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.
3. Comply with minimum clearance requirements between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs.

H. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:
  - a. Relative displacements at connections between components, including distributed systems (e.g., conduit, cable tray); do not exceed load limits for equipment utility connections.
  - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
  - c. Design displacements at seismic separations.
  - d. Anticipated drifts between floors.
2. Include provisions to prevent interruption of utility service due to seismic displacements.

## 2.03 VIBRATION-ISOLATED EQUIPMENT SUPPORT BASES

A. Manufacturers:

1. Vibration-Isolated Equipment Support Bases:
  - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
  - b. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)

- c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/](http://www.veco-nyc.com/)
- 2. Substitutions: See Section 01 6000 - Product Requirements.
- 3. Source Limitations: Furnish vibration-isolated equipment support bases and associated components and accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Vibration-Isolated Structural Steel Bases:
  - 1. Description: Engineered structural steel frames with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
- C. Vibration-Isolated Concrete Inertia Bases:
  - 1. Description: Concrete-filled engineered steel forms with integral mounting provisions for vibration isolators, sized and configured for mounting of equipment.
  - 2. Minimum Base Depth: 6 inches (152 mm).
  - 3. Minimum Base Mass (Including Concrete): 1.5 times weight of supported equipment.
  - 4. Concrete Reinforcement: Welded or tied reinforcing bars running both ways in a single layer.
  - 5. Concrete: Filled on site with minimum 3000 psi (20 mPa) concrete in accordance with Section 03 3000.

## 2.04 VIBRATION ISOLATORS

- A. Manufacturers:
  - 1. Vibration Isolators:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - b. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)
    - c. Vibration Eliminator Company, Inc: [www.veco-nyc.com/](http://www.veco-nyc.com/)
  - 2. Substitutions: See Section 01 6000 - Product Requirements.
  - 3. Source Limitations: Furnish vibration-isolators and associated accessories produced by a single manufacturer and obtained from a single supplier.
- B. General Requirements:
  - 1. Resilient Materials for Vibration Isolators: Oil, ozone, and oxidant resistant.
  - 2. Spring Elements for Spring Isolators:
    - a. Color code or otherwise identify springs to indicate load capacity.
    - b. Lateral Stability: Minimum lateral stiffness to vertical stiffness ratio of 0.8.
    - c. Designed to operate in the linear portion of their load versus deflection curve over deflection range of not less than 50 percent above specified deflection.
    - d. Designed to provide additional travel to solid of not less than 50 percent of rated deflection at rated load.
    - e. Selected to provide designed deflection of not less than 75 percent of specified deflection.
    - f. Selected to function without undue stress or overloading.
  - 3. Seismic Snubbing Elements for Seismic Isolators:
    - a. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
    - b. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.
- C. Vibration Isolators for Nonseismic Applications:
  - 1. Resilient Material Isolator Pads:
    - a. Description: Single or multiple layer pads utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material.
    - b. Pad Thickness: As required for specified minimum static deflection; minimum 0.25 inch (6 mm) thickness.
    - c. Multiple Layer Pads: Provide bonded, galvanized sheet metal separation plate between each layer.

2. Resilient Material Isolator Mounts, Nonseismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material; fail-safe type.
  3. Open (Unhoused) Spring Isolators:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) without a housing.
    - b. Bottom Load Plate: Nonskid, molded, elastomeric isolator material or steel with nonskid elastomeric isolator pad with provisions for bolting to supporting structure as required.
    - c. Furnished with integral leveling device for positioning and securing supported equipment.
  4. Housed Spring Isolators:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing.
    - b. Furnished with integral elastomeric snubbing elements, nonadjustable type, for limiting equipment movement and preventing metal-to-metal contact between housing elements.
    - c. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
    - d. Furnished with integral leveling device for positioning and securing supported equipment.
  5. Restrained Spring Isolators, Nonseismic:
    - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop.
    - b. Bottom Load Plate: Steel with nonskid, elastomeric isolator pad with provisions for bolting to supporting structure as required.
    - c. Furnished with integral leveling device for positioning and securing supported equipment.
    - d. Provides constant free and operating height.
  6. Resilient Material Isolator Hangers, Nonseismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the lower hanger rod connection.
  7. Spring Isolator Hangers, Nonseismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
  8. Combination Resilient Material/Spring Isolator Hangers, Nonseismic:
    - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) or fiberglass isolator material for the upper hanger rod connection.
    - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
- D. Vibration Isolators for Seismic Applications:
1. Resilient Material Isolator Mounts, Seismic:
    - a. Description: Mounting assemblies for bolting equipment to supporting structure utilizing elastomeric (e.g., neoprene, rubber) isolator material; specifically designed and rated for seismic applications with integral snubbing in all directions.

2. Restrained Spring Isolators, Seismic:
  - a. Description: Isolator assembly consisting of single or multiple free-standing, laterally stable steel spring(s) in series with elastomeric (e.g., neoprene, rubber) isolator material within a metal housing designed to prevent movement of supported equipment above an adjustable vertical limit stop; specifically designed and rated for seismic applications with integral snubbing in all directions.
  - b. Bottom Load Plate: Steel with provisions for bolting to supporting structure as required.
  - c. Furnished with integral leveling device for positioning and securing supported equipment.
  - d. Provides constant free and operating height.
3. Resilient Material Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing elastomeric (e.g., neoprene, rubber) isolator material for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
4. Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) in series with an elastomeric element for the lower hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.
5. Combination Resilient Material/Spring Isolator Hangers, Seismic:
  - a. Description: Isolator assembly designed for installation in hanger rod suspension system utilizing single or multiple free-standing, laterally stable steel spring(s) for the lower hanger rod connection and elastomeric (e.g., neoprene, rubber) isolator material for the upper hanger rod connection; specifically designed and rated for seismic applications with vertical limit stop to prevent upward travel of hanger rod and cushion impact.
  - b. Designed to accommodate misalignment of bottom hanger rod up to 30 degrees (plus/minus 15 degrees) without short-circuiting of isolation.

## 2.05 EXTERNAL SEISMIC SNUBBER ASSEMBLIES

- A. Manufacturers:
  1. External Seismic Snubber Assemblies:
    - a. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - b. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)
  2. Substitutions: See Section 01 6000 - Product Requirements.
  3. Source Limitations: Furnish external seismic snubber assemblies and associated accessories produced by the same manufacturer as the vibration isolators and obtained from a single supplier.
- B. Description: Steel snubbing assemblies designed for external attachment to both equipment and supporting structure that, as part of a complete system, restrain equipment motion in all directions during a seismic event while maintaining vibration isolation during normal operation.
- C. Seismic Snubbing Elements:
  1. Air Gap: Between 0.125 inches (3 mm) and 0.25 inches (6 mm) unless otherwise indicated.
  2. Points of Contact: Cushioned with resilient material, minimum 0.25 inch (6 mm) thick; capable of being visually inspected for damage and replaced.

## 2.06 SEISMIC RESTRAINT SYSTEMS

- A. Manufacturers:

1. Seismic Restraint Systems:
    - a. AFCON, a brand of Anvil International: [www.anvilintl.com/](http://www.anvilintl.com/)
    - b. Eaton Corporation: [www.eaton.com/](http://www.eaton.com/)
    - c. Kinetics Noise Control, Inc: [www.kineticsnoise.com/](http://www.kineticsnoise.com/)
    - d. Mason Industries: [www.mason-ind.com/](http://www.mason-ind.com/)
  2. Substitutions: See Section 01 6000 - Product Requirements.
  3. Source Limitations: Furnish seismic restraint system components and accessories produced by a single manufacturer and obtained from a single supplier.
- B. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- C. Cable Restraints:
1. Comply with ASCE 19.
  2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
  3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
  4. Use protective thimbles for cable loops where potential for cable damage exists.
- D. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

#### **3.02 CODE-REQUIRED SPECIAL INSPECTIONS**

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
  1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
  2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:
  1. Seismically Qualified Equipment: Verification that label, anchorage, and mounting comply with certificate of compliance.
  2. Anchorage of electric equipment for emergency and standby power systems for Seismic Design Categories C, D, E, and F; periodic inspection.
  3. Installation and anchorage of vibration isolation systems for Seismic Design Categories C, D, E, and F where Contract Documents require a nominal clearance of 1/4 inch (6.4 mm) or less between equipment support frame and seismic restraint; periodic inspection.
  4. Verification of required clearances between electrical equipment, distribution systems, and associated supports and fire protection sprinkler system drops and sprigs for Seismic Design Categories C, D, E, and F; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.

- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

### 3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible conduit and cable connections to provide sufficient slack for vibration isolation and/or seismic relative displacements as indicated or as required.
- F. Vibration Isolation Systems:
  - 1. Vibration-Isolated Equipment Support Bases:
    - a. Provide specified minimum clearance beneath base.
  - 2. Spring Isolators:
    - a. Position equipment at operating height; provide temporary blocking as required.
    - b. Lift equipment free of isolators prior to lateral repositioning to avoid damage to isolators.
    - c. Level equipment by adjusting isolators gradually in sequence to raise equipment uniformly such that excessive weight or stress is not placed on any single isolator.
  - 3. Isolator Hangers:
    - a. Use precompressed isolator hangers where required to facilitate installation and prevent damage to equipment utility connection provisions.
    - b. Locate isolator hangers at top of hanger rods in accordance with manufacturer's instructions.
  - 4. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
  - 5. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
  - 6. Adjust isolators to be free of isolation short circuits during normal operation.
  - 7. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.
- G. Seismic Controls:
  - 1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
  - 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
  - 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch (3 mm), use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch (3 mm) or less.
  - 4. Equipment with Sheet Metal Housings:
    - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
    - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
    - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
  - 5. Concrete Housekeeping Pads:
    - a. Size in accordance with seismic design to meet anchor requirements.
    - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
  - 6. Seismic Restraint Systems:



- a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
- b. Install restraints within permissible angles in accordance with seismic design.
- c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
- d. Install cable restraints for vibration-isolated components slightly slack to prevent short-circuiting of isolation.
- e. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

**3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect vibration isolation and/or seismic control components for damage and defects.
- C. Provide services of a manufacturer's authorized representative for vibration isolation systems and seismic controls to observe installation and assist in inspection and testing. Include manufacturer's detailed testing and inspection procedures and field reports with submittals.
- D. Vibration Isolation Systems:
  1. Verify isolator static deflections.
  2. Verify required clearance beneath vibration-isolated equipment support bases.
  3. Verify vibration isolation performance during normal operation; investigate sources of isolation short circuits.
- E. Seismic Controls:
  1. Verify snubbing element air gaps.
- F. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken.

**END OF SECTION 26 0548**

**SECTION 26 0553**  
**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Underground warning tape.
- E. Warning signs and labels.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 26 2726 - Wiring Devices - Lutron: Device and wallplate finishes; factory pre-marked wallplates.

**1.03 REFERENCE STANDARDS**

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

**PART 2 PRODUCTS**

**2.01 IDENTIFICATION REQUIREMENTS**

- A. Identification for Equipment:
  - 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
    - a. Switchboards:
      - 1) Identify ampere rating.
      - 2) Identify voltage and phase.
      - 3) Identify power source and circuit number. Include location when not within sight of equipment.
      - 4) Use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    - b. Panelboards:
      - 1) Identify ampere rating.
      - 2) Identify voltage and phase.
      - 3) Identify power source and circuit number. Include location when not within sight of equipment.
      - 4) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.
      - 5) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
    - c. Transformers:
      - 1) Identify kVA rating.
      - 2) Identify voltage and phase for primary and secondary.
    - d. Enclosed switches, circuit breakers, and motor controllers:
      - 1) Identify voltage and phase.
    - e. Transfer Switches:
      - 1) Identify voltage and phase.
      - 2) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

2. Service Equipment:
    - a. Use identification nameplate to identify each service disconnecting means.
  3. Emergency System Equipment:
    - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
    - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
  4. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".
  5. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
    - a. Service equipment.
    - b. Industrial control panels.
    - c. Motor control centers.
    - d. Elevator control panels.
    - e. Industrial machinery.
  6. Arc Flash Hazard Warning Labels: Use warning labels to identify arc flash hazards for electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are likely to require examination, adjustment, servicing, or maintenance while energized.
- B. Identification for Conductors and Cables:
1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
  2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
  3. Use underground warning tape to identify direct buried cables.
- C. Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
  2. Use identification label to identify fire alarm system devices.
  3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
    - a. For receptacles in public areas, provide identification on inside surface of wallplate.
- D. Identification for Luminaires:
1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

## **2.02 IDENTIFICATION NAMEPLATES AND LABELS**

- A. Identification Nameplates:
1. Materials:
    - a. Indoor Clean, Dry Locations: Use plastic nameplates.
    - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
  2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
  3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
  4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
  5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch (25 mm) high; Four, located at corners for larger sizes.

- B. Identification Labels:
  - 1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
  - 2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification:
  - 1. Minimum Size: 1 inch (25 mm) by 2.5 inches (64 mm).
  - 2. Legend:
    - a. System designation where applicable:
      - 1) Emergency Power System: Identify with text "EMERGENCY".
      - 2) Fire Alarm System: Identify with text "FIRE ALARM".
    - b. Equipment designation or other approved description.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height:
    - a. System Designation: 1 inch (25 mm).
    - b. Equipment Designation: 1/4 inch (6 mm).
  - 5. Color:
    - a. Normal Power System: White text on black background.
    - b. Emergency Power System: White text on red background.
- D. Format for Receptacle Identification:
  - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
  - 2. Legend: Power source and circuit number or other designation indicated.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch (5 mm).
  - 5. Color: Black text on clear background.
- E. Format for Fire Alarm Device Identification:
  - 1. Minimum Size: 3/8 inch (10 mm) by 1.5 inches (38 mm).
  - 2. Legend: Designation indicated and device zone or address.
  - 3. Text: All capitalized unless otherwise indicated.
  - 4. Minimum Text Height: 3/16 inch (5 mm).
  - 5. Color: Red text on white background.

### **2.03 WIRE AND CABLE MARKERS**

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
- E. Minimum Text Height: 1/8 inch (3 mm).
- F. Color: Black text on white background unless otherwise indicated.

### **2.04 UNDERGROUND WARNING TAPE**

- A. Materials: Use non-detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Non-detectable Type Tape: 6 inches (152 mm) wide, with minimum thickness of 4 mil (0.1 mm).
- C. Legend: Type of service, continuously repeated over full length of tape.

## **2.05 WARNING SIGNS AND LABELS**

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
  - 1. Materials:
    - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
    - b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
  - 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
  - 3. Minimum Size: 7 by 10 inches (178 by 254 mm) unless otherwise indicated.
- C. Warning Labels:
  - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
  - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
  - 3. Minimum Size: 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
  - 1. Surface-Mounted Equipment: Enclosure front.
  - 2. Flush-Mounted Equipment: Inside of equipment door.
  - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
  - 4. Elevated Equipment: Legible from the floor or working platform.
  - 5. Branch Devices: Adjacent to device.
  - 6. Interior Components: Legible from the point of access.
  - 7. Conductors and Cables: Legible from the point of access.
  - 8. Devices: Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

**END OF SECTION 26 0553**

**SECTION 26 0573  
POWER SYSTEM STUDIES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
  - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

**1.03 REFERENCE STANDARDS**

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- B. IEEE 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants; 1993 (Reaffirmed 1999).
- C. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems; 2001, with Errata (2003).
- D. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis; 1997.
- E. IEEE 551 - IEEE Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems; 2006.
- F. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations; 2018, with Errata (2019).
- G. NEMA MG 1 - Motors and Generators; 2021.
- H. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems; 2021.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 70E - Standard for Electrical Safety in the Workplace; 2024.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
  - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
  - 1. Submit study reports prior to or concurrent with product submittals.
  - 2. Do not order equipment until matching study reports and product submittals have both been evaluated by Architect.
  - 3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Study reports, stamped or sealed and signed by study preparer.

- C. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
  - 1. Where required, include characteristic time-current trip curves for protective devices.
  - 2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
  - 3. Identify modifications made in accordance with studies that:
    - a. Can be made at no additional cost to Owner.
    - b. As submitted will involve a change to the contract sum.
- D. Arc Flash Hazard Warning Label Samples: One of each type and legend specified.
- E. Site-specific arc flash hazard warning labels.
- F. Certification that field adjustable protective devices have been set in accordance with requirements of studies.

#### **1.06 POWER SYSTEM STUDIES**

- A. Scope of Studies:
  - 1. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
  - 2. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
    - a. Known Operating Modes:
      - 1) Utility as source.
- B. General Study Requirements:
  - 1. Comply with NFPA 70.
  - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
  - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
    - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
      - 1) Obtain up-to-date information from Utility Company.
    - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
    - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
    - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
    - e. Protective Devices:
      - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
      - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
    - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.

- g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
- D. Short-Circuit Study:
  - 1. Comply with IEEE 551 and applicable portions of IEEE 141, IEEE 242, and IEEE 399.
  - 2. For purposes of determining equipment short circuit current ratings, consider conditions that may result in maximum available fault current, including but not limited to:
    - a. Maximum utility fault currents.
    - b. Maximum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  - 3. For each bus location, calculate the maximum available three-phase bolted symmetrical and asymmetrical fault currents. For grounded systems, also calculate the maximum available line-to-ground bolted fault currents.
- E. Protective Device Coordination Study:
  - 1. Comply with applicable portions of IEEE 242 and IEEE 399.
  - 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
  - 3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors. Adjusting and/or swapping breaker types, settings or style in order to meet full selective coordination shall be at no additional cost to the Owner.
- F. Arc Flash and Shock Risk Assessment:
  - 1. Comply with NFPA 70E.
  - 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
  - 3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
    - a. Maximum and minimum utility fault currents.
    - b. Maximum and minimum motor contribution.
    - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- G. Study Reports:
  - 1. General Requirements:
    - a. Identify date of study and study preparer.
    - b. Identify study methodology and software product(s) used.
    - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
    - d. Identify base used for per unit values.
    - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
    - f. Include conclusions and recommendations.
  - 2. Short-Circuit Study:
    - a. For each scenario, identify at each bus location:
      - 1) Calculated maximum available symmetrical and asymmetrical fault currents (both three-phase and line-to-ground where applicable).
      - 2) Fault point X/R ratio.
      - 3) Associated equipment short circuit current ratings.
    - b. Identify locations where the available fault current exceeds the equipment short circuit current rating, along with recommendations.
  - 3. Protective Device Coordination Study:
    - a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.



- b. For each graph include (where applicable):
    - 1) Partial single-line diagram identifying the portion of the system illustrated.
    - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
    - 3) Conductors: Damage curves.
    - 4) Transformers: Inrush points and damage curves.
    - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
    - 6) Motors: Full load current, starting curves, and damage curves.
    - 7) Capacitors: Full load current and damage curves.
  - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
    - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
    - 2) Include ground fault pickup and delay.
    - 3) Include fuse ratings.
    - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
  - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.
4. Arc Flash and Shock Risk Assessment:
- a. For the worst case for each scenario, identify at each bus location:
    - 1) Calculated incident energy and associated working distance.
    - 2) Calculated arc flash boundary.
    - 3) Bolted fault current.
    - 4) Arcing fault current.
    - 5) Clearing time.
    - 6) Arc gap distance.
  - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.

#### **1.07 QUALITY ASSURANCE**

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
  - 1. Study preparer may be employed by manufacturer of electrical distribution equipment.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

### **PART 2 PRODUCTS**

#### **2.01 ARC FLASH HAZARD WARNING LABELS**

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
  - 1. Materials: Comply with Section 26 0553.
  - 2. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
    - a. Include the following information:
      - 1) Arc flash boundary.
      - 2) Available incident energy and corresponding working distance.
      - 3) Nominal system voltage.

**PART 3 EXECUTION**

**3.01 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Adjust equipment and protective devices for compliance with studies and recommended settings.
- D. Notify Architect of any conflicts with or deviations from studies. Obtain direction before proceeding.

**END OF SECTION 26 0573**

**SECTION 26 0583  
WIRING CONNECTIONS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical connections to equipment.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 2726 - Wiring Devices.

**1.03 REFERENCE STANDARDS**

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
  - 1. Colors: Comply with NEMA WD 1.
  - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
  - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

**PART 3 EXECUTION**

**3.01 ELECTRICAL CONNECTIONS**

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

**END OF SECTION 26 0583**

**SECTION 26 0923  
LIGHTING CONTROL DEVICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Occupancy/Vacancy sensors.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0529 - Hangers and Supports for Electrical Systems
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches, wall dimmers, and fan speed controllers.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the placement of wall switch occupancy sensors with actual installed door swings.
  - 2. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage installed under other sections or by others.
  - 3. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

**PART 2 PRODUCTS**

**2.01 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.

**2.02 OCCUPANCY/VACANCY SENSORS**

- A. All Occupancy Sensors:
  - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.
  - 2. Sensor Technology:
    - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
  - 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
  - 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval. Vacancy sensor to have manual on operation and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.

5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
  6. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
  7. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.
- B. Wall Switch Occupancy Sensors:
1. All Wall Switch Occupancy Sensors:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.
    - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    - c. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.
  2. Passive Infrared/Ultrasonic Dual Technology Wall Switch Occupancy Sensors: Capable of detecting motion within an area of 900 square feet (83.6 sq m).
- C. Wall Dimmer Occupancy Sensors:
1. General Requirements:
    - a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.
    - b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).
    - c. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.
- D. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
    - a. Description: Low profile occupancy sensors designed for ceiling installation.
    - b. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
  2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
    - a. Standard Range Sensors: Capable of detecting motion within an area of 450 square feet (41.8 sq m) at a mounting height of 9 feet (2.7 m), with a field of view of 360 degrees.
- E. Power Packs for Low Voltage Occupancy Sensors:
1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.
  2. Provide quantity and configuration of power and slave packs with all associated wiring and accessories as required to control the load indicated on drawings.
  3. Input Supply Voltage: Dual rated for 120/277 V ac.
  4. Load Rating: As required to control the load indicated on drawings.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
- G. Provide required supports in accordance with Section 26 0529.
- H. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- I. Occupancy Sensor Locations:
  - 1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.
  - 2. Locate dual technology passive infrared/ultrasonic occupancy sensors a minimum of 4 feet (1.2 m) from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

### **3.02 ADJUSTING**

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.

**END OF SECTION 26 0923**

**SECTION 26 2100**  
**LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Electrical service requirements.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2413 - Switchboards: Service entrance equipment.
- F. Section 26 2416 - Panelboards: Service entrance equipment.

**1.03 REFERENCE STANDARDS**

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
  - 1. Verify the following with Utility Company representative:
    - a. Utility Company requirements, including division of responsibility.
    - b. Exact location and details of utility point of connection.
    - c. Utility easement requirements.
    - d. Utility Company charges associated with providing service.
  - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
  - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. Utility Company charges associated with providing permanent service to be paid by Owner.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
  - 1. Arrange for inspections necessary to obtain Utility Company approval of installation.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

## **1.06 QUALITY ASSURANCE**

- A. Comply with the following:
  - 1. IEEE C2 (National Electrical Safety Code).
  - 2. NFPA 70 (National Electrical Code).
  - 3. The requirements of the Utility Company.

## **PART 2 PRODUCTS**

### **2.01 ELECTRICAL SERVICE REQUIREMENTS**

- A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.
- D. Division of Responsibility: As indicated on drawings.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment components in accordance with Section 26 0529.
- E. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.
- F. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

**END OF SECTION 26 2100**



**SECTION 26 2413  
SWITCHBOARDS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- F. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.
- G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 1000 Volts or Less; 2023.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- I. UL 891 - Switchboards; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.

**PART 2 PRODUCTS**

**2.01 SWITCHBOARDS**

- A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.
- D. Service Conditions:
  - 1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:
    - a. Altitude: Less than 6,600 feet (2,000 m).
    - b. Ambient Temperature:
      - 1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).

2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- E. Short Circuit Current Rating:
  1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- F. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- G. Bussing: Sized in accordance with UL 891 temperature rise requirements.
  1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.
  2. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
  3. Phase and Neutral Bus Material: Aluminum.
  4. Ground Bus Material: Aluminum.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures:
  1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  2. Finish: Manufacturer's standard unless otherwise indicated.
- J. Future Provisions:
  1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Instrument Transformers:
  1. Comply with IEEE C57.13.
  2. Select suitable ratio, burden, and accuracy as required for connected devices.
  3. Current Transformers: Connect secondaries to shorting terminal blocks.
  4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

## **2.02 OVERCURRENT PROTECTIVE DEVICES**

- A. Circuit Breakers:
  1. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
    - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
  2. Molded Case Circuit Breakers:
    - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch (10 mm) between switchboard and wall.

- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install switchboards plumb and level.
- G. Unless otherwise indicated, mount switchboards on properly sized 4 inch (100 mm) high concrete pad constructed in accordance with Section 03 3000.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Install all field-installed devices, components, and accessories.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Provide filler plates to cover unused spaces in switchboards.

**END OF SECTION 26 2413**

**SECTION 26 2416  
PANELBOARDS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 67 - Panelboards; Current Edition, Including All Revisions.
- J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

**PART 2 PRODUCTS**

**2.01 PANELBOARDS - GENERAL REQUIREMENTS**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Short Circuit Current Rating:
  - 1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- C. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- D. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- E. Bussing: Sized in accordance with UL 67 temperature rise requirements.
  - 1. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

- F. Conductor Terminations: Suitable for use with the conductors to be installed.
- G. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 2. Boxes: Galvanized steel unless otherwise indicated.
    - a. Provide wiring gutters sized to accommodate the conductors to be installed.
  - 3. Fronts:
    - a. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
  - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- H. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

## **2.02 OVERCURRENT PROTECTIVE DEVICES**

- A. Molded Case Circuit Breakers:
  - 1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
  - 2. Interrupting Capacity:
    - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
      - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
      - 2) 14,000 rms symmetrical amperes at 480 VAC.
  - 3. Conductor Terminations:
    - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
  - 4. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
  - 5. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Install panelboards plumb.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Install all field-installed branch devices, components, and accessories.
- J. Provide filler plates to cover unused spaces in panelboards.

**END OF SECTION 26 2416**

**SECTION 26 2726  
WIRING DEVICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0533.16 - Boxes for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

**PART 2 PRODUCTS**

**2.01 WIRING DEVICE APPLICATIONS**

- A. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- B. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- C. Provide GFCI protection for receptacles installed in kitchens.
- D. Provide GFCI protection for receptacles serving electric drinking fountains.

**2.02 WIRING DEVICE FINISHES**

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
- C. Wiring Devices Installed in Finished Spaces: White with white nylon wall plate.
- D. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.

**2.03 WALL SWITCHES**

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

#### **2.04 WALL DIMMERS**

- A. Wall Dimmers - General Requirements: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1472; types and ratings suitable for load controlled as indicated on the drawings.

#### **2.05 RECEPTACLES**

- A. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
  - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
  - 2. NEMA configurations specified are according to NEMA WD 6.

#### **2.06 WALL PLATES**

- A. Wall Plates: Comply with UL 514D.
  - 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
  - 2. Screws: Metal with slotted heads finished to match wall plate finish.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- I. Install wall switches with OFF position down.
- J. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- K. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

- N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

**END OF SECTION 26 2726**



**SECTION 26 2813  
FUSES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fuses.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 2816.16 - Enclosed Switches: Fusible switches.

**1.03 REFERENCE STANDARDS**

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

**PART 2 PRODUCTS**

**2.01 FUSES**

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

**END OF SECTION 26 2813**

**SECTION 26 2816.16  
ENCLOSED SWITCHES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Enclosed safety switches.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 2813 - Fuses.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- E. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
  - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
  - 4. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

**PART 2 PRODUCTS**

**2.01 ENCLOSED SAFETY SWITCHES**

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Horsepower Rating: Suitable for connected load.
- D. Voltage Rating: Suitable for circuit voltage.
- E. Short Circuit Current Rating:
  - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the

available fault current at the installed location as indicated on the drawings.

- F. Provide with switch blade contact position that is visible when the cover is open.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
- J. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.

**END OF SECTION 26 2816.16**

**SECTION 26 3213  
ENGINE GENERATORS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Packaged engine generator system and associated components and accessories:
  - 1. Engine and engine accessory equipment.
  - 2. Alternator (generator).
  - 3. Generator set control system.
  - 4. Generator set enclosure.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
- C. NEMA MG 1 - Motors and Generators; 2021.
- D. NFPA 99 - Health Care Facilities Code; 2024, with Errata.
- E. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
- F. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
- G. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
  - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.
  - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
- C. Manufacturer's factory emissions certification.

## **PART 2 PRODUCTS**

### **2.01 PACKAGED ENGINE GENERATOR SYSTEM**

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. System Description:
  - 1. Application: Emergency/standby.
  - 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
- D. Packaged Engine Generator Set:
  - 1. Type: Gaseous (spark ignition).
- E. Generator Set General Requirements:
  - 1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
  - 2. Factory-assembled, with components mounted on suitable base.
  - 3. List and label engine generator assembly as complying with UL 2200.
  - 4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
  - 5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
  - 6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.
- F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
- G. Starting and Load Acceptance Requirements:
  - 1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
  - 2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.
  - 3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
  - 4. Maximum Load Step: Supports 100 percent of rated load in one step.
- H. Exhaust Emissions Requirements:
  - 1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
  - 2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

### **2.02 ENGINE AND ENGINE ACCESSORY EQUIPMENT**

- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.
- B. Engine Fuel System - Gaseous (Spark Ignition):
  - 1. Fuel Source: Natural gas.
  - 2. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
  - 3. Provide components/features indicated and as necessary for operation and/or required by applicable codes, including but not limited to:
    - a. Carburetor.

- b. Gas pressure regulators.
  - c. Fuel shutoff control valves.
  - d. Low gas pressure switches.
- C. Engine Starting System:
  - 1. System Type: Electric, with DC solenoid-activated starting motor(s).
  - 2. Battery(s):
    - a. Battery Type: Lead-acid.
    - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
    - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.
  - 3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
  - 4. Battery Charger:
    - a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
    - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
    - c. Recognized as complying with UL 1236.
    - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
    - e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
    - f. Provide alarm output contacts as necessary for alarm indications.
- D. Engine Speed Control System (Governor):
  - 1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
  - 2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- E. Engine Lubrication System:
  - 1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication. Provide oil cooler where recommended by manufacturer.
- F. Engine Cooling System:
  - 1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
  - 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
- G. Engine Air Intake and Exhaust System:
  - 1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
  - 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.

### **2.03 ALTERNATOR (GENERATOR)**

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:

1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
  2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
  3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
- C. Temperature Rise: Comply with UL 2200.
- D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.
- E. Enclosure: NEMA MG 1, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.

#### **2.04 GENERATOR SET CONTROL SYSTEM**

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. Control Panel:
1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
  2. Generator Set Control Functions:
    - a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).
    - b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
    - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
    - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
    - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
    - f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).
    - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
  3. Generator Set Status Indications:
    - a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
    - b. Current (Amps): For each phase.
    - c. Frequency (Hz).
    - d. Real power (W/kW).
    - e. Reactive power (VAR/kVAR).
    - f. Apparent power (VA/kVA).
    - g. Power factor.
    - h. Duty Level: Actual load as percentage of rated power.
    - i. Engine speed (RPM).
    - j. Battery voltage (Volts DC).
    - k. Engine oil pressure.
    - l. Engine coolant temperature.
    - m. Engine run time.
    - n. Generator powering load (position signal from transfer switch).
  4. Generator Set Protection and Warning/Shutdown Indications:
    - a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
      - 1) Overcrank (shutdown).
      - 2) Low coolant temperature (warning).
      - 3) High coolant temperature (warning).
      - 4) High coolant temperature (shutdown).
      - 5) Low oil pressure (shutdown).
      - 6) Overspeed (shutdown).

- 7) Low fuel level (warning).
  - 8) Low coolant level (warning/shutdown).
  - 9) Generator control not in automatic mode (warning).
  - 10) High battery voltage (warning).
  - 11) Low cranking voltage (warning).
  - 12) Low battery voltage (warning).
  - 13) Battery charger failure (warning).
- b. In addition to NFPA 110 requirements, provide the following protections/indications:
  - 1) High AC voltage (shutdown).
  - 2) Low AC voltage (shutdown).
  - 3) High frequency (shutdown).
  - 4) Low frequency (shutdown).
  - 5) Overcurrent (shutdown).
- c. Provide contacts for local and remote common alarm.
- d. Provide lamp test function that illuminates all indicator lamps.
- 5. Other Control Panel Features:
  - a. Event log.
- C. Remote Annunciator:
  - 1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
  - 2. Generator Set Status Indications:
    - a. Generator powering load (via position signal from transfer switch).
    - b. Communication functional.
  - 3. Generator Set Warning/Shutdown Indications:
    - a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
      - 1) Overcrank (shutdown).
      - 2) Low coolant temperature (warning).
      - 3) High coolant temperature (warning).
      - 4) High coolant temperature (shutdown).
      - 5) Low oil pressure (shutdown).
      - 6) Overspeed (shutdown).
      - 7) Low fuel level (warning).
      - 8) Low coolant level (warning/shutdown).
      - 9) Generator control not in automatic mode (warning).
      - 10) High battery voltage (warning).
      - 11) Low cranking voltage (warning).
      - 12) Low battery voltage (warning).
      - 13) Battery charger failure (warning).
    - b. Provide audible alarm with silence function.
    - c. Provide lamp test function that illuminates all indicator lamps.
- D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

## **2.05 GENERATOR SET ENCLOSURE**

- A. Enclosure Type: Sound attenuating, weather protective.
- B. Enclosure Material: Steel or aluminum.
- C. Hardware Material: Stainless steel.
- D. Color: Manufacturer's standard.
- E. Access Doors: Lockable, with all locks keyed alike.



- F. Openings: Designed to prevent bird/rodent entry.
- G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.
- H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch (150 mm) high concrete pad constructed in accordance with Section 03 3000.
- F. Provide required support and attachment in accordance with Section 26 0529.
- G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
- H. Provide engine exhaust piping in accordance with Section 23 5100, where not factory installed.
  - 1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
  - 2. Do not exceed manufacturer's maximum back pressure requirements.
- I. Provide grounding and bonding in accordance with Section 26 0526.
- J. Identify system wiring and components in accordance with Section 26 0553.

**END OF SECTION 26 3213**

**SECTION 26 3600  
TRANSFER SWITCHES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:
  - 1. Automatic transfer switches.
  - 2. Includes service entrance rated transfer switches.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 2816.16 - Enclosed Switches: Safety switches not listed for use as transfer switch equipment.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2020.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.
  - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
  - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
  - 4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
  - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

**PART 2 PRODUCTS**

**2.01 TRANSFER SWITCHES**

- A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.

- C. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
- D. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).
- E. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
- F. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.
- G. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
- H. Enclosures:
  - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
    - a. Indoor Clean, Dry Locations: Type 1 or Type 12.
    - b. Outdoor Locations: Type 3R or Type 4.
  - 2. Finish: Manufacturer's standard unless otherwise indicated.
- I. Short Circuit Current Rating:
  - 1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install transfer switches plumb and level.
- F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

**END OF SECTION 26 3600**

**SECTION 26 4300  
SURGE PROTECTIVE DEVICES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

**PART 2 PRODUCTS**

**2.01 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS**

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. UL 1449 Voltage Protection Ratings (VPRs):
  - 1. Equivalent to basis of design.
- E. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- F. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
  - 1. Indoor clean, dry locations: Type 1.
  - 2. Outdoor locations: Type 3R.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- C. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

**END OF SECTION 26 4300**

**SECTION 26 5100  
INTERIOR LIGHTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems; 2006.
- B. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- F. UL 1598 - Luminaires; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
  - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
  - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
  - 4. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

**PART 2 PRODUCTS**

**2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.

**2.02 LUMINAIRES**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

### **2.03 EMERGENCY LIGHTING UNITS**

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
  - 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

### **2.04 EXIT SIGNS**

- A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.
  - 1. Number of Faces: Single- or double-face as indicated or as required for installed location.
  - 2. Directional Arrows: As indicated or as required for installed location.
- B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install accessories furnished with each luminaire.
- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Emergency Lighting Units:
  - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- I. Exit Signs:
  - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting

controls.

J. Install lamps in each luminaire.

**END OF SECTION 26 5100**

**SECTION 26 5600  
EXTERIOR LIGHTING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Exterior luminaires.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- B. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1598 - Luminaires; Current Edition, Including All Revisions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

**PART 2 PRODUCTS**

**2.01 LUMINAIRE TYPES**

- A. Furnish products as indicated in luminaire schedule included on the drawings.

**2.02 LUMINAIRES**

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Install products in accordance with manufacturer's instructions.
- C. Install luminaires in accordance with NECA/IESNA 501.
- D. Provide required support and attachment in accordance with Section 26 0529.



- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install accessories furnished with each luminaire.
- G. Bond products and metal accessories to branch circuit equipment grounding conductor.
- H. Install lamps in each luminaire.

**END OF SECTION 26 5600**

**SECTION 27 0500  
COMMON WORK RESULTS FOR COMMUNICATIONS**

**PART 1 - GENERAL**

**1.01 QUALITY ASSURANCE**

- A. Specifications, Standards, and Codes
  - 1. All work shall be in accordance with the following:
    - a. This Technical Specification and Associated Drawings
    - b. TIA/EIA 568-C.0 Generic Telecommunications Cabling for Customer Premises
    - c. TIA/EIA 568-C.1 Commercial Building Telecommunications Cabling Standard
    - d. TIA/EIA 568-C.2 Balanced Twisted Pair Cabling Components Standard
    - e. TIA/EIA 568-C.3 Optical Fiber Cabling Components Standard
    - f. TIA/EIA 942 Telecommunications Infrastructure for Data Centers
    - g. TIA/TIA 569-A Commercial Building Standard for Telecommunications Pathways and Spaces
    - h. TIA/EIA 606-A Administration Standard for the Telecommunications Infrastructure of Commercial
    - i. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
    - j. ANSI/TIA-758-A Customer Owned Outside Plant Telecommunications Infrastructure Standard
    - k. National Fire Protection Agency (NFPA)-70 National Electric Code (NEC)
    - l. UL 50 Enclosures for Electrical Equipment
    - m. Current design and installation agreement with single solution manufacturer.
  - 2. If a conflict exists between applicable documents that cannot be verbally negotiated, then the order in the list above starting with #1 above shall dictate the order of precedence in resolving conflicts. This order of precedence shall be maintained unless a lesser order document has been adopted as code by a local, state or federal entity, and is therefore enforceable as law by a local, state, or federal inspection agency. If a conflict is found, it shall be the discovering party's responsibility to notify the Design Professional of these specifications for clarification and resolution.
  - 3. Comply with all requirements for permits and tests, shall provide all certificates, and shall pay all costs for same.

**1.02 SCOPE**

- A. The work to be done under this Section of the Specifications shall include the furnishing of labor, material, equipment and tools required for the complete installation of the work indicated on the Drawings or as specified herein.
- B. All materials, obviously a part of the Telecommunications Infrastructure and necessary to its proper operation, but not specifically mentioned or shown on the Drawings, shall be furnished and installed without additional charge.
- C. The Drawings and Specifications are complementary to each other and what is called for by one shall be as binding as if called for by both. If a discrepancy exists between the Drawing and Specifications, the higher cost shall be included, and the Design Professional shall be notified of the discrepancy.

**1.03 WORK INCLUDED**

- A. The Communications Infrastructures installed and work performed under this Division of the Specifications shall include but not necessarily be limited to the following:
  - 1. Horizontal and Backbone Cabling Infrastructure
  - 2. Telecommunications conduits, raceways, cable tray, racks, cabinets and equipment mounting boards as indicated on the Drawings.
  - 3. Grounding and Bonding
  - 4. Concrete work for wall and floor penetration.

#### **1.04 DEFINITIONS**

- A. Terms: The following definitions of terms supplement those of the GENERAL REQUIREMENTS and are applicable to the TELECOMMUNICATIONS WORK SCOPE.
- B. Provide: As used herein shall mean "furnish, install and test (if applicable) complete".
- C. Infrastructure: As used herein shall mean cable, installed in conduit, raceway, or cable tray with all required boxes, fittings, connectors, and accessories; completely installed."
- D. Work: As used herein shall be understood to mean the materials completely installed, including the labor involved.

#### **1.05 DRAWINGS**

- A. Drawings are generally diagrammatic and show the arrangement and location of pathways, outlets, support structures and equipment. Carefully investigate the structural and finish conditions affecting his work and arrange his work accordingly. Should conditions on the job make it necessary to make adjustments to pathways or materials, advise the Engineer and secure approval before proceeding with such work.
- B. Where exact locations are required by equipment for stubbing-up and terminating conduit concealed in floor slabs, request shop Drawings, equipment location Drawings, foundation Drawings, and any other data required by him to locate the concealed conduit before the floor slab is poured.
- C. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a complete installation shall be provided. Drawings and Specifications do not undertake to indicate every item of material, equipment, or labor required to produce a complete and properly operating installation.
- D. The right is reserved to make reasonable changes in locations of equipment indicated on Drawings prior to rough-in without increase in contract cost.
- E. Do not reduce the size or number of conduit runs indicated on the Drawings without the written approval of the Engineer.
- F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.
- G. The location of equipment, support structures, outlets, and similar devices shown on the Drawings are approximate only. Do not scale Drawings. Obtain layout dimensions for equipment from Architectural plans unless indicated on Technology plans.
- H. Schematic diagrams shown on the Drawings indicate the required functions only. The technology of a particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic Drawings shown. Additional labor and materials required for such deviations shall be additional expense.
- I. Verify the ceiling type, ceiling suspension systems, and clearance above hung ceilings prior to ordering cabling and associated hardware. Notify the Engineer of any discrepancies.
- J. Review all architectural Drawings for modular furniture.
- K. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Omissions of words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "In accordance with", "a", "the" and "all are intended" shall be supplied by inference.

#### **1.06 QUALITY ASSURANCE**

- A. Equipment and materials required for installation under these Specifications shall be the current model and new (less than one [1] year from the date of manufacture), unused and without blemish or defect.
- B. Equipment shall bear labels attesting to Underwriters Laboratories or certification by other recognized laboratory, where subject to label service. Manufacturers of equipment and

materials pertinent to these items shall have been engaged in the manufacture of said equipment a minimum of three (3) years and, if so directed by the Owner, be able to furnish proof of their ability by submitting affidavits and descriptive data about their product including size and magnitude comparable to requirements specified herein.

#### **1.07 CONTRACTOR QUALIFICATIONS**

- A. Have total responsibility for the coordination and installation of the work shown and described in the Drawings and Specifications. Shall be a company specializing in the design, fabrication and installation of integrated telecommunications systems.

#### **1.08 COORDINATION WITH OTHER TRADES**

- A. Coordinate telecommunications work with that of other Sections as required to ensure that the entire telecommunications work will be carried out in an orderly, complete and coordinated fashion.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. All materials used in this work shall be new and shall bear the inspection label of Underwriters' Laboratories Inc. or certification by other recognized laboratory.
- B. The published standards and requirements of the Telecommunications Industries Association (TIA), National Electrical Manufacturers Association (NEMA), the American National Standard Institute (ANSI), the Institute of Electrical and Electronic Engineers (IEEE), and the American Society of Testing Materials (ASTM), are made a part of these Specifications and shall apply wherever applicable.
- C. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts are available.
- D. When more than one unit of the same class of equipment or material is required, such units shall be the products of a single manufacturer or partner manufacturers that offer a certified solution.
- E. Components of an assembled unit need not be products of the same manufacturer, but must offer a certified end-to-end solution.
- F. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
- G. Components shall be compatible with each other and with the total assembly for the intended service.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION OF SURFACE CONDITIONS**

- A. Prior to the start of work, carefully inspect the installed work of other trades and verify that such work is complete to the point where installation may properly commence. Start of work indicates acceptance of conditions.
- B. Install equipment in accordance with applicable codes and regulations, the original design and the referenced standards.
- C. In the event of a discrepancy, immediately notify the Project Manager.
- D. Do not proceed with installation until unsatisfactory conditions and discrepancies have been fully resolved.

#### **3.02 PROTECTION OF SYSTEMS AND EQUIPMENT**

- A. Protect materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, theft, moisture, extreme temperature and rain.
- B. Damage from rain, dirt, sun and ground water shall be prevented by storing the equipment on elevated supports and covering the sides with securely fastened protective rigid or flexible

waterproof coverings.

- C. During installation, equipment shall be protected against entry of foreign matter on the inside and be vacuum cleaned both inside and outside before testing, operating or painting.
- D. As determined by the Project Manager, damaged equipment shall be fully repaired or shall be removed and replaced with new equipment to fully comply with requirements of the Contract Documents. Decision of the Project Manager shall be final.
- E. Damaged paint on equipment and materials shall be repainted with painting equipment and finished with the same quality of paint and workmanship as used by the manufacturer.

### **3.03 ACCESS TO EQUIPMENT**

- A. Equipment shall be installed in location and manner that will allow convenient access for maintenance and inspection.
- B. Working spaces shall be not less than specified in the National Electrical Code (NEC) for voltages specified.
- C. Where the Project Manager determines that the installed equipment is not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled, one time only, as directed by the Project Manager, at no additional cost to the Owner. "Conveniently accessible" is defined as being capable of being reached without the use of ladders or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping and duct work.

### **3.04 CLEANING**

- A. During construction, and prior to Owner acceptance of the building, remove from the premises and dispose of packing material and debris caused by telecommunications work.
- B. Remove dust and debris from interiors and exteriors of electrical equipment. Clean accessible current carrying elements prior to being energized.

### **3.05 COMPLETION**

- A. General: Upon completion of the work, remove excess debris, materials, equipment, apparatus, tools and similar items. Leave the premises clean, neat and orderly.
- B. Results Expected: Systems shall be complete and operational and controls shall be set and calibrated. Testing, start-up and cleaning work shall be complete.
- C. Maintenance Materials: Special tools for proper operation and maintenance of the equipment provided under this Specification shall be delivered to the Owner.

### **3.06 SURFACE MOUNTED CONDUIT AND DEVICES**

- A. New Construction: Unless otherwise noted on the drawings or specifications, all conduit shall be concealed and wall mounted devices recessed flush within walls. Surface mounted conduit and devices are prohibited.
- B. Renovations: Unless otherwise note on the drawings or specifications, all conduit shall be concealed and wall mounted devices recessed within existing walls. Contractors pricing to include cutting existing walls to install concealed conduit and flush wall mounted devices. Price to also include patching existing walls back to original condition. Surface mounted conduit and devices are prohibited.

**END OF SECTION 27 0500**

**SECTION 27 0526**  
**GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**PART 1- GENERAL****1.01 GENERAL REQUIREMENTS**

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Grounding & Bonding for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document.
- D. Locations of telecommunications equipment and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

**1.02 WORK INCLUDED**

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. Provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
  - 1. Furnish and install all Grounding Conductors.
  - 2. Furnish and install all Grounding Lugs and Hardware.
- C. Perform installation and termination of the main bonding conductor to the building service entrance ground.

**PART 2 - PRODUCTS****2.01 APPROVED PRODUCTS**

- A. Approved Equipment Grounding Conductor manufacturer(s):
  - 1. Southwire
  - 2. West Penn
  - 3. Belden
- B. Approved Grounding Lug manufacturer(s):
  - 1. Burndy
  - 2. Thomas & Betts
  - 3. Chatsworth Products, Inc.
  - 4. Harger
- C. Approved Grounding Busbar manufacturer(s):
  - 1. Burndy
  - 2. Thomas & Betts
  - 3. Chatsworth Products, Inc.
  - 4. Harger

**2.02 GROUNDING CONDUCTORS**

- A. Grounding Conductor
  - 1. Construction shall be Type THHN copper conductors, insulated with heat and moisture resistant PVC over which a UL listed jacket is applied.
  - 2. Jacket color shall be green. Jacketed cable shall be identified at each termination point with a wrap of green tape.

**2.03 GROUNDING LUGS****A. Grounding Lugs and Hardware**

1. Grounding lugs shall be 2-hole and installed with a crimper that when properly executed the die of the crimper impresses the die # on the lug base. All lugs shall be sleeved with clear heat-shrink to allow for inspection of the crimp. Silicon bronze or stainless steel bolts and washers shall be used to install lugs to equipment. Exothermic welding is also allowed.

**PART 3 - EXECUTION****3.01 GROUNDING**

- A. All equipment, racks, cabinets, enclosures, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in the MC/IC/TC shall be grounded to the respective TGB or TMGB using a minimum #6 AWG stranded copper bonding conductor and compression lugs.
- B. All wires used for telecommunications grounding purposes shall be identified with a green insulation. Non-insulated wires shall be identified at each termination point with a wrap or green tape. All cables and busbars shall be identified and labeled in accordance with the ANSI/TIA/EIA- 606-A.
- C. The ground/earth system must be designed for high reliability. Therefore, the grounding/earthing system shall meet following criteria:
  1. Local electrical codes shall be adhered to.
  2. The grounding/earthing system shall comply with ANSI/TIA-942 and J-STD-607-A.
  3. All grounding/earthing conductors shall be copper.
  4. Lugs, HTAPs, grounding strips, and busbars shall be UL Listed and made of premium quality tin-plated electrolytic copper that provides low electrical resistance while inhibiting corrosion. Antioxidant shall be used when making bonding connections in the field.
- D. The gauge of the connecting ground/earth cable, known as the Telecommunications Bonding Backbone (TBB) will follow J-STD-607-A guidelines, as is shown in the table below.

| Sizing of the TBB                  |                |
|------------------------------------|----------------|
| TBB Length in Linear meters (feet) | TBB Size (AWG) |
| Less than 4 (13)                   | 6              |
| 4-6 (14-20)                        | 4              |
| 6-8 (21-26)                        | 3              |
| 8-10 (27-33)                       | 2              |
| 10-13 (34-41)                      | 1              |
| 13-16 (42-52)                      | 1/0            |
| 16-20 (53-66)                      | 2/0            |
| Greater than 20 (66)               | 3/0            |

- E. Ladder racks shall be bonded per the manufacturer's installation instructions. To provide electrical continuity between ladder rack segments drill holes in rack and use a #6 AWG code cable with green/yellow stripe to jumper between segments. The jumper shall be made with 2-hole copper compression connectors terminated on both ends. Attach jumpers as required to ladder rack and then bond the entire assembly to the TGB.
- F. Equipment and racks shall be bonded in accordance with the methods prescribed in ANSI/TIA-942. To provide electrical continuity between rack elements, paint piercing grounding washers shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack. All racks shall utilize a full-length rack ground strip attached to the rear of the side rail with thread-forming screws to ensure metal-to-metal contact. Patch panels will be bonded to racks using bonding screws for racks having #12-24 equipment mounting holes.

- G. Reference low voltage drawing package for additional requirements.

**END OF SECTION 27 0526**



**SECTION 27 0528  
PATHWAYS FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.01 GENERAL REQUIREMENTS**

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the products and execution requirements relating to Pathways for Communications Systems.
- C. Product specifications, general design considerations, and installation guidelines are provided in this document. Locations of interior telecommunications pathways and typical installation details will be provided on Drawings as an attachment to this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

**1.02 WORK INCLUDED**

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete the installation. Provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
  - 1. Furnish and install complete Conduit System – Reference Electrical Specifications.
  - 2. Furnish and install all Telecommunications Outlet Boxes.
  - 3. Furnish and install all Pull Boxes.
  - 4. Furnish and install complete Cable Tray System.
  - 5. Furnish and install all Velcro Straps.

**PART 2 PRODUCTS**

**2.01 APPROVED PRODUCTS**

- A. Approved Velcro Strap manufacturer(s):
  - 1. Panduit
  - 2. Tyco
  - 3. Hubbell
  - 4. Or Approved Equal
- B. Innerduct
  - 1. Exposed innerduct shall be rated CMP (plenum), corrugated plastic equipped with pull-string or mule tape.
  - 2. Sizes shall be 2", 1-1/4" & 1" inside diameter.
  - 3. See Drawings for innerduct details.

**2.02 PULL BOXES**

- A. Pull boxes shall be constructed of galvanized steel with flat, removable covers fastened with plated steel screws.
- B. Pull boxes shall be equipped with keyhole screw slots in the cover to permit removal of the cover without extracting the screws.
- C. Pull boxes shall have provisions for grounding.

**2.03 CABLE TRAY**

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Chalfant Manufacturing Company.
  - 2. Cooper B-Line, Inc.
  - 3. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
  - 4. GS Metals Corp.; GLOBETRAY Products.

5. MONO-SYSTEMS, Inc.
6. MPHusky.
7. PW Industries.
- B. Steel, complying with NEMA VE 1.
  1. Factory-standard primer, ready for field painting; with cadmium-plated hardware according to ASTM B 766.
  2. Mill galvanized before fabrication, complying with ASTM A 653/A 653M, G90 (Z275) coating; with hardware galvanized according to ASTM B 633. Electrogalvanized before fabrication, complying with ASTM B 633; with hardware galvanized according to ASTM B 633.
  3. Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, hardware.
  4. Epoxy-resin paint over paint manufacturer's recommended primer and corrosion-inhibiting treatment; with cadmium-plated hardware according to ASTM B 766.
- C. Sizes and Configurations: Refer to Drawings for specific requirements for types, materials, sizes, and configurations.
- D. Center-hanger supports may be used only when specifically indicated.
- E. Cable Tray Accessories:
  1. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and
    - a. finishes as cable tray.
  2. Barrier Strips: Same materials and finishes as cable tray.
  3. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.
- F. Warning - Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."
- G. Materials and fastening are specified in Division 26 Section "Electrical Identification."
- H. Source Quality Control - Perform design and production tests according to NEMA VE 1.

## **2.04 VELCRO STRAPS**

- A. Velcro Straps
  1. Cables shall be fastened to support structures with Velcro straps.
  2. Velcro straps installed in air handling spaces must be plenum rated.
    - a. Plenum Velcro strap color shall be red.
  3. Use 1-inch wide Velcro to secure cables to all support structures.

## **PART 3 - EXECUTION**

### **3.01 CABLE TRAY INSTALLATION**

- A. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.
- B. Remove burrs and sharp edges from cable trays.
- C. Fasten cable tray supports to building structure.
  1. Design each fastener and support to carry load indicated by seismic requirements.
  2. Place supports so that spans do not exceed maximum spans on schedules.
  3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
  4. Support bus assembly to prevent twisting from eccentric loading.

5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA VE 1.
- D. Make connections to equipment with flanged fittings fastened to cable tray and to equipment. Support cable tray independent of fittings. Do not carry weight of cable tray on equipment enclosure.
- E. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed dimensions recommended in NEMA VE 1. Space connectors and set gaps according to applicable standard.
- F. Make changes in direction and elevation using standard fittings.
- G. Make cable tray connections using standard fittings.
- H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- I. Workspace: Install cable trays with enough space to permit access for installing cables.
- J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

### **3.02 CONNECTIONS**

- A. Ground cable trays according to manufacturer's written instructions.
- B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

### **3.03 FIELD QUALITY CONTROL**

- A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:
  1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
  2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
  3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
  4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
  5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorqued in suspect areas.
  6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
  7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.
- B. Report results in writing.

### **3.04 PROTECTION**

- A. Protect installed cable trays.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
  2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.

### 3.05 PENETRATIONS

- A. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw upon approval of the structural engineer of record for the base of building. Impact electric, hand or manual hammer type drills shall not be allowed, except where permitted by the Project Manager as required by limited working space. X-ray all floor penetrations accordingly.
- B. Holes shall be located so as not to affect structural sections such as ribs or beams.
- C. Holes shall be laid out in advance. The Project Manager shall be advised prior to drilling through structural sections, for determination of proper layout.
- D. Structural Penetrations: Where conduits, wireways and other raceways pass through fire partitions, fire walls or walls and floors provide a code compliant effective barrier against the spread of fire, smoke and gases.
- E. All penetrations where conduit is not used shall be sleeved.
- F. No gaps or rough edges shall be allowed between wall and conduit/sleeve.

### 3.06 CONDUIT SYSTEM

- A. All conduit shall not be less than 3/4" trade size.
- B. No more than two 90 degree sweep bends or the equivalent shall be permitted between junction boxes, pull boxes, cabinets, or cable access points.
- C. Conduit shall be provided as a continuous run perpendicular from the cable tray to the work area outlet. All cables shall be enclosed in conduit or cable tray for protection.
- D. Conceal all conduits, except in unfinished spaces such as equipment rooms or as indicated by symbol on the Drawings.
- E. Leave all empty conduits with a 200 pound test nylon cord pull line.
- F. A 200 pound test nylon cord pull line shall be co-installed with all cable installed in any conduit.
- G. Flattened, dented, or deformed conduits are not permitted and shall be removed and replaced.
- H. Fasten conduit support device to structure with wood screws on wood, toggle bolts on hollow masonry, anchors as specified on solid masonry or concrete, and machine bolts, clamps, or spring steel clips, on steel.
- I. Install conduit with wiring, including homeruns as indicated on the Drawings. Any change resulting in a savings in labor or materials is to be made only in accordance with a contract change. Deviations shall be made only where necessary to avoid interferences and when approved by Engineer by written authorization.
- J. Conduit shall be run parallel or at right angles to existing walls, ceilings, and structural members.
- K. Attach backbone conduits larger than one-inch trade diameter to or from structure on intervals not exceeding twelve feet with conduit beam clamps, one-hole conduit straps or trapeze type support.
- L. Where conduits must pass through structural members obtain approval of Design Professional.
- M. Install all conduits or sleeves penetrating or routed within rated firewalls or fire floors to maintain fire rating of wall or floor. Conduit shall not be installed in rated floors or walls if it compromises or violates the fire rating of floor or wall. Refer to architectural documents.
- N. Provide expansion and deflection coupling where conduit passes over a building expansion joint.
- O. All other conduit, unless specified herein, shall be electrical metallic tubing (EMT). PVC conduit is not allowed in exposed or concealed areas. PVC to be installed below concrete in grade. Utilize Rigid Galvanized Steel (RGS) elbows for all slab penetrations and stub- ups.
- P. Metallic conduits shall be grounded in accordance with J-STD-607-A.

- Q. For runs that total more than 100 feet in length, insert pull boxes so that no segment between boxes exceeds the 100 feet limit.
- R. Conduit runs shall not have more than two (2) 90-degree bends between pull points.
- S. Telecommunications conduit system shall contain no condulets (also known as an LB).
- T. Horizontal Conduits
  - 1. Support horizontal conduits at intervals not exceeding ten feet and within three feet of each outlet, junction box, backboard, enclosure or cabinet. Support conduits from structural steel members with spring steel type or beam conduit clamps and to non-metallic structural members with one-hole conduit straps. For exposed conduits and where conduits must be suspended below structure, single conduit runs shall be supported from structure by hanger rod and conduit clamp assembly, and multiple conduits shall be supported by trapeze type support suspended from structure. Do not attach conduits to ceiling suspension system channels or suspension wires.

### **3.07 TELECOMMUNICATIONS OUTLET BOXES**

- A. Exact locations of the outlet boxes shall be coordinated with other trades.
- B. The approximate locations of the outlets are indicated on the Drawings. The exact locations shall be determined at the building. The right is reserved to change, without additional cost, the exact location of any outlet, a maximum of 10' before it is permanently installed.
- C. Orientation of outlet boxes (horizontal or vertical) shall be as indicated on the architectural elevations.
- D. Install all outlet boxes in finished areas flush with the wall. Maintain 1/4" or less space between outlet box front and finished wall surface.
- E. Outlet boxes shall be firmly anchored in place and shall not depend on the cover plate to hold it secure to the wall.
- F. Outlet boxes installed back-to-back in fire-rated walls shall be separated horizontally by a minimum of 24".

### **3.08 PULL BOXES**

- A. Pull boxes shall be secured, independent of the conduit entries into the box. Pull boxes shall be secured to the building structure. In ceiling applications, pull boxes shall not be supported with ceiling wires.
- B. Conduits entering pull boxes shall connect to pull boxes using die-cast zinc connectors.
- C. Pull boxes shall be free from burrs, dirt and debris.
- D. Pull boxes shall be installed in accordance with ANSI/TIA/EIA-569-A.
- E. Pull boxes shall be grounded in accordance with J-STD-607-A.

### **3.09 CABLE TRAY SYSTEM**

- A. Install trays in accordance with recognized industry practices, to ensure that the cable tray equipment complies with requirements of the NEC.
- B. All open trays shall be installed a minimum of six (6) inches away from any light fixture.
- C. Provide external grounding strap at expansion joints, sleeves, crossover and other locations where tray continuity is interrupted.
- D. Support all pathways from building construction. Do not support pathways from ductwork, piping or equipment hangers.
- E. Install cable tray level and straight.
- F. Provide all hardware, accessories, fasteners, anchors, threaded rods and support channels required to provide a complete cable tray system.

- G. Cable trays shall not be used to house both low voltage and power cables unless cables are separated by a grounded physical barrier.
- H. Cable tray system shall be grounded in accordance with J-STD-607-A.
- I. Bundle horizontal distribution cables in groups not greater than 50 cables.

**3.10 VELCRO STRAPS**

- A. Velcro straps shall be installed around cables at intervals of 12" minimum.
- B. Do not over-cinch cables.

**END OF SECTION 27 0528**

**SECTION 27 0529  
HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.

**1.03 REFERENCE STANDARDS**

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- D. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- E. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).

**PART 2 PRODUCTS****2.01 SUPPORT AND ATTACHMENT COMPONENTS**

- A. General Requirements:
  - 1. Comply with the following. Where requirements differ, comply with most stringent.
    - a. TIA-569.
    - b. NFPA 70.
    - c. Requirements of authorities having jurisdiction.
  - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of communications work.
  - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
  - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
  - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
  - 6. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
    - a. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    - b. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit Supports: Straps and clamps suitable for conduit to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- D. Metal Channel/Strut Framing Systems:
  1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
  2. Comply with MFMA-4.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
- F. Anchors and Fasteners:
  1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment:
  1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.
  2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
  3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
  4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Secure fasteners in accordance with manufacturer's recommended torque settings.
- I. Remove temporary supports.

**END OF SECTION 27 0529**



**SECTION 27 0533.13**  
**CONDUIT FOR COMMUNICATIONS SYSTEMS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel electrical metallic tubing (EMT).
- C. Rigid polyvinyl chloride (PVC) conduit.
- D. Polyvinyl chloride (PVC) plastic utilities duct.

**1.02 RELATED REQUIREMENTS**

- A. Section 07 8400 - Firestopping.

**1.03 REFERENCE STANDARDS**

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S); 2020.
- C. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- D. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- E. BICSI TDMM - Telecommunications Distribution Methods Manual, 14th Edition; 2020.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- G. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- H. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- I. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- J. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- K. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- L. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. TIA-568.0 - Generic Telecommunications Cabling for Customer Premises; 2020e.
- N. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- O. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- P. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- Q. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- R. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate minimum sizes of conduits with actual type and quantity of cables to be installed.
  - 2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts.
  - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.
  5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not begin installation of communications cables until installation of conduit between termination points is complete.

## **PART 2 PRODUCTS**

### **2.01 CONDUIT APPLICATIONS**

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, TIA-569, BICSI ITSIMM, BICSI TDMM, manufacturers' instructions, and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
  1. Under Slab on Grade: Use rigid PVC conduit.
  2. Exterior, Direct-Buried: Use rigid PVC conduit.
  3. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC) where emerging from underground.
- D. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC).
- E. Concealed Within Hollow Stud Walls: Use stainless steel electrical metallic tubing (EMT).
- F. Concealed Above Accessible Ceilings: Use stainless steel electrical metallic tubing (EMT).

### **2.02 CONDUIT - GENERAL REQUIREMENTS**

- A. Comply with NFPA 70 and TIA-569.
- B. Provide conduit, fittings, supports, and accessories required for complete communications pathway.
- C. Provide products listed, classified, and labeled as suitable for purpose intended.
- D. Where conduit size is not indicated, size to comply with NFPA 70, TIA-569, and BICSI TDMM, but not less than applicable minimum size requirements specified. Where specified standards differ, comply with most stringent.

### **2.03 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)**

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
  1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
  2. Material: Use steel or malleable iron.
  3. Connectors and Couplings: Use threaded fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.
  4. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
    - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

### **2.04 STAINLESS STEEL ELECTRICAL METALLIC TUBING (EMT)**

- A. Description: NFPA 70, Type EMT stainless steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797A.
- B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
3. Connectors and Couplings: Use compression/gland or set-screw type.
4. Conduit Bodies: Standard conduit bodies designed for electrical raceways are not permitted.

## **2.05 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT**

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage.
- B. Fittings:
  1. Manufacturer: Same as manufacturer of conduit to be connected.
  2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.
  3. Conduit Bodies: Use only conduit bodies specifically designed for communications cabling. Standard conduit bodies designed for electrical raceways are not permitted.
    - a. Comply with TIA-568.0 minimum bend radius requirements for fiber optic cables.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1, BICSI ITSIMM, and BICSI N1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- E. Conduit Routing:
  1. Conceal conduits unless specifically indicated to be exposed.
  2. Conduits in the following areas may be exposed, unless otherwise indicated:
    - a. Electrical rooms.
    - b. Communications rooms.
    - c. Mechanical equipment rooms.
  3. Unless otherwise approved, do not route exposed conduits:
    - a. Across floors.
    - b. Across roofs.
    - c. Across top of parapet walls.
    - d. Across building exterior surfaces.
- F. Conduit Support:
  1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction.
  2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
  3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
- G. Connections and Terminations:
  1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
  2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
  3. Use suitable adapters where required to transition from one type of conduit to another.
  4. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

5. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect cables.
  6. Secure joints and connections to provide mechanical strength and electrical continuity.
- H. Penetrations:
1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
  2. Make penetrations perpendicular to surfaces unless otherwise indicated.
  3. Provide sleeves and/or slots for penetrations as indicated or as required to facilitate installation.
  4. Conceal bends for conduit risers emerging above ground.
  5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
  6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.
  7. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.
- I. Underground Installation:
1. Provide underground warning tape along entire conduit length where not concrete-encased.
- J. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed cables or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
  2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
  3. Where conduits are subject to earth movement by settlement or frost.
- K. Provide grounding and bonding.

**END OF SECTION 27 0533.13**

**SECTION 27 0553  
IDENTIFICATION FOR COMMUNICATIONS SYSTEMS**

**PART 1 - GENERAL**

**1.01 GENERAL REQUIREMENTS**

- A. Applicable requirements of Division 27 Communications shall be considered a part of this section and shall have the same force as if printed herein full.
- B. This document describes the equipment and execution requirements relating to Administration & Labeling for Communications Systems.
- C. Equipment specifications, general considerations, and guidelines are provided in this document. If the bid documents are in conflict, the Drawings shall take precedence. The successful vendor shall meet or exceed all requirements described in this document.

**1.02 SUBMITTALS**

- A. Provide the following submittals:
  - 1. Product data
  - 2. Product samples
  - 3. Label sample showing example and text size for each item
  - 4. Software program sample

**1.03 WORK INCLUDED**

- A. The work included under this Specification consists of furnishing all labor, equipment, materials, supplies and performing all operations necessary to complete installation. The contractor will provide and install all of the required material whether specifically addressed in the technical specifications or not.
- B. The work shall include, but not be limited to the following:
  - 1. Perform all Labeling.

**PART 2 - PRODUCTS**

**2.01 LABELS**

- A. All labels shall be vinyl.
- B. All labels shall have an adhesive backing for permanent attachment.
- C. All labels shall be of sufficient size. Minimum sizes shall be as follows:
  - 1. 1-1/2"W x 3/16"H for:
    - a. Outlets
    - b. Outlet cables
    - c. Patch panels
    - d. Ground wires
    - e. Backbone cable pairs
  - 2. 4"W x 1"H for:
    - a. Backbone cables
    - b. Equipment racks
    - c. MDF frames
    - d. Active hardware and multiplexers
  - 3. 3" Square Tag mechanically stamped, legible, and permanent affixed. Tag shall be copper, brass, or 1/16" plastic.
    - a. Cable Tray
    - b. Riser Backbone Conduits
    - c. Backbone Conduits

**2.02 LABEL HOLDERS**

- A. Labels attached to backbone cable bundles shall be installed on a label holder of sufficient size. Label holder to be plastic and have tie wrapping provisions.

### **2.03 SOFTWARE PROGRAM**

- A. Software program shall be of the following types or similar:
  - 1. PANDUIT labeling program
  - 2. Brady labeling program
  - 3. Thomas & Betts labeling program
  - 4. Excel, customized

### **2.04 TEMPORARY LABELS**

- A. Vinyl labels, hand written, with permanent marker.

### **2.05 CHARTS**

- A. Provide printed charts containing required punch down and cross-connect information. Charts to be computer generated. File information shall be turned over to owner in printed and electronic format four (4) weeks prior to job completion.

### **2.06 AS-BUILT PLAN**

- A. Description: At the completion of the project, provide an "as-built" floor plan of each floor to the Project Engineer for approval.

## **PART 3 - EXECUTION**

### **3.01 LABELING REQUIREMENTS**

- A. Labeling shall be done in accordance with the recommendations made in the ANSI/TIA/EIA-606
  - 1. document, manufacturer's recommendations and best industry practices.
- B. All spaces, pathways, outlets, cables, termination hardware, grounding system and equipment shall be labeled with machine-generated labels.
- C. All labels shall be clear with black text.
- D. All cables shall be labeled with machine generated, wrap around labels.
- E. A total of three (3) labels per horizontal cable are required at the following intervals: 6" from outlet; 18" from outlet' 12" from termination block/patch panel.
- F. Labeling scheme shall be alphanumeric.
- G. Provide and generate all labeling (no labels will be furnished by the owner).
- H. Labels shall be developed and printed using a software program.
- I. Software program and all in-puts shall be turned over to the owner at the end of the project.

### **3.02 INSTALLATION**

- A. All labels shall be installed straight.
- B. Provide labels at locations as indicated on the Drawings and as follows:
  - 1. Outlet face plates
  - 2. Inside of outlet boxes
  - 3. Outlet cable inside box
  - 4. Outlet cable in ceiling above outlet
  - 5. Outlet cables at poke through entrance on both sides
  - 6. Outlet cable at rear of patch panel.
  - 7. Port at rear of patch panel
  - 8. Port on front of patch panel
  - 9. Individual fiber strands at rear of patch panel
  - 10. Backbone cables & conduits whenever exposed on minimum 10' intervals
  - 11. Backbone cable & conduit at point of termination
  - 12. Ends of any cored cable put in place that is not terminated
  - 13. On front of racks, cabinets frames, active hardware, multiplexers

14. Cable tray.

### **3.03 LABELING SCHEME**

- A. In general the following items shall receive labeling:
  1. Outlets:
    - a. Top Label: Present Room–Telecom Room–Box Designation in Room. Ex: 112-119-3  
Bottom Label: Port Designation: D=Data Jack; T=Voice Jack – Ex. D1, D2, T1
  2. Outlet cables
  3. Backbone cables - (CVR=139) copper backbone to room 139, 1-25, 26-50, 51-75, etc - 200)
  4. Patch panels - (ex. PP#1, PP#2, etc)
  5. Patch panel ports (each) - Station room #, Box Designation in Room, Port Designation in Room. Ex – 112-3-4. Note – If Telecom Room serves 100 jacks, labels would start at 001 and go to 100.
  6. Equipment racks and cabinets - (EX. Rack 1, rack 2, etc)
  7. Ground wires
  8. Active hardware and multiplexers (by owner)
    - a. Note – Contractor to obtain approval from owner/engineer before beginning labeling task.
- B. Patch Panel labeling strip colors:
  1. Voice patch panels shall have port labels in "light blue" strips.
  2. Data patch panels shall have port labels in yellow" strips.

### **3.04 TEMPORARY LABELS**

- A. Provide temporary labels on all outlet cable as it is roughed-in. The bid documents will not show outlet/cable labeling at the time of the cable rough-in. Replace temporary labels with permanent labels after contract documents have been revised.

### **3.05 TEXT SIZE AND INFORMATION**

- A. Text size should be as large and as bold as possible.
- B. Exact text required information is shown on the Drawings.
- C. Refer to Drawings for all outlet, outlet cables, and backbone cables labels.
- D. Refer to the Cover Drawing for exact labeling coding schemes, where applicable.

### **3.06 LABELING AND REFERENCE CHARTS**

- A. Contractor to provide a labeling reference chart(s) indicating the following:
  1. Backbone termination of pairs at the local telecommunication room (TR) and main telecommunications room (MR).
  2. Horizontal outlet cable pair termination at the TR.
  3. Data patch panel outlet port termination.

### **3.07 AS-BUILT PLAN & FRAME**

- A. Provide and mount frame with "as-built" on TR wall near the data racks, or as indicated on the plans.

**END OF SECTION 27 0553**

**SECTION 28 4600  
FIRE DETECTION AND ALARM**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Fire alarm system design and installation, including all components, wiring, and conduit.

**1.02 REFERENCE STANDARDS**

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
  - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
  - 3. Certification by Contractor that the system design will comply with Contract Documents.
  - 4. Proposed maintenance contract.
- C. Evidence of designer qualifications.
- D. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
  - 1. Copy (if any) of list of data required by authority having jurisdiction.
  - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
  - 3. Clear and concise description of operation, with input/output matrix similar to that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
  - 4. System zone boundaries and interfaces to fire safety systems.
  - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
  - 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
  - 7. List of all devices on each signaling line circuit, with spare capacity indicated.
  - 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
  - 9. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
  - 10. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
  - 11. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
  - 12. Certification by Contractor that the system design complies with Contract Documents.
- E. Evidence of installer qualifications.



- F. Inspection and Test Reports:
  - 1. Submit inspection and test plan prior to closeout demonstration.
  - 2. Submit documentation of satisfactory inspections and tests.
  - 3. Submit NFPA 72 "Inspection and Test Form," filled out.
- G. Operating and Maintenance Data:
  - 1. Complete set of specified design documents, as approved by authority having jurisdiction.
  - 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
  - 3. Contact information for firm that will be providing contract maintenance and trouble call-back service.
  - 4. List of recommended spare parts, tools, and instruments for testing.
  - 5. Replacement parts list with current prices, and source of supply.
  - 6. Detailed troubleshooting guide and large scale input/output matrix.
  - 7. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
  - 8. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- H. Project Record Documents:
  - 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
  - 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
  - 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- I. Closeout Documents:
  - 1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
  - 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.

## **PART 2 PRODUCTS**

### **2.01 FIRE ALARM SYSTEM**

- A. Fire Alarm System: Provide a new automatic fire detection and alarm system:
  - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
  - 2. Protected Premises: Entire building shown on drawings.
  - 3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
    - a. ADA Standards.
    - b. Applicable local codes.
    - c. Contract Documents (drawings and specifications).
    - d. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
  - 4. Evacuation Alarm: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises.
  - 5. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
  - 6. General Evacuation Zones: Each smoke zone is considered a general evacuation zone unless otherwise indicated, with alarm notification in all zones on the same floor, on the floor above, and the floor below.

7. Program notification zones and voice messages as directed by Owner.
  8. Fire Command Center: Location indicated on drawings.
  9. Fire Alarm Control Unit: New, located at fire command center.
- B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
- C. Circuits:
1. Initiating Device Circuits (IDC): Class B, Style A.
  2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
  3. Notification Appliance Circuits (NAC): Class B, Style W.
- D. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
  2. Secondary: Storage batteries.
  3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
  4. Each Computer System: Provide uninterruptible power supply (UPS).

## **2.02 FIRE SAFETY SYSTEMS INTERFACES**

- A. Supervision: Where required, provide supervisory signals in accordance with NFPA 72 for the following:
1. Sprinkler water control valves.
  2. Dry-pipe sprinkler system pressure.
  3. Dry-pipe sprinkler valve room low temperature.
  4. Elevator shut-down control circuits.
- B. Alarm: Where required, provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
  2. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
  3. Duct smoke detectors.
- C. Elevators: Where required, shall meet the following:
1. Elevator lobby, hoistway, and machine room smoke detectors: Elevator recall for fire fighters' service.
  2. Elevator Machine Room Heat Detector: Shut down elevator power prior to hoistway sprinkler activation.
  3. Sprinkler pressure or waterflow: Shut down elevator power prior to hoistway sprinkler activation.
- D. HVAC: Where required, shall meet the following:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors: Where required, shall meet the following:
1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 08 7100.
  2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 08 7100.

## **2.03 COMPONENTS**

- A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
  2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.

- C. Addressable Modules:
  - 1. Provide addressable modules suitable for connection to fire alarm control unit signaling line circuits.
  - 2. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.
- D. Initiating Devices:
  - 1. Addressable Systems:
    - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
    - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
- E. Notification Appliances:
  - 1. Bells: as indicated on drawings..
  - 2. Horns/Speakers: as indicated on drawings..
  - 3. Strobes: as indicated on drawings..
- F. Circuit Conductors: Copper or optical fiber; provide 200 feet (60 m) extra; color code and label.
- G. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
- H. Locks and Keys: Deliver keys to Owner.
- I. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
  - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
  - 2. Provide one for each control unit where operations are to be performed.
  - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
  - 4. Provide extra copy with operation and maintenance data submittal.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Install in accordance with applicable codes, NFPA 72, NFPA 70, and Contract Documents.
- B. Conceal all wiring, conduit, boxes, and supports where installed in finished areas.
- C. Obtain Owner's approval of locations of devices, before installation.
- D. Install instruction cards and labels.

### **3.02 INSPECTION AND TESTING FOR COMPLETION**

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.
- G. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

**3.03 CLOSEOUT**

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
  - 1. Be prepared to conduct any of the required tests.
  - 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
  - 3. Have authorized technical representative of control unit manufacturer present during demonstration.
  - 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
  - 5. Repeat demonstration until successful.

**END OF SECTION 28 4600**

**SECTION 31 1000  
SITE CLEARING**

**PART 1 GENERAL**

**1.01 RELATED REQUIREMENTS**

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- C. Section 01 5713 - Temporary Erosion and Sediment Control.
- D. Section 01 7000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products.
- E. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- F. Section 31 2200 - Grading: Topsoil removal.

**PART 2 PRODUCTS -- NOT USED**

**PART 3 EXECUTION**

**3.01 SITE CLEARING**

- A. Comply with other requirements specified in Section 01 7000.
- B. Minimize production of dust due to clearing operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

**3.02 EXISTING UTILITIES AND BUILT ELEMENTS**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are not to be removed.

**3.03 VEGETATION**

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, playing fields, lawns, and planting beds.
- B. Do not begin clearing until vegetation to be relocated has been removed.
- C. Do not remove or damage vegetation beyond the limits indicated on drawings.
  - 1. Exception: Specific trees and vegetation indicated on drawings to be removed.
  - 2. Exception: Selective thinning of undergrowth specified elsewhere.
- D. Install substantial, highly visible fences at least 3 feet high (at least 1 m high) to prevent inadvertent damage to vegetation to remain:
  - 1. At vegetation removal limits.
  - 2. Around trees to remain within vegetation removal limits; locate no closer to tree than at the drip line.
  - 3. Around other vegetation to remain within vegetation removal limits.
- E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum disturbance of the subsoil.
- F. Vegetation Removed: Do not burn, bury, landfill, or leave on site, except as indicated.
  - 1. Chip, grind, crush, or shred vegetation for mulching, composting, or other purposes; preference should be given to on-site uses.
  - 2. Trees: Sell if marketable; if not, treat as specified for other vegetation removed; remove stumps and roots to depth of 18 inches (450 mm).

- 3. Sod: Re-use on site if possible; otherwise sell if marketable, and if not, treat as specified for other vegetation removed.
- G. Restoration: If vegetation outside removal limits or within specified protective fences is damaged or destroyed due to subsequent construction operations, replace at no cost to Owner.

**3.04 DEBRIS**

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

**END OF SECTION 31 1000**

**SECTION 31 2200  
GRADING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Removal and storage of topsoil.
- B. Rough grading the site.
- C. Finish grading.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 1000 - Site Clearing.
- B. Section 31 2316 - Excavation.
- C. Section 31 2316.13 - Trenching: Trenching and backfilling for utilities.
- D. Section 31 2316.26 - Rock Removal.
- E. Section 31 2323 - Fill: Filling and compaction.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Topsoil: See Section 31 2323.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the Work are as indicated.
- B. Verify the absence of standing or ponding water.

**3.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect from damage above- and below-grade utilities to remain.
- D. Notify utility company to remove and relocate utilities.
- E. Provide temporary means and methods to remove all standing or ponding water from areas prior to grading.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs, from damage by grading equipment and vehicular traffic.
- G. Protect trees to remain by providing substantial fencing around entire tree at the outer tips of its branches; no grading is to be performed inside this line.
- H. Protect plants, lawns, rock outcroppings, and other features to remain as a portion of final landscaping.

**3.03 ROUGH GRADING**

- A. Remove topsoil from areas to be further excavated, re-landscaped, or re-graded, without mixing with foreign materials.
- B. Do not remove topsoil when wet.
- C. Remove subsoil from areas to be further excavated, re-landscaped, or re-graded.
- D. Do not remove wet subsoil, unless it is subsequently processed to obtain optimum moisture content.
- E. When excavating through roots, perform work by hand and cut roots with sharp axe.
- F. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

- G. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack surface water control.

#### **3.04 SOIL REMOVAL**

- A. Stockpile topsoil to be re-used on site; remove remainder from site.
- B. Stockpiles: Use areas designated on site; pile depth not to exceed 8 feet (2.5 m); protect from erosion.

#### **3.05 FINISH GRADING**

- A. Before Finish Grading:
  - 1. Verify building and trench backfilling have been inspected.
  - 2. Verify subgrade has been contoured and compacted.
- B. Remove debris, roots, branches, stones, in excess of 1/2 inch (13 mm) in size. Remove soil contaminated with petroleum products.
- C. In areas where vehicles or equipment have compacted soil, scarify surface to depth of 3 inches (75 mm).
- D. Place topsoil in areas where seeding are indicated.
- E. Place topsoil to the following compacted thicknesses:
  - 1. Areas to be Seeded with Grass: 6 inches (150 mm).
  - 2. Areas to be Sodded: 4 inches (100 mm).
  - 3. Shrub Beds: 18 inches (450 mm).
- F. Place topsoil during dry weather.
- G. Remove roots, weeds, rocks, and foreign material while spreading.
- H. Near plants spread topsoil manually to prevent damage.
- I. Fine grade topsoil to eliminate uneven areas and low spots. Maintain profiles and contour of subgrade.
- J. Lightly compact placed topsoil.
- K. Maintain stability of topsoil during inclement weather. Replace topsoil in areas where surface water has eroded thickness below specifications.

#### **3.06 REPAIR AND RESTORATION**

- A. Existing Facilities, Utilities, and Site Features to Remain: If damaged due to this work, repair or replace to original condition.
- B. Other Existing Vegetation to Remain: If damaged due to this work, replace with vegetation of equivalent species and size.

#### **3.07 FIELD QUALITY CONTROL**

- A. See Section 31 2323 for compaction density testing.

#### **3.08 CLEANING**

- A. Remove unused stockpiled topsoil. Grade stockpile area to prevent standing water.
- B. Leave site clean and raked, ready to receive landscaping.

**END OF SECTION 31 2200**



**SECTION 31 2301**

**EXCAVATING, BACKFILLING, AND COMPACTING FOR STRUCTURES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Section includes the excavation, backfilling and compacting required for the structures shown in the Contract Drawings.

**1.02 RELATED SECTIONS**

- A. Section 013330 - Structural Submittals.
- B. Section 014525 - Structural Testing/Inspection Agency Services.

**1.03 REFERENCES**

- A. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.
- B. ASTM D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>).
- C. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
- D. ASTM D1586 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils.
- E. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
- F. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

**1.04 DEFINITIONS**

- A. Granular subbase: Granular fill directly beneath slabs-on-grade.
- B. Backfill: Fill immediately behind foundation elements or retaining walls.
- C. Structural fill: Fill under the structure other than the granular subbase.

**1.05 SUBMITTALS**

- A. Upon request, submit soil test reports performed by the Structural Testing/Inspection Agency.

**1.06 QUALITY ASSURANCE**

- A. Structural Testing/Inspection Agency shall perform the following quality related items:
  - 1. Verify structural fill complies with specifications.
  - 2. Determine particle size, liquid limit, plastic limit, plasticity index and maximum density of each type of soil.
  - 3. Observe proofrolling.
  - 4. Perform a sufficient number of field density tests to verify compaction of structural fill. As a minimum, perform one test per lift for every 2500 square feet of fill placed.
  - 5. Verify foundation bearing capacity.
  - 6. Verify quantities of material removed and quantities of material placed where Unit Prices are involved.

**1.07 SURVEY**

- A. Prior to construction, have structure location staked and certified by a licensed surveyor. If discrepancies between actual lines and elevations exist, notify Design Professional before proceeding with layout of structure.

**1.08 SUBSURFACE CONDITIONS**

- A. Copies of a subsurface investigation of the site will be made available upon request. The data is not intended as a representation or warranty of the continuity of such conditions. Owner will not be responsible for interpretation or conclusions drawn therefrom by the Contractor. The data is made available for the convenience of the Contractor and is not guaranteed to represent all conditions that may be encountered.

- B. Contractor may examine the site and make his own subsurface explorations at no additional cost to the Owner. Notify Owner prior to making any subsurface explorations.

#### **1.09 EXISTING UTILITIES**

- A. Locate existing underground utilities by careful hand excavation. If utilities are to remain in place, provide protection from damage during construction operations.
- B. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Do not interrupt existing utility service facilities occupied and used by Owner or others, unless written permission is given by the Design Professional and then only after temporary utility services have been provided.
- C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Design Professional immediately for directions.
- D. Repair damaged utilities to satisfaction of utility owner.

#### **1.10 NOTICE**

- A. Notify the Design Professional 48 hours prior to the beginning of any excavation work.

### **PART 2 PRODUCTS**

#### **2.01 GRANULAR SUBBASE**

- A. Granular subbase shall be sound and free-draining, such as sand, gravel or crushed stone with less than 10% passing the 200 sieve. Maximum diameter shall be 1-1/2 inches.

#### **2.02 BACKFILL**

- A. Backfill shall meet the requirements of the granular subbase.

#### **2.03 STRUCTURAL FILL**

- A. Structural fill shall be SM, ML, CL soils (represented by their USCS group symbols), and should be tested by Laboratory Proctor compaction tests and classification tests to determine acceptability and for quality control.
- B. Structural fill shall be free of organics, debris and deleterious materials, and should not contain rocks having a diameter over 4 inches.

### **PART 3 EXECUTION**

#### **3.01 STRIPPING**

- A. Strip vegetation, topsoil, roots, and other unsuitable material to a depth determined by the Structural Testing/Inspection Agency but not less than one foot, nor less than 10 feet outside the perimeter of the structure.
- B. Stockpile sufficient amounts of topsoil as required to cover areas to be landscaped with a minimum of six inches of material.

#### **3.02 EXCAVATION**

- A. Excavation shall be considered unclassified.
- B. Perform excavation to the depths and limits on the Drawings and as specified herein.
- C. Do not excavate to full depth when there is probability of frost forming or ground freezing in excavation before concrete is placed.
- D. Ground water may be encountered during the foundation excavation. Provide a system for controlling the ground water to a level at least three feet below the lowest point of the excavation.
- E. Keep excavations dry by sloping ground away from holes and trenches.

#### **3.03 PROOFROLLING**

- A. After stripping or excavation and before any fill placement, fill areas shall be proofrolled with a minimum of two coverages of a loaded dump truck or scraper in each of two perpendicular directions.
- B. Areas found to be soft or pumping shall have the soft soil removed and replaced with structural fill and compacted as outlined herein.

#### **3.04 PLACEMENT OF STRUCTURAL FILL**

- A. Do not place structural fill on subgrade that contains frost, mud or is frozen.
- B. Structural fill shall be placed and compacted in 8-inch thick loose layers.
- C. Compact structural fill to 98 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with water content within  $\pm 3$  percent of the optimum moisture content.

**3.05 PLACEMENT OF GRANULAR SUBBASE**

- A. Do not place granular subbase on subgrade that contains frost, mud or is frozen.
- B. Compact granular subbase to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with the water content within  $\pm 3$  percent of the optimum moisture content.

**3.06 PLACEMENT OF BACKFILL**

- A. Backfill behind wall shall be placed in layers of six inches.
- B. Compact backfill behind walls to 95 percent of the maximum dry density as measured by Standard Proctor, ASTM D698, with water content within  $\pm 3$  percent of the optimum moisture content.

**3.07 CLEAN UP**

- A. Remove excess excavated materials from job site and upon completion leave site in clean condition.

**END OF SECTION 31 2301**

**SECTION 31 2316.13  
TRENCHING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Backfilling and compacting for utilities outside the building to utility main connections.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 31 2200 - Grading: Site grading.
- C. Section 31 2316 - Excavation: Building and foundation excavating.
- D. Section 31 2323 - Fill: Backfilling at building and foundations.

**1.03 REFERENCE STANDARDS**

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)); 2012 (Reapproved 2021).
- C. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)); 2012 (Reapproved 2021).

**PART 2 PRODUCTS**

**2.01 FILL MATERIALS**

- A. General Fill: Complying with State of Georgia Highway Department standard.
- B. Structural Fill: Complying with State of Georgia Highway Department standard.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

**3.02 TRENCHING**

- A. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet (1.2 meters) to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.
- E. Hand trim excavations. Remove loose matter.
- F. Remove excavated material that is unsuitable for re-use from site.
- G. Remove excess excavated material from site.
- H. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- I. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot (305 mm) into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

**3.03 PREPARATION FOR UTILITY PLACEMENT**

- A. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- B. Compact subgrade to density equal to or greater than requirements for subsequent fill material.

- C. Until ready to backfill, maintain excavations and prevent loose soil from falling into excavation.

**3.04 BACKFILLING**

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
  - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
- H. Reshape and re-compact fills subjected to vehicular traffic.

**3.05 BEDDING AND FILL AT SPECIFIC LOCATIONS**

- A. Use general fill unless otherwise specified or indicated.

**3.06 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- C. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- D. Frequency of Tests: 1.

**END OF SECTION 31 2316.13**

**SECTION 31 2316.26  
ROCK REMOVAL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Removal of identified rock during excavation.

**1.02 RELATED REQUIREMENTS**

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 31 2323 - Fill: Fill materials.

**1.03 DEFINITIONS**

- A. Site Rock: Solid mineral material with a volume in excess of 1/3 cubic yard (0.25 cubic meter) or solid material that cannot be removed with a 3/4 cubic yard (0.57 cubic meter) capacity power shovel without drilling.

**1.04 REFERENCE STANDARDS**

- A. NFPA 495 - Explosive Materials Code; 2023.

**PART 3 EXECUTION**

**2.01 EXAMINATION**

- A. Verify site conditions and note subsurface irregularities affecting work of this section.

**2.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum.

**2.03 ROCK REMOVAL**

- A. Excavate and remove rock by mechanical methods only; use of explosives is prohibited.
- B. Mechanical Methods: Drill holes and utilize expansive tools to fracture rock.
- C. Form level bearing at bottom of excavations.
- D. Remove shaled layers to provide sound and unshattered base for footings.
- E. In utility trenches, excavate to 6 inches (150 mm) below invert elevation of pipe and 24 inches (600 mm) wider than pipe diameter.
- F. Remove excavated materials from site.
- G. Correct unauthorized rock removal in accordance with backfilling and compacting requirements of Section 31 2323.

**2.04 FIELD QUALITY CONTROL**

- A. Independent agency field inspection will be provided under provisions of Section 01 4000 - Quality Requirements.

**END OF SECTION 31 2316.26**

**SECTION 31 2316  
EXCAVATION**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Excavating for building volume below grade, footings, pile caps, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to utility main connections.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.
- C. Section 31 2200 - Grading: Soil removal from surface of site.
- D. Section 31 2323 - Fill: Fill materials, backfilling, and compacting.
- E. Section 31 3700 - Riprap.

**1.03 REFERENCE STANDARDS**

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

**1.04 QUALITY ASSURANCE**

- A. Designer Qualifications: For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

**PART 2 PRODUCTS**

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that survey bench mark and intended elevations for the work are as indicated.

**3.02 PREPARATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Locate, identify, and protect utilities that remain and protect from damage.
- C. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.

**3.03 EXCAVATING**

- A. Excavate to accommodate new structures and construction operations.
- B. Notify Architect of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

**3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Provide for visual inspection of load-bearing excavated surfaces by Architect before placement of foundations.

**3.05 PROTECTION**

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

**END OF SECTION 31 2316**



**SECTION 31 2323  
FILL**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Filling, backfilling, and compacting for building volume below grade, footings, slabs-on-grade, paving, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to utility main connections.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 5713 - Temporary Erosion and Sediment Control: Slope protection and erosion control.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 31 2316 - Excavation: Removal and handling of soil to be re-used.
- D. Section 31 2316.26 - Rock Removal: Removal of rock during excavating.
- E. Section 31 3700 - Riprap.

**1.03 QUALITY ASSURANCE**

- A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. When necessary, store materials on site in advance of need.

**PART 2 PRODUCTS**

**2.01 FILL MATERIALS**

- A. General Fill: Complying with State of Georgia Highway Department standard.
- B. Structural Fill: Complying with State of Georgia Highway Department standard.
- C. Topsoil: See Section 32 9119.

**2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of soil material.
- B. If tests indicate materials do not meet specified requirements, change material and retest.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Identify required lines, levels, contours, and datum locations.
- B. Verify areas to be filled are not compromised with surface or ground water.

**3.02 PREPARATION**

- A. Scarify and proof roll subgrade surface to a depth of 6 inches (150 mm) to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with general fill.
- C. Compact subgrade to density equal to or greater than requirements for subsequent fill material.
- D. Until ready to fill, maintain excavations and prevent loose soil from falling into excavation.

**3.03 FILLING**

- A. Fill to contours and elevations indicated using unfrozen materials.
- B. Employ a placement method that does not disturb or damage other work.
- C. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.

- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 2 inches in 10 feet (50 mm in 3 m), unless noted otherwise. Make gradual grade changes. Blend slope into level areas.
- F. Correct areas that are over-excavated.
  - 1. Other areas: Use general fill, flush to required elevation, compacted to minimum 97 percent of maximum dry density.
- G. Compaction Density Unless Otherwise Specified or Indicated:
- H. Reshape and re-compact fills subjected to vehicular traffic.
- I. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.

**3.04 FILL AT SPECIFIC LOCATIONS**

- A. Use general fill unless otherwise specified or indicated.

**3.05 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.

**3.06 CLEANING**

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

**END OF SECTION 31 2323**

**SECTION 31 3700  
RIPRAP**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Riprap .

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Riprap: Provide in accordance with State of Georgia Highways standards.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Do not place riprap bags over frozen or spongy subgrade surfaces.

**3.02 PLACEMENT**

- A. Place riprap at culvert pipe ends, embankment slopes, \_\_\_\_\_, and as indicated.

**END OF SECTION 31 3700**

**SECTION 32 1123  
AGGREGATE BASE COURSES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Aggregate base course.
- B. Paving aggregates.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 2200 - Grading: Preparation of site for base course.
- B. Section 31 2316.13 - Trenching: Compacted fill over utility trenches under base course.
- C. Section 31 2323 - Fill: Topsoil fill at areas adjacent to aggregate base course.
- D. Section 32 1216 - Asphalt Paving: Finish and binder asphalt courses.
- E. Section 32 1313 - Concrete Paving: Finish concrete surface course.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Coarse Aggregate: Coarse aggregate, complying with State of Georgia Highway Department standard.
- B. Fine Aggregate: Sand; complying with State of Georgia Highway Department standard.

**2.02 SOURCE QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for general requirements for testing and analysis of aggregate materials.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that survey bench marks and intended elevations for the work are as indicated.
- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

**3.02 PREPARATION**

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

**3.03 INSTALLATION**

- A. Place aggregate in maximum 4 inch (100 mm) layers and roller compact to specified density.
- B. Level and contour surfaces to elevations and gradients indicated.
- C. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- D. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- E. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

**3.04 CLEANING**

- A. Leave unused materials in a neat, compact stockpile.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

**END OF SECTION 32 1123**

**SECTION 32 1216  
ASPHALT PAVING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Single course bituminous concrete paving.
- B. Double course bituminous concrete paving.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 2200 - Grading: Preparation of site for paving and base.
- B. Section 32 1123 - Aggregate Base Courses: Aggregate base course.

**1.03 QUALITY ASSURANCE**

- A. Perform Work in accordance with State of Georgia Highways standard.
- B. Mixing Plant: Complying with State of Georgia Highways standard.
- C. Obtain materials from same source throughout.

**1.04 FIELD CONDITIONS**

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.
- B. Place bitumen mixture when temperature is not more than 15 F degrees (8 C degrees) below bitumen supplier's bill of lading and not more than maximum specified temperature.

**PART 2 PRODUCTS**

**2.01 MATERIALS**

- A. Aggregate for Binder Course: In accordance with State of Georgia Highways standards.
- B. Aggregate for Wearing Course: In accordance with State of Georgia Highways standards.
- C. Fine Aggregate: In accordance with State of Georgia Highways standards.
- D. Primer: In accordance with State of Georgia Highways standards.
- E. Tack Coat: Homogeneous, medium curing, liquid asphalt.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify that compacted subgrade is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

**3.02 PREPARATION - PRIMER**

- A. Apply primer in accordance with manufacturer's instructions.
- B. Apply primer on aggregate base or subbase at uniform rate of 1/3 gal/sq yd (1.5 L/sq m).
- C. Use clean sand to blot excess primer.

**3.03 PREPARATION - TACK COAT**

- A. Apply tack coat in accordance with manufacturer's instructions.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 1/3 gal/sq yd (1.5 L/sq m).

**3.04 PLACING ASPHALT PAVEMENT - SINGLE COURSE**

- A. Install Work in accordance with State of Georgia Highways standards.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.

- D. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

**3.05 PLACING ASPHALT PAVEMENT - DOUBLE COURSE**

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place asphalt wearing course within two hours of placing and compacting binder course.
- C. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- D. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

**END OF SECTION 32 1216**

**SECTION 32 1313  
CONCRETE PAVING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete sidewalks, stair steps, integral curbs, gutters, median barriers, parking areas, and roads.

**1.02 RELATED REQUIREMENTS**

- A. Section 32 1726 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

**1.03 REFERENCE STANDARDS**

- A. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- D. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- F. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- G. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2021.
- H. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.
- I. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2017.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.

**PART 2 PRODUCTS**

**2.01 PAVING ASSEMBLIES**

- A. Concrete Sidewalks and Median Barrier: 3,500 psi (20.7 MPa) 28 day concrete, 4 inches (100 mm) thick, buff color Portland cement, exposed aggregate finish.
- B. Parking Area Pavement: minimum 4,000 psi (27.6 MPa) 28 day concrete, 8 inches (125 mm) thick, 6 by 6 - W2.9 by W2.9 mesh reinforcement, wood float finish.

**2.02 FORM MATERIALS**

- A. Wood form material, profiled to suit conditions.

**2.03 REINFORCEMENT**

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa) yield strength; deformed billet steel bars; unfinished.
- B. Steel Welded Wire Reinforcement: Plain type, ASTM A1064/A1064M; in flat sheets; unfinished.
- C. Dowels: ASTM A615/A615M, Grade 40 - 40,000 psi (280 MPa) yield strength; deformed billet steel bars; unfinished finish.

## **2.04 CONCRETE MATERIALS**

- A. Concrete Materials: Provide in accordance with State of Georgia Highways standards.

## **2.05 ACCESSORIES**

- A. Tactile Warning Surfaces: See Section 32 1726.

## **2.06 CONCRETE MIX DESIGN**

- A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
- B. Concrete Properties:
  - 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; As indicated on drawings.

## **2.07 MIXING**

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C685/C685M. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C94/C94M.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

### **3.02 SUBBASE**

- A. Prepare subbase in accordance with State of Georgia Highways standards.

### **3.03 PREPARATION**

- A. Moisten base to minimize absorption of water from fresh concrete.

### **3.04 FORMING**

- A. Place and secure forms to correct location, dimension, profile, and gradient.

### **3.05 REINFORCEMENT**

- A. Place reinforcement as indicated.

### **3.06 COLD AND HOT WEATHER CONCRETING**

- A. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- B. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F (4 degrees C), or surface is wet or frozen.

### **3.07 PLACING CONCRETE**

- A. Place concrete in accordance with ACI PRC-304.
- B. Place concrete in accordance with State of Georgia Highways standards.
- C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.

### **3.08 JOINTS**

- A. Provide keyed joints as indicated.

### **3.09 FINISHING**

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge 1/4 inch radius ( 6 mm radius).
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.



- D. Inclined Vehicular Ramps: Broomed perpendicular to slope.

**3.10 FIELD QUALITY CONTROL**

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
  - 1. Provide free access to concrete operations at project site and cooperate with appointed firm.

**3.11 PROTECTION**

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
- B. Do not permit pedestrian traffic over pavement for 7 days minimum after finishing.

**END OF SECTION 32 1313**

**SECTION 32 1623  
SIDEWALKS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Concrete sidewalks.
- B. Concrete wheelchair ramps.

**1.02 RELATED REQUIREMENTS**

- A. Section 32 1313 - Concrete Paving.
- B. Section 32 1726 - Tactile Warning Surfacing.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

**PART 2 PRODUCTS**

**2.01 CONCRETE SIDEWALKS AND WHEELCHAIR RAMPS**

- A. Concrete Forms: Wood.
- B. Concrete Materials: Comply with ASTM C94/C94M.
- C. Aggregate: Pit Run, washed, 3/8 inch (1 cm) stone; free of shale, clay, friable material and debris.
- D. Tactile Warning Surfaces: See Section 32 1726.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify gradients and elevations of the subgrade are correct as shown on drawings. Where poor subgrade material is encountered, remove and replace with suitable material.
- B. Verify compacted subgrade is acceptable, ready to support imposed loads and paving, and ready to receive work.

**3.02 CONCRETE SIDEWALK AND WHEELCHAIR RAMP INSTALLATION**

- A. Forming:
  - 1. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
  - 2. Sidewalk Forms: Place and secure forms to location, dimension, profile, and gradient shown on drawings. Height equal to the full depth of the finished sidewalk.
  - 3. Wheelchair Ramps: Place and secure forms to location, dimension, profile, and gradient shown on drawings. Comply with ADA Standards.
- B. Placement:
  - 1. Place concrete in a single lift.
  - 2. Consolidate concrete by tamping and spading.
- C. Joints:
  - 1. Spacing: Provide scored joints every 10 feet (3 m).
  - 2. Filler height equal to the full depth of the finished concrete.
- D. Finishing:
  - 1. Sidewalk Paving: Light broom, texture perpendicular to direction of travel with troweled and radiused edge, 1/4 inch radius (6 mm radius).

2. Wheelchair Ramps: Broomed perpendicular to slope.

**END OF SECTION 32 1623**

**SECTION 32 1723  
PAVEMENT MARKINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Painted pavement markings.
- B. Raised pavement markings.
- C. Plastic pavement markings.

**1.02 REFERENCE STANDARDS**

- A. AASHTO M 249 - Standard Specification for White and Yellow Reflective Thermoplastic Striping Material (Solid Form); 2012 (Reapproved 2020).
- B. ASTM D4505 - Standard Specification for Preformed Retroreflective Pavement Marking Tape for Extended Service Life; 2012 (Reapproved 2017).
- C. FHWA MUTCD - Manual on Uniform Traffic Control Devices; 2010, with Errata.

**1.03 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience and approved by manufacturer.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver paint in containers of at least 5 gallons (18 L) accompanied by batch certificate.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

**1.05 FIELD CONDITIONS**

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

**PART 2 PRODUCTS**

**2.01 PAINTED PAVEMENT MARKINGS**

- A. Comply with State of Georgia Highway Department standards.
- B. Comply with FHWA MUTCD.
- C. Painted Pavement Markings: As indicated on drawings.

**2.02 RAISED PAVEMENT MARKINGS**

- A. Comply with State of Georgia Highway Department standards.
- B. Comply with FHWA MUTCD.
- C. Surface Reflectors: Bidirectional, visible to approaching traffic; capable of withstanding pavement-rated loading.
  - 1. Housing: Plastic, yellow.
  - 2. Lens: Prismatic, acrylic, yellow.

**2.03 PLASTIC PAVEMENT MARKINGS**

- A. Comply with State of Georgia Highway Department standards.
- B. Comply with FHWA MUTCD.
- C. Plastic Pavement Markings: Preformed, uniform, smooth edges.
  - 1. Marking Tape: Vinyl, with retroreflective beads, in accordance with ASTM D4505.
    - a. Class: Class 1, in accordance with ASTM D4505.
    - b. Color: Yellow.

- c. Primer: As recommended by manufacturer.
- 2. Thermoplastic Markings: Alkyd, in accordance with AASHTO M 249.
  - a. Color: Yellow.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verification of Conditions: Verify that pavement is dry and ready for installation.
- B. Notify Architect of unsatisfactory conditions before proceeding.

#### **3.02 PREPARATION**

- A. Clean surfaces prior to installation.
  - 1. Remove dust, dirt, and other debris.

#### **3.03 INSTALLATION**

- A. General:
  - 1. Position pavement markings as indicated on drawings.
  - 2. Field location adjustments require approval of Architect.
- B. Painted Pavement Markings:
  - 1. Apply in accordance with manufacturer's instructions.
  - 2. Apply in accordance with State of Georgia Highway Department standards.
  - 3. Apply in accordance with FHWA MUTCD standards.
- C. Raised Pavement Markings:
  - 1. Install in accordance with manufacturer's instructions in manner necessary to maintain manufacturer's warranty.
  - 2. Install in accordance with State of Georgia Highway Department standards.
  - 3. Install in accordance with FHWA MUTCD standards.
  - 4. Surface Reflectors:
    - a. Cut pavement and remove depth equal to height of reflector.
    - b. Partially fill area with road marker epoxy adhesive.
    - c. Press reflector into adhesive and apply pressure.
- D. Plastic Pavement Markings:
  - 1. Install in accordance with manufacturer's instructions in manner necessary to maintain manufacturer's warranty.
  - 2. Install in accordance with State of Georgia Highway Department standards.
  - 3. Install in accordance with FHWA MUTCD standards.
  - 4. Marking Tape: Place tape on pavement smooth and without wrinkles. 1/4 inch (6 mm) maximum gap between adjacent pieces. Immediately apply uniform pressure until firmly adhered.
    - a. Apply primer to pavement at a rate of 1 oz/sq ft (3 L/sq m) and allow to set for 10 minutes prior to taping.
  - 5. Thermoplastic Markings: Preheat pavement surface to 275 degrees F (135 degrees C). Place markings on pavement smooth and without wrinkles. 1/4 inch (6 mm) maximum gap between adjacent markings. Uniformly heat markings between 400 degrees F (204 degrees C) to 440 degrees F (227 degrees C). Do not overheat, scorch, or disperse embedded glass beads.

#### **3.04 PROTECTION**

- A. Prevent approaching traffic from crossing newly applied pavement markings.
- B. Replace damaged or removed markings at no additional cost to Owner.

**END OF SECTION 32 1723**

**SECTION 32 1726  
TACTILE WARNING SURFACING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

**1.02 REFERENCE STANDARDS**

- A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2011.

**PART 2 PRODUCTS**

**2.01 TACTILE AND DETECTABLE WARNING DEVICES**

- A. Plastic Tactile and Detectable Warning Tiles: ADA Standards compliant, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory-applied removable protective sheeting.
  - 1. Pattern: In-line pattern of truncated domes complying with ADA Standards.

**PART 3 EXECUTION**

**3.01 INSTALLATION, GENERAL**

- A. Install in accordance with manufacturer's written instructions.
  - 1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
  - 2. Do not install when ambient or substrate temperature has been below 40 degrees F (4 degrees C) during the preceding 8 daylight hours.
- B. Field Adjustment:
  - 1. Cut units to size and configuration shown on drawings.
  - 2. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
  - 3. Orient so dome pattern is aligned with the direction of ramp.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.

**END OF SECTION 32 1726**

**SECTION 32 3113  
CHAIN LINK FENCES AND GATES**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Posts, rails, and frames.
- B. Wire fabric.

**1.02 REFERENCE STANDARDS**

- A. FS RR-F-191/1D - Fencing, Wire and Post Metal (Chain-Link Fence Fabric); 1990.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

**PART 2 PRODUCTS**

**2.01 COMPONENTS**

- A. Line Posts: 1.9 inch (48 mm) diameter.
- B. Corner and Terminal Posts: 2.38 inch (60 mm) diameter.
- C. Fabric: 2 inch (51 mm) diamond mesh interwoven wire, 6 gauge, 0.1920 inch (4.9 mm) thick, top selvage knuckle end closed, bottom selvage twisted tight.
- D. Tension Wire: 6 gauge, 0.1920 inch (4.9 mm) thick steel, single strand.
- E. Tie Wire: Aluminum alloy steel wire.

**2.02 MATERIALS**

- A. Posts, Rails, and Frames: \_\_\_\_\_:
  - 1. Line Posts: Type I round in accordance with FS RR-F-191/1D.
  - 2. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round in accordance with FS RR-F-191/1D.
- B. Wire Fabric: \_\_\_\_\_:

**END OF SECTION 32 3113**

**SECTION 32 3300  
SITE FURNISHINGS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Bollards.

**1.02 REFERENCE STANDARDS**

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

**PART 2 PRODUCTS**

**2.01 BOLLARDS**

- A. Steel Pipe Bollards: Hollow steel pipe with plain shaft.
  - 1. Shape: Round.
  - 2. Diameter: 6 inches (153 mm).
  - 3. Cap: Formed steel dome.
  - 4. Materials:
    - a. Steel Pipe: ASTM A53/A53M, standard weight.
    - b. Factory Finish: Primed.
  - 5. Mounting: In-ground.

**PART 3 EXECUTION**

**3.01 EXAMINATION**

- A. Verify proper installation of mounting surfaces, preinstalled anchor bolts, and other mounting devices; and ready to receive site furnishing items.

**3.02 INSTALLATION**

- A. Install site furnishings in accordance with approved shop drawings, and manufacturer's installation instructions.

**END OF SECTION 32 3300**



**SECTION 33 0500  
COMMON WORK RESULTS FOR UTILITIES**

**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. This Section includes the following:
  - 1. Piping joining materials.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Sleeves.
  - 5. Identification devices.
  - 6. Grout.
  - 7. Flowable fill.
  - 8. Piped utility demolition.
  - 9. Piping system common requirements.
  - 10. Equipment installation common requirements.
  - 11. Painting.
  - 12. Concrete bases.
  - 13. Metal supports and anchorages.

**1.03 DEFINITIONS**

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed 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.
- C. ABS: Acrylonitrile-butadiene-styrene plastic.
- D. CPVC: Chlorinated polyvinyl chloride plastic.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. DIP: Ductile iron pipe.

**1.04 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Dielectric fittings.
  - 2. Identification devices.

**1.05 INFORMATIONAL SUBMITTALS**

- A. Welding certificates.

**1.06 QUALITY ASSURANCE**

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.08 COORDINATION**

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.
- C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in Section 033000 "Cast-in-Place Concrete".

### **PART 2 - PRODUCTS**

#### **2.01 PIPING JOINING MATERIALS**

- A. Provide in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

#### **2.02 TRANSITION FITTINGS**

- A. Provide in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

#### **2.03 SLEEVES**

- A. Provide in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

#### **2.04 IDENTIFICATION DEVICES**

- A. Provide in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

#### **2.05 GROUT**

- A. Provide in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

#### **2.06 FLOWABLE FILL**

- A. Provide in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

### **PART 3 - EXECUTION**

#### **3.01 PIPED UTILITY DEMOLITION**

- A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
  - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.

5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### **3.02 PIPING INSTALLATION**

- A. Install piping according to the following requirements in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.
- 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 to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
  1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches above finished floor level.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections for roughing-in requirements.

### **3.03 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

### **3.04 PIPING CONNECTIONS**

- A. Make connections in accordance with the Forsyth Department of Water & Sewer "Water Distribution and Sanitary Sewer Specifications".

### **3.05 EQUIPMENT INSTALLATION**

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

### **3.06 PAINTING**

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.07 IDENTIFICATION**

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  - 1. Stenciled Markers: According to ASME A13.1.
  - 2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
  - 3. Locate pipe markers on exposed piping according to the following:
    - a. Near each valve and control device.
    - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    - d. At manholes and similar access points that permit view of concealed piping.
    - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
  - 1. Lettering Size: Minimum 1/4 inch high for name of unit if viewing distance is less than 24 inches, 1/2 inch high for distances up to 72 inches, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
  - 2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

### **3.08 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete."

### **3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Section 055000 "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

**3.10 GROUTING**

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure place grout.

**END OF SECTION 33 0500**

**SECTION 33 1416**  
**SITE WATER UTILITY DISTRIBUTION PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Water pipe for site conveyance lines.
- B. Pipe valves.
- C. Fire hydrants.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9113 - Exterior Painting.
- B. Section 21 1100 - Facility Fire-Suppression Water-Service Piping.
- C. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

**1.03 REFERENCE STANDARDS**

- A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- B. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.
- C. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2020.
- D. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- E. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.
- F. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- G. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- H. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2017.
- I. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

**1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with utility company requirements.

**PART 2 PRODUCTS**

**2.01 WATER PIPE**

- A. Ductile Iron Pipe: AWWA C151/A21.51:
  - 1. Fittings: Ductile iron, standard thickness.
  - 2. Joints: AWWA C111/A21.11, Styrene butadiene rubber (SBR) or vulcanized SBR gasket with rods.
  - 3. Jackets: AWWA C105/A21.5 polyethylene jacket.
- B. PVC Pipe: ASTM D1785 Schedule 40.
  - 1. Fittings: ASTM D2466, PVC.
  - 2. Joints: ASTM D2855, solvent weld.
- C. PVC Pipe: AWWA C900 Class 100:
  - 1. Fittings: AWWA C111/A21.11, Schedule 40 per ASTM D2466 or schedule 80 per ASTM D2467.

- 2. Joints: ASTM D3139 compression gasket ring.
- D. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

## **2.02 VALVES**

- A. Valves: Manufacturer's name and pressure rating marked on valve body.

## **2.03 HYDRANTS**

- A. Hydrants: Type as required by utility company.
- B. Hydrant Extensions: Fabricate in multiples of 6 inches (150 mm) with rod and coupling to increase barrel length.
- C. Hose and Streamer Connection: Match sizes with utility company, two hose nozzles , one pumper nozzle.
- D. Finish: Primer and two coats of enamel in color required by utility company.

## **2.04 BEDDING AND COVER MATERIALS**

- A. Bedding: As specified in Section 31 2316.13.
- B. Cover: As specified in Section 31 2316.13.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.

### **3.02 PREPARATION**

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

### **3.03 TRENCHING**

- A. See the sections on excavation and fill for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

### **3.04 INSTALLATION - PIPE**

- A. Install ductile iron piping and fittings to AWWA C600.
- B. Route pipe in straight line.
- C. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- D. Slope water pipe and position drains at low points.

### **3.05 INSTALLATION - VALVES AND HYDRANTS**

- A. Set valves on solid bearing.
- B. Center and plumb valve box over valve. Set box cover flush with finished grade.
- C. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 1100.
- D. Set hydrants to grade, with nozzles at least 20 inches (500 mm) above ground in accordance with Section 21 1100.
- E. Locate control valve 4 inches (100 mm) away from hydrant.
- F. Provide a drainage pit 36 inches (900 mm) square by 24 inches (600 mm) deep filled with 2 inches (50 mm) washed gravel. Encase elbow of hydrant in gravel to 6 inches (150 mm) above drain opening. Do not connect drain opening to sewer.

G. Paint hydrants in accordance with Section 09 9113.

**END OF SECTION 33 1416**



**SECTION 33 3113**  
**SITE SANITARY SEWERAGE GRAVITY PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Sanitary sewerage drainage piping, fittings, and accessories.
- B. Connection of building sanitary drainage system to municipal sewers.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

**1.03 REFERENCE STANDARDS**

- A. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- B. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Project Record Documents:
  - 1. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.

**PART 2 PRODUCTS**

**2.01 SEWER PIPE MATERIALS**

- A. Plastic Pipe: ASTM D1785, Schedule 40, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of 4 inches (105 mm), bell and spigot style solvent sealed joint end.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.

**2.02 PIPE ACCESSORIES**

- A. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service" in large letters.

**2.03 BEDDING AND COVER MATERIALS**

- A. Pipe Bedding Material: As specified in Section 31 2323.
- B. Pipe Cover Material: As specified in Section 31 2323.

**PART 3 EXECUTION**

**3.01 GENERAL**

- A. Perform work in accordance with applicable code(s).

**3.02 TRENCHING**

- A. See Section 31 2316.13 for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

**3.03 INSTALLATION - PIPE**

- A. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
  - 1. Plastic Pipe: Also comply with ASTM D2321.
- B. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 10 feet (3 m).

- C. Connect to building sanitary sewer outlet and municipal sewer system , through installed sleeves.
- D. Install trace wire 6 inches (150 mm) above top of pipe; coordinate with Section 31 2316.13.

**END OF SECTION 33 3113**

**SECTION 33 4211  
STORMWATER GRAVITY PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Stormwater drainage piping.

**1.02 RELATED REQUIREMENTS**

- A. Section 31 2316 - Excavation: Excavating of trenches.
- B. Section 31 2323 - Fill: Bedding and backfilling.

**1.03 REFERENCE STANDARDS**

- A. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

**PART 2 PRODUCTS**

**2.01 STORMWATER PIPE MATERIALS**

- A. Provide products that comply with applicable code(s).

**PART 3 EXECUTION**

**3.01 TRENCHING**

- A. See Section 31 2316 - Excavation and Section 31 2323 - Fill for additional requirements.
- B. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

**3.02 INSTALLATION**

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
  - 1. Plastic Pipe: Also comply with ASTM D2321.
- C. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch (3 mm) in 10 feet (3 m).
- D. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.

**END OF SECTION 33 4211**

**SECTION 33 4230  
STORMWATER DRAINS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Precast concrete catch basins.
- B. Cast-in-place concrete catch basins.
- C. Cast-in-place concrete base pad.
- D. Prefabricated drop inlets.
- E. Prefabricated trench drains.
- F. Frames and grates.

**1.02 REFERENCE STANDARDS**

- A. AASHTO HB - Standard Specifications for Highway Bridges; 2005, with Errata.
- B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- D. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2023.
- E. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- F. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.
- G. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants; 2009 (Reapproved 2019).
- H. ASTM C1634 - Standard Specification for Concrete Facing Brick and Other Concrete Masonry Facing Units; 2023.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.

**PART 2 PRODUCTS**

**2.01 CATCH BASINS**

- A. Weight Rating: HS20 according to AASHTO HB.
- B. Precast Concrete Catch Basins: Comply with ASTM C478/C478M, reinforced.
  - 1. Wall Thickness: 6 inches (152 mm).
  - 2. Base Thickness: 12 inches (305 mm).
  - 3. Cone Thickness: 6 inches (152 mm).
  - 4. Lid Thickness: 10 inches (254 mm).
  - 5. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
  - 6. Joint Sealant: Comply with ASTM C990.
- C. Cast-In-Place Concrete Catch Basins: Comply with ASTM C94/C94M, reinforced.
  - 1. Wall Thickness: 6 inches (152 mm).
  - 2. Weep Holes: Two holes, 4 inch (100 mm) diameter, galvanized wire screen.
- D. Cast-In-Place Concrete Base Pads: Comply with ASTM C94/C94M, reinforced.
  - 1. Thickness: 12 inches (305 mm).
  - 2. Width: Match outside catch basin diameter.
  - 3. Length: Match outside catch basin diameter.
- E. Cast-In-Place Concrete Materials:
  - 1. Cement: ASTM C150/C150M, Type II.

2. Sand: ASTM C33/C33M, fine aggregate.
  3. Crushed Gravel: ASTM C33/C33M, coarse aggregate.
  4. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
  5. Water: Potable.
- F. Grade Adjustments:
1. Concrete Bricks: ASTM C1634 or ASTM C55 Grade N, cored, normal weight; 8 by 4 by 2 inches (225 by 112.5 by 75 mm).

## **2.02 DROP INLETS**

- A. Weight Rating: HS20 according to AASHTO HB.
- B. Prefabricated Drop Inlet: Polymer concrete, glass fiber reinforced, metal installation brackets.
- C. Frames and Grates: Galvanized steel support, steel grate, checkerboard pattern, match drain opening size.

## **2.03 PREFABRICATED TRENCH DRAINS**

- A. Prefabricated Trench Drain: Polymer concrete, glass fiber reinforced, metal installation brackets.
  1. Weight Rating: HS20 according to AASHTO HB.
  2. Frames and Grates: Galvanized steel support, steel grate, linear pattern, match drain opening size.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify built-in items are in proper location and ready for roughing into work.
- C. Verify excavation location and depth are correct.

### **3.02 EXCAVATION AND FILL**

- A. Hand trim excavation for accurate placement to indicated elevations.
- B. Backfill with cover fill, tamp in place and compact, then complete backfilling.
- C. Cover weep holes with 3/4 inch (19 mm) crushed stone.

### **3.03 INSTALLATION**

- A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.
- B. Precast Concrete Catch Basins:
  1. Place base section plumb and level.
  2. Install joint sealant uniformly around section lip.
- C. Cast-In-Place Concrete Base Pad:
  1. Form bottom of excavation walls clean and smooth to correct limits.
  2. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
  3. Place concrete in accordance with ACI PRC-304.
  4. Float base pad top surface level.
- D. Cast-In-Place Concrete Catch Basins:
  1. Form catch basin on concrete base pad plumb and level.
  2. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
  3. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
  4. Place concrete in accordance with ACI PRC-304.
  5. Float catch basin top surface level.

- E. Prefabricated Drop Inlets or Trench Drains:
  - 1. Place base section plumb and level.
  - 2. Install according to manufacturer's instructions.
  - 3. Secure installation brackets.
- F. Grade Adjustments:
  - 1. Lay brick or masonry units uniformly on mortar bed with full head joints, running bond. Top with mortar, plumb and level.
  - 2. Place adjacent materials tight and smooth following design grades.
- G. Frames and Grates:
  - 1. Place frame plumb and level.
  - 2. Mount frame on prefabricated drop inlets or trench drains according to manufacturer's instructions.
  - 3. Place grate in frame securely.

**3.04 FIELD QUALITY CONTROL**

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Perform field inspection for pipe invert elevations.
- C. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to Owner.

**END OF SECTION 33 4230**