



EAPC
ARCHITECTS ENGINEERS

VIBRA HEALTHCARE OF CENTRAL DAKOTAS, LLC
REHABILITATION HOSPITAL

829 43RD AVE
BISMARCK ND 58503

ISSUED FOR BIDDING
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(ALL DISCIPLINES/PACKAGES)

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END OF SECTION 00 0110

SECTION 00 7000 - ARTICLE 16 - SUPPLEMENTARY CONDITIONS

PART 1 SUPPLEMENTARY CONDITIONS

1.1 SUPPLEMENTS

- A. These General Conditions of the Contract for Construction (AIA Document A201 - 2017, 15 Articles on 38 pages) are hereby made part of the Contract Documents whether bound herein or not. This Article 16 contains changes and additions to the AIA A201, cross referenced to the original Article numbers in AIA A201 - 2017. Where any part of AIA A201 - 2017 is not modified or voided by this Article 16 or Division 1 Specifications Sections, the unaltered part remains in effect.

1.2 ARTICLE 1 - GENERAL PROVISIONS

- A. **§1.1.3 The Work**
 - 1. **Add:** The term "provide" shall mean furnish and install in place.
- B. **§1.1.5 The Drawings**
 - 1. **Add:** The general character and scope of the Work is shown by the Drawings. Where a portion of the Work is fully drawn and the remainder is merely indicated, the portion fully drawn shall apply to all similar part of the Work. Figured dimensions shall be followed in preference to scaled measurements. Dimensions on the Drawings are subject to field verification to suit adjacent elements.
- C. **§1.1.6 The Specifications**
 - 1. **Add:** Where Specifications are abbreviated type, they indicate complete sentences in the same manner as when a note occurs in the Drawings. Omissions of words such as "the Contractor shall" and "as shown on the Drawings" is intentional. The words "shall" or "shall be" are to be supplied by inference.
 - a. Where a number is listed in the Specifications (as for gauges, weights, temperatures, amount of time, etc.), the number shall be interpreted as that or better.
 - b. Division 00 and Division 01 of this book apply to every Specification Section in this book.
- D. **§1.2 Correlation and Intent of the Contract Documents**
 - 1. **§1.2.1; Add:** Change the period at the end of the first sentence to a comma and add: "in operating order".
 - 2. **Add new paragraph:**
 - a. **§1.2.4** In case of a conflict between the Contract Documents and any portion bid separately to the owner, if not reconciled by Addendum, the Architect/Engineer will determine which document is the most specific and the Contractor shall do the Work accordingly, at no change in price.

1.3 ARTICLE 2 - OWNER

A. **§2.3 Information and Services Required of the Owner**

1. **§2.3.6; Replace text with:** The Contractor(s) will be furnished as many sets of Drawings and Project Manuals as the Architect has available for distribution, but in no case less than one (1). If the Contractor(s) require additional sets, they will be furnished to the Contractor(s) at the cost of reproduction, and postage and handling, to be paid by the Contractor(s).

1.4 ARTICLE 3 - CONTRACTOR

A. **§3.3 Supervision and Construction Procedures**

1. **Add new paragraphs:**

- a. **§3.3.1.1** Where multiple Prime Contracts are in effect the [General] Contractor's schedule, prepared in accordance with Article 3.10.1 of these Supplementary Conditions and progress shall govern the Work of the other Prime Contractors. Each Contractor shall notify other Prime Contractors, within a reasonable time, of phases or items of the Work requiring incorporation of Work by the other Prime Contractors. The other Prime Contractors shall, after such notification and within a reasonable time, proceed with the furnishing, installation, laying out or incorporation of their Work so as not to delay or impede the progress of the Work.
- b. **§3.3.1.2** Each Prime Contractor shall be responsible for the regular and on-going coordination of their Work with the affected Work of other Prime Contractors and for maintaining and coordinating the progress of the Work in accordance with the construction schedule, prepared in accordance with Article 3.10.1 of these Supplementary Conditions for scheduling requirements.

B. **§3.4 Labor and Materials**

1. **Add new section:**

a. **§3.4.4 Workmanship and Materials**

- 1) **.1** No trade shall commence Work until conditions are right for carrying out the Work properly, and surfaces affecting the Work of that trade are suitable.
- 2) **.2** Manufacturer's printed instructions covering details of installations shall be followed where not in conflict with these Specifications. If there is a conflict, notify the Architect and obtain approval before proceeding.
- 3) **.3** Completed Work shall be left plumb, level, true to line or plane, anchored securely in place, free from damage.
- 4) **.4** Unless otherwise called for, all pieces of material shall be as large a stock size as is in conformity with standard good practice of the trade.
- 5) **.5** Except where in conflict with these specifications, current manufacturer's printed specifications of herein specified proprietary products are made part of these specifications.
- 6) **.6** Deliver and store materials so as to protect from damage. Inspect materials for damage as delivered.

- 7) **.7** For items fabricated to fit the needs of this project, verify dimensions by field measurements where practical. Establish Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabrication. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.
- 8) **.8** For brand name materials where purchase method allows: Deliver in original container with seals unbroken and with original labels with manufacturer's name, product brand name and directions intact.
- 9) **.9** Where these specifications call for products that meet national standards (such as ASTM, CS, Federal Specifications, etc.), furnish a certification from the manufacturer that those products do meet the specified standards.
- 10) **.10** Obtain each separate type of product from the same manufacturer.
- 11) **.11** Before each trade commences work, conduct a pre-installation conference at the area of the site where the work will begin. The conference shall include the General Contractor's Superintendent and representatives of all trades whose work interfaces with the trade about to begin work. The purpose will be to determine that conditions are proper for beginning the work and assure that other trades will coordinate as needed.

2. ***Add new paragraph:***

- a. **§3.4.5** NDSU has an obligation to make information available to the campus on where to get information about Registered Sex Offenders who are working on NDSU property. You are obligated to inform NDSU Campus Police, in advance of any of your employees being on NDSU property, of any such employee who is a Registered Sex Offender. This obligation also includes property owned or controlled by NDSU that is at locations other than the main campus (for example, the Equine Center, Downtown Campus, Research & Extension Centers, etc.).

C. **§3.6 Taxes**

1. ***Add new paragraph:***

- a. **§3.6.1** Contractor shall pay the ND Use tax per section 57-40.202.1 of the Century Code. Use tax applies to the purchase of tangible personal property by an individual or business not taxed at the time of purchase for storage, use or consumption in North Dakota.
- b. **§3.6.1** Contractors shall be responsible for paying all required State and Municipal Use/Excise taxes on their gross receipts of material on a project including the value of material furnished by the owner per South Dakota Codified Law Chapters 10-45, 10-46 and 10-52. Subcontractors do not owe excise tax IF a prime contractor's exemption certificate is received for the project.

2. ***Add new paragraph:***

- a. **§3.6.2** Include the City of Grand Forks, ND sales tax.
 - 1) For projects to be built in the City of Grand Forks, ND, a special \$5,000 License and Permit bond, obtained through the Contractor's insurance company will be required by the City. Original copy of bond must be filed with the City. Consult with the City Building Inspector or City Auditor in City Hall for information. (701) 746-2631.

D. **§3.7 Permits, Fees, Notices and Compliance with Laws**

1. **§3.7.1; Replace text with:** The Owner will take out and pay for the Building Permit. The Owner will pay any City special assessments against the property, such as those for street paving, water and sewer projects and sewage disposal.
2. **§3.7.1; Add:** If separate Mechanical and Electrical Contracts are being bid, each General Contractor shall include in his bid the permit fee on an amount equal to 100% of his bid, plus all his add alternate plus 50% of this sum for the Mechanical and Electrical Contracts. The Contract amount shall be adjusted by change order for the difference between this bid amount and the actual amount.
3. **Add new section:**
 - a. **§3.7.6 Equal Opportunity Clause**
 - 1) During the performance of this contract, the Contractor agrees to follow Section 202 of “ Executive Order 11246 of September 24, 1965” relative to Non Discrimination in Employment by Government Contractors and Subcontractors and/or any directive regarding Equal Opportunity Employment issued by State where the project is located.

E. **§3.10 Contractor's Construction and Submittal Schedules**

1. **§3.10.1; Add:** The Contractor with the largest Contract shall prepare the construction schedule in cooperation with the other prime Contractors and obtain written evidence of their concurrence. The first payment will not be certified by the Architect until the progress schedule is received. See also Section 01 3200.

F. **§3.11 Documents and Samples at the Site**

1. **Add new paragraphs:**
 - a. **§3.11.1** Immediately upon receipt of contract documents, identify one each of the documents with the title, "RECORD DOCUMENTS - JOB SET." Update the record set with all Addenda items.
 - b. **§3.11.2** Through progress of the work, the Contractor shall maintain an accurate record of changes in the contract documents, as described below. Upon completion of the work, transfer the recorded change in ink to a set of record documents. See also Section 01 7839 – Project Record Documents.
 - c. **§3.11.3** Changes that shall be recorded are major concealed items from what is called for by the Contract Documents. This is to include such items as main pipes and conduit or changed structural members which cannot be observed on completion even with the use of access doors or removable panels.
 - d. **§3.11.4** Coordinate changes within the record documents, making adequate and proper entries on each page of specifications and each sheet of drawings and other documents where such entry is required to show the change properly.
 - e. **§3.11.5** Accuracy of records shall be such that future searches for items shown in the contract documents may rely reasonably on information obtained from the approved project record documents.
 - f. **§3.11.6** Make entries within 24 hours after receipt of information that the change has occurred. Prior to submitting request for final payment, submit the final project record documents to the Architect and secure his approval. Maintain the job set of record documents completely protected from deterioration and from loss and damage until completion of the work and transfer of all recorded data to the final project record documents.

- g. **§3.11.7** Submit the completed set of project record documents to EAPC as described in Section 01 7839.
 - h. **§3.11.8** Participate in review meeting as required.
 - i. **§3.11.9** Make required changes and promptly deliver the final project record documents to EAPC.
 - j. **§3.11.10** EAPC will review for completeness of record documents.
 - 2. The purpose of the final project record documents is to provide factual information regarding all aspects of the work, both concealed and visible, to enable future modification of the work to proceed without lengthy and expensive site measurement, investigation, and examination.
- G. **§3.14 Cutting and Patching**
- 1. *Add new paragraph:*
 - a. **§3.14.3** On projects with more than one prime Contract, the General Contractor shall provide all openings in all new general construction, provided the information has been furnished to the General Contractor in time. If said information is not furnished in time, other Contractors shall cut, patch and repair as necessary all that is required for an installation per drawings and specifications. Use persons with the required skills for the work involved. Where support members are involved, cutting shall be approved in advance by the Architect/Engineer. Openings required in existing construction are the responsibility of the Contractor requiring the opening, including patching of existing construction to match adjacent finishes.
- H. **§3.15 Cleaning Up**
- 1. *Add new sections:*
 - a. **§3.15.1.1 Cleaning During Construction.** The building and site shall be cleaned weekly and more often if necessary to provide a safe and hazard free work place. Maintain floors broom clean. See also AIA A201.6.3.
 - b. **§3.15.1.2 Cleaning on Completion of the Building.**
 - 1) **.1** "Clean," for the purpose of this article shall be interpreted on finished surfaces as meaning the level of cleanliness generally provided by skilled cleaners using quality building maintenance equipment and materials.
 - 2) **.2** Remove all window stickers and labels.
 - 3) **.3** Clean all plumbing, heating and electrical items upon completion of the project, and before Owner's occupancy.
- I. **§3.16 Access to Work**
- 1. *Add new paragraph:*
 - a. **§3.16.1** The Owner will clear the building of removable equipment and supplies and allow the Contractor exclusive use of the interior spaces until Substantial Completion – under the terms stated elsewhere in these Specifications.
 - b. The Contractor shall confine the Work, the storage of items and parking within the building and the “Contract Limit Lines” shown on the Site Plan.
- J. **§3.18 Indemnification**
- 1. **§3.18.1; Add:** Actions that EAPC might take or fail to take with regard to Shop Drawings are to be covered by 3.18.1 to the same extent as actions in other matters.

1.5 ARTICLE 4 ARCHITECT

A. **§4.1 General**

1. **§4.1.2; Add:** The Architect/Engineer has no duties or responsibilities in regard to insurance or legal decisions, surveying, subsurface soil exploration, geophysical testing, soil analysis or soil testing, testing for contamination by airborne asbestos fibers, bulk sample analysis for asbestos identification and content determination. The Architect/Engineer's obligations are solely to the Owner. In meeting such obligations, EAPC may increase the burdens and expenses of the Contractor, Subcontractors or Employees or the Surety of any of them. Nothing in the performance of EAPC's services in connection with this project implies any undertaking for the benefit of, or which may be enforced by the Contractor, Subcontractor or Employees, or the Surety of any of them.

B. **§4.2 Administration of the Contract**

1. **§4.2.3; Add:** The Architect will not be responsible for the acts or omissions of the Owner.

C. **§4.2.4 Communications**

1. **Add:** If there are any direct communications between Owner and Contractor, that affect the performance or Administration of the Contract, the gist of such communication shall be reduced to writing by the Owner, with a copy to the Architect.

1.6 ARTICLE 5 - SUBCONTRACTORS *NO SUPPLEMENT*

1.7 ARTICLE 6 - CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS *NO SUPPLEMENT*

1.8 ARTICLE 7 - CHANGES IN THE WORK

A. **§7.1 General**

1. **Add new paragraph:**

- a. **§7.1.4** Divisions 00 and 01 state generally how change proposals shall be handled. When quoting on a change proposal, a Contractor shall furnish a complete and itemized list of materials involved due to a proposed change in work if so requested showing:
 - 1) The actual cost of:
 - a) Labor, including foreman, on a per item basis.
 - b) Materials, all individually priced, entering permanently into the work.
 - c) The Ownership or rental cost of construction plant and equipment during the time of use on the extra work.
 - d) Insurances, permits, fees and other direct job expenses applicable to the changes.
 - e) To the total cost of the items above, add an allowance for overhead and profit, as appropriate for the paperwork involved.
 - f) Compute add or deduct change orders on the same basis.
 - g) The Architect shall have the right to require actual quotations for materials and/or labor from the contractor or suppliers.

- 2) *When either or both additions and credits covering related work or substitutions are involved in any one change, the allowance for overhead and profit shall be calculated on basis of the net amount of cost or credit.*
 - a) *The allowance for overhead and profit combined, included in the total cost shall be based on the following schedule:*
 - 1 *For the Contractor; for added work performed by the Contractor's own forces, 15 percent of the cost; for deleted work performed by the Contractor's own forces, 5 percent of the cost.*
 - 2 *For the Contractor; for added work performed by the Contractor's Subcontractor, 5 percent of the cost due the Subcontractor.*
 - 3 *For each Subcontractor or Sub-subcontractor involved; for added work performed by the Subcontractor's own forces; 15 percent of the cost; for deleted work performed by the Subcontractor's own forces; 5 percent of the cost.*
 - 4 *For each Subcontractor; for added or deleted work performed by the Subcontractor's Sub-subcontractor, 5 percent of the amount due the subcontractor.*
 - 5 *Cost to which overhead and profit is to be applied shall be determined in accordance with Subparagraph 7.3.4.*
 - b) *In order to facilitate the checking of quotations for extras or credit, all proposals, except those so minor that their propriety can seem by inspection, shall be accomplished by a complete itemization of costs including labor, materials, and subcontracts. Labor and materials shall be itemized in the manner described above. Where major cost items are subcontract, they shall be itemized also.*

2. ***Add new paragraph:***

- a. **§7.1.5** By signing a Change Order, the Contractor agrees that the changed Contract Amount is in full payment for the changed work, including that resulting from any resulting changes in the time schedule.

1.9 ARTICLE 8 - TIME

A. **§8.3 Delays and Extensions of Time**

1. **§8.3.1; Add:** The following will not be considered justifications for extension of time unless due to one of the causes stated within this Article 8.
 - a. Delay caused by Subcontractors or Supplier except if the Supplier goes out of business and another Supplier cannot be found in time to meet schedule.
 - b. Shortage of workmen.

1.10 ARTICLE 9 - PAYMENTS AND COMPLETION

A. **§9.2 Schedule of Values**

1. **Add:** Schedule of Values shall to suit the Contractor's judgment for the particular project following the format of the sample in Section 00 3000. Use the same form for payment requests, along with the form "Partial Payment Summary Sheet" in Section 00 3000.

B. **§9.3 Applications for Payment**

1. **Add new paragraphs:**

- a. **§9.3.4** Contractor to comply with Minnesota Rules 290.9705 Surety Deposits Required for Construction Contracts.
- b. **§9.3.5** Contractor to comply with Minnesota Rules 337.10 Building and Construction Contracts; prohibited provisions regarding Waiver of lien or claim; Prompt payment to subcontractors, and Progress payment and retainages
 - 1) **.1** Bills, certificates, notes or bonds of the United States;
 - 2) **.2** Other obligations of the United States or its agencies;
 - 3) **.3** Obligations of any corporation wholly owned by the federal government; or
 - 4) **.4** Indebtedness of the Federal National Mortgage Associations.
- c. **§9.3.6** Contractor to comply with Minnesota Rules 289A.09 Filing requirements for taxes withheld from wages, from compensation of entertainers, and from payments to out-of-state contractors; and taxes withheld by partnerships and small business corporations.

C. **§9.6 Progress Payments**

1. **Add new paragraph:**

- a. **§9.6.9** Except where other statutory requirements apply, progress payment shall be made monthly upon application, in the amount of 90% of the Work completed and materials described under 9.3.2. For a Contract over \$100 thousand, the Architect will authorize the payment of 100% of the amount completed after a total of 5% of the Contract amount has been retained, providing progress on the Work is in accordance with or ahead of the Contractor's Progress Schedule and is otherwise satisfactory to the Architect, and if the Contractor has filed a Consent of Surety with the Architect.

D. **§9.8 Substantial Completion**

- 1. **§9.8.1; Add:** Minor corrective Work and the replacement of defective Work or materials, and the adjustment of control apparatus will not delay the determination that the Contract is Substantially Complete. See 12.2.2.
- 2. **Add new paragraph:**
 - a. **§9.8.6** At 12:01 a.m. on the Date of Substantial Completion, the Owner becomes responsible for the care and operation of the accepted Work.

1.11 ARTICLE 10 - PROTECTION OF PERSONS OR PROPERTY

A. **§10.2.8 Injury or Damage to Person or Property**

1. **Add new paragraph:**

- a. **§10.2.8.1** Contractor shall submit to the Owner a copy of the written safety program to be used as guidelines and direction of the Contractor's and subcontractors' worksite activities. This program must meet all federal, state and local laws and other legal requirements and include the following minimum provisions: (1) a worksite safety policy and mission statement; (2) assigned responsibilities among management, supervisors and employees; (3) a system for periodic self-inspections, including inspection of job sites, materials, work performance and equipment; (4) a thorough accident and injury reporting and investigation process; (5) a safety orientation program including first aid, medical attention, emergency facilities, fire protection and prevention, housekeeping, illumination, sanitation, personal protective equipment and occupational noise exposure; and (6) a safety training program including safety "tool box" meetings and other systems for ongoing training, including training for employees on the recognition, avoidance and prevention of unsafe conditions.
- b. It shall be a condition of the Contract and shall be made a condition of each subcontract entered into pursuant to the contract, that the owner assumes no liability relating to its receipt and review of the Contractor's safety plan. Safety remains the responsibility of the Contractor. Furthermore, the right of the Owner to receive and review the safety plan shall not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity.

B. **§10.3 Hazardous Materials and Substances**

1. **§10.3.4; Add:** Asbestos containing materials are prohibited from use in the construction of this project. The Contractor shall certify that only non-asbestos materials were used (See certification Form in Section 00 3000). Typical materials likely to contain asbestos include roofing, acoustical treatments, fireproofing, drywall, plaster, resilient flooring, insulation's, mastics/adhesives, gaskets, mineral products, cementitious boards/pipes/mortar, etc.
2. Lead containing materials are prohibited from use in the construction of this project.

1.12 ARTICLE 11 - INSURANCE AND BONDS *NO SUPPLEMENT*

1.13 ARTICLE 12 - UNCOVERING AND CORRECTION OF WORK *NO SUPPLEMENT*

1.14 ARTICLE 13 - MISCELLANEOUS PROVISIONS

A. **§13.1 Governing Law**

1. **Add new paragraphs:**
 - a. **§13.1.1** Where the Contract Documents require Work better than that required by statute, the Contract Documents shall govern.
 - b. **§13.1.2** If changes in laws, regulations, or codes made after the date of the Bid Opening require substantial revisions in the scope, extent or complexity of the Work called for by the Contract Documents, an equitable adjustment will be made in the terms of the Contract.
2. **Add new sections:**
 - a. **§13.6 Notification of Demolition and Renovation**

- 1) For any project located in North Dakota which will have either demolition or renovation, the Contractor shall fill out the form at the end of this section, get it signed by the Owner and send it by mail or fax and mail to the ND State Department of Health to be received by them at least 10 days before beginning the activity, all per the instructions on the form.
- b. **§13.7 Minnesota Wage Rates**
 - 1) All Contractor and Subcontractors shall conform to the laws of the State of Minnesota and all other laws, ordinances and legal requirements affecting their work in Minnesota. Refer to the Minnesota Department of Labor and Industry website for Minnesota laws, statutes and other information.
<https://www.dli.mn.gov/business/employment-practices/prevaling-wage-information>
- c. **§13.8 Liquidated Damages**
 - 1) The parties acknowledge and agree that time is of the essence under the Contract, and delays in Substantial Completion of the Work beyond the date specified in the Contract, subject to adjustment as provided in the Contract, would result in ____ (insert result). Accordingly, the parties hereby agree that if Contractor fails to achieve Substantial Completion of the Work within such time specified in the Contract, subject to adjustments as provided in the Contract, then Owner's remedy, in addition to other remedies at law or in equity, for such failure shall be to recover from Contractor, the following amounts ____ (insert result).
 - 2) The parties acknowledge and agree that time is of the essence under the Contract, and delays in Substantial Completion of the Work beyond the date specified in the Contract, subject to adjustment as provided in the Contract, would result in harm to the Owner for lack of occupancy for the areas within the Work. The parties hereby agree to work in good faith to achieve the schedule without penalties of liquidated damages.

1.15 ARTICLE 14 - TERMINATION OR SUSPENSION OF THE CONTRACT *NO SUPPLEMENT*

1.16 ARTICLE 15 - CLAIMS AND DISPUTES

- A. **§15.3.2; Add:** Claims not resolved by mediation shall be decided by arbitration which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Arbitration Rules of the American Arbitration Association in effect as of July 1, 2001. Any provision in such Rules to the effect that rules in effect at the time of filing of a demand for arbitration shall apply are hereby deleted, it being the intent that no amendments to the Rules shall apply to these parties. Notwithstanding the foregoing, the administrative fees to be paid shall be those in effect as of the time of filing the demand for arbitration. The demand for arbitration shall be filed in writing with the other party to the Contract and with the American Arbitration Association, and a copy shall be filed with the Architect.

END OF SECTION 00 7000

SECTION 00 7000 - GENERAL CONDITIONS

PART 1 GENERAL

1.1 CONTENTS

- A. This Section contains the printed standard document AIA Document A201 - 2017, General Conditions of the Contract for Construction, 15 Articles on 38 pages.
- B. It also contains Article 16, Supplementary Conditions, which has changes and additions to the printed AIA standard document.
- C. The printed standard document as modified by Article 16, both included in this Section 00 7000, applies to this Project except to the extent that it is supplemented for this Project by Division 1 Sections.
- D. Note especially:
 - 1. Section 00 7000-3.7.1 - Building Permit by Owner
 - 2. Section 00 8000 - Special Conditions Federal Funded Projects

SECTION 00 9000 - INFECTION CONTROL AND INTERIM LIFE SAFETY MEASURES

PART 1 - INFECTION CONTROL

1.1 INFECTION CONTROL RISK ASSESSMENT

- A. An Infection Control Risk Assessment (ICRA) is a matrix of precautions for construction & renovation projects in healthcare environments. This matrix system was developed and adopted by the CDC “Center for Disease Control” facility owner and staff will complete the ICRA and the contractor shall post it at a conspicuous place near the entry to the construction area. The contractor shall assist the building owner in meeting all requirements listed in the ICRA and the specifications listed below to maintain a safe environment. The ICRA document will set the requirements for the containment of the construction project. The contractor shall work with the infection control person to maintain a safe environment.
- B. ICRA Matrix and forms are included in Part 3 of this Section..

PART 2 - INTERIM LIFE SAFETY MEASURES

2.1 DESCRIPTION:

- A. Interim Life Safety Measures (ILSM) is a list of actions taken to maintain a safe environment during construction activities. The ILSM is a requirement of most Code enforcement agencies. During construction there are operations that will disable or impede the life safety measures set forth in the building codes and the 2012 version of the Life Safety Code NFPA101. The ILSM lists temporary measures to be taken during the time when these codes requirements are compromised. Interim Life Safety Measures shall be maintained during all phases of construction. The building owner will institute and document Interim Life Safety Measures to temporarily compensate for hazards posed to buildings and grounds during construction. The contractor shall post the ILSM at a conspicuous place near the entry to the construction area. The contractor shall assist the building owner in meeting all requirements listed in the ILSM and the specifications listed below as needed to maintain a safe environment.

2.2 REFERENCE STANDARDS

- A. NFPA 101 - Life Safety Code (LSC®); Most recent addition adopted by Authority Having Jurisdiction, including all applicable amendments and supplements.

2.3 POLICY

- A. Interim Life Safety Measures will be maintained during all phases of construction. The medical facility, Vibra Hospitals of the Central Dakotas , will institute and document Interim Life Safety Measures to temporarily compensate for hazards posed to buildings and grounds during construction. These will include, but are not limited to:

1. All exits will be unobstructed and useable. All personnel will receive training if alternative exists must be designated. Buildings or areas under construction will maintain escape facilities for construction workers at all times. The means of egress in construction area will be inspected daily. Alternate routes for public access will be provided if normal access routes are affected. Roads and walkways are maintained passable and safe.
2. There will be free and unobstructed access to the Emergency Department/Services for emergency forces.
3. Before fire-warning systems are taken out of service, plans are instituted to compensate for alarms, detection and suppression. The owner will post a 24-hour fire watch as required. A temporary but equivalent system shall be provided. Temporary systems must be inspected and tested monthly.
4. Any penetrations in fire separations will be inspected daily during construction and receive high completion priority. Temporary construction partitions must be smoke tight and noncombustible.
5. Provide additional firefighting equipment and use training for personnel.
6. Smoking shall be prohibited in or adjacent to all construction areas.
7. Construction area will be maintained in a clean and fire safe manner. Develop and enforce storage housekeeping and debris removal policies and procedures that reduce flammable and combustible fire load to the lowest level necessary for daily operations.
8. Conduct and minimum of two fire drills per shift per quarter.
9. Construction area will be properly restricted from the rest of the building operations. Construction area will be maintained in a clean and fire safe manner.
10. Train personnel when structural or compartment features of fire safety are compromised.
11. Conduct safety education programs to ensure awareness of Life Safety Code deficiencies, construction hazards and these Interim Life Safety Measures.
12. Increase hazard surveillance of grounds, building, and equipment with special attention to construction areas, storage and field offices.

2.4 PROCEDURE

- A. Contract documents will reflect the requirements of Vibra Hospitals of the Central Dakotas for providing safe conditions during construction by the General Contractor.
- B. The Project shall have a designated Safety Officer. The Safety Officer will monitor practices during construction to ensure maintenance of a safe environment. Safety Officer will make recommendations for special training and safe procedures.
- C. Documentation relating to safety-related issues during construction is the responsibility of the Safety Officer.
- D. When conditions change, due to construction, program function additions or deletions in the Vibra Hospitals of the Central Dakotas policies and procedures contained herein will be revised as needed.
- E. On-site inspections both during and after hours.
- F. Additional fire drills and training in the affected areas.
- G. Proper barricades (interior and exterior).

- H. Specific assignments for fire watches when cutting and/or brazing torches are being used or when interruptions are made in the fire warning system.
- I. Proper storage of flammable liquids at the project site.

2.5 MANAGEMENT OF THE ENVIRONMENT OF CARE

- A. The organization implements the life safety management plan and performance improvement standards, including all features described in EC.1.7.
 - 1. The organization also:
 - a. Maintains current record drawings (or documents) addressing all structural features of fire protection;
 - b. Develops a policy for use of Interim Life Safety Measures (ILSM*) that include written criteria to evaluate various LSC® deficiencies and construction hazards for determining when and to what extent on or more of the following are applicable;
 - c. Implements, documents, and enforces appropriate Interim Life Safety Measures (ILSM) as determined by the organization.
 - d. Examples of Evidence of Performance for EC.2.6.
 - 1) Staff Interviews.
 - 2) Building tour.
 - 3) Implementation of ILSM, if applicable.
 - 4) Review of technical drawings of fire protection system.
 - 5) Records of fire drill performance.
- B. The ILSM consist of the following actions
 - 1. Ensuring free and unobstructed exits. Personnel receive additional training when alternative exits are designated. Buildings or areas under construction must maintain escape routes for construction workers at all times. Means of exiting construction areas are inspected daily.
 - 2. Ensuring free and unobstructed access to emergency services and for fire, police, and other emergency forces.
 - 3. Ensuring fire alarm, detection, and suppression systems are in good working order. A temporary but equivalent system shall be provided when any fire system is impaired. Temporary systems must be inspected and tested monthly.
 - 4. Note: The Life Safety Code, NFPA 101, requires that the municipal fire department (or applicable emergency forces group) is notified and a fire watch is provided whenever an approved fire alarm or automatic sprinkler system is out of service for more than four hours in a 24-hour period in an occupied building.
 - 5. Ensuring temporary construction partitions are smoke tight and built of noncombustible or limited combustible materials that will not contribute to the development or spread of fire.
 - 6. Providing additional fire-fighting equipment and training personnel in its use.
 - 7. Prohibiting smoking according to EC.5 throughout the organization's buildings, and in and adjacent to construction areas.
 - 8. Developing and enforcing storage, housekeeping, and debris removal practices that reduce the building's flammable and combustible fire load to the lowest feasible level.
 - 9. Conducting a minimum of two fire drills per shift per quarter.

10. Increasing hazard surveillance of buildings, grounds, and equipment, with special attention to excavations, construction areas, construction storage, and field offices.
11. Training personnel to compensate for impaired structural or compartmentalization features of fire safety.
12. Conducting organization wide safety education programs to promote awareness of LSC® deficiencies, construction hazards, and ILSM.

2.6 PROTECTION OF PERSONS AND PROPERTY

- A. Interim Life Safety Measures (ILSM). A series of 11 administrative actions required to temporarily compensate for the significant hazards posed by existing NFPA 101® 2012 Life Safety Code (LSC®) deficiencies or construction activities. ILSM apply to appropriate staff (including construction workers) must be implemented upon project development, and must be continuously enforced through project completion. Implementation of ILSM is required in or adjacent to all construction areas and throughout buildings with existing LSC® deficiencies. ILSM are intended to provide a level of life safety comparable to that described in Chapters 1-7, and the applicable occupancy chapters of the LSC®. Each ILSM action must be documented through written policies and procedures. Frequencies for inspection, testing, training, and monitoring and evaluation must be established by the organization.
- B. The Contractor shall adopt and enforce uniform life safety measures consistent with the guidelines promulgated by the Joint Commission on Accreditation of Healthcare Organizations, including the following:
 1. All work areas must have adequate barriers to ensure a safe environment for all patients, visitors, and staff at all times during construction. This includes appropriate signage.
 2. All work done must comply with federal, state, and local authorities having jurisdiction. All applicable codes must be adhered to.
 3. All exits must be clear and provide free and unobstructed egress.
 4. Access to the emergency department and services must be free and unobstructed.
 5. Fire sprinkler, detection and suppression systems shall not be impaired.
 6. The fire alarm system must remain operational.
 7. Temporary construction partitions shall be smoke tight and noncombustible. Adequate signage shall be erected to discourage casual observers from opening or entering partitions.
 8. Additional firefighting equipment shall be provided.
 9. Smoking shall be prohibited in and adjacent to all construction areas.
 10. The construction site shall be kept clean and orderly, including material piles, debris, platforms, and break areas.
 11. Contractor shall conduct and document two fire drills per shift per quarter in the construction zone and areas adjacent to the construction areas.
 12. Hazard surveillance of sites shall be increased and documented, with attention to be given to evacuation routes, construction areas, storage, office/lunch areas, and full storage.
 13. Staff shall be informed whenever the safety of adjacent areas is compromised.
 14. The construction site must be restricted from all but authorized staff. Adequate signage must be provided.
 15. Proper notification must be made to local authorities whenever life safety is diminished.
 16. Alternate access shall be provided for public and emergency traffic whenever disruption occurs.

17. Roads and pathways shall be kept clear of snow, materials, and other obstructions.
18. Vibra Hospitals of the Central Dakotas shall be kept apprised of the status of life safety during the project.
19. Construction workers shall be made aware of egress routes.
20. Construction worker's egress routes must be inspected daily to ensure no obstacles.
21. Effective storage, housekeeping, and debris removal policies and procedures must be in place to reduce collection of combustibles in construction area.
22. Staff shall be informed of changed fire zones, ILSM compartment and fire safety.

C. **A schedule for enforcement of the above procedures should be adopted and maintained.**
The Contractor is to coordinate these items with the Owners Representative.

PART 3 - ILSM ASSESSMENT AND ICRA MATRIX

SECTION 01 1000 - SUMMARY

PART 1 GENERAL

1.1 PROJECT

- A. Project Name: _____.
- B. Project Name: 20251200 - Vibra Rehabilitation Hospital
- C. Owner's Name: _____.
- D. Architect's Name: _____.
- E. The Project consists of the construction of _____.

1.2 CONTRACT DESCRIPTION

- A. Contract Type: Multiple prime contracts, each based on a Stipulated Price as described in Document 00 5000 - Contracting Forms and Supplements.
- B. Contract Type: A single prime contract based on a Stipulated Price as described in Document 00 5200 - Agreement Form.

1.3 WORK BY OWNER

- A. Owner has awarded a contract for supply and installation of _____ which commenced _____.
- B. Items noted NIC (Not in Contract) will be supplied and installed by Owner before Date of Substantial Completion. Some items include:
 - 1. _____.
 - 2. _____.
 - 3. _____.
 - 4. _____.
- C. Owner will supply and install the following:
 - 1. _____.
 - 2. _____.
 - 3. _____.
 - 4. _____.
- D. Owner will supply the following for installation by Contractor:
 - 1. _____.
 - 2. _____.
 - 3. _____.
 - 4. _____.

1.4 FUTURE WORK

- A. Project is designed for future _____.
- B. Provide _____ for future installation of _____.

1.5 OWNER OCCUPANCY

- A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.
- B. Owner intends to occupy the Project upon Substantial Completion.
- C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- D. Schedule the Work to accommodate Owner occupancy.

1.6 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. Arrange use of site and premises to allow:
 - 1. Owner occupancy.
 - 2. Work by Others.
 - 3. Work by Owner.
 - 4. Use of site and premises by the public.
 - 5. _____.
 - 6. _____.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Existing building spaces may not be used for storage.
- E. Time Restrictions:
 - 1. Limit conduct of especially noisy exterior work to the hours of _____.
 - 2. Limit conduct of the hours of _____.
- F. Utility Outages and Shutdown:
 - 1. Limit disruption of utility services to hours the building is unoccupied.
 - 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 3. Limit shutdown of utility services to ____ hours at a time, arranged at least 24 hours in advance with Owner.
 - 4. Prevent accidental disruption of utility services to other facilities.

1.7 WORK SEQUENCE

- A. Construct Work in stages during the construction period:
 - 1. Stage 1: _____.
 - 2. Stage 2: _____.
 - 3. Stage 3: _____.
- B. Coordinate construction schedule and operations with Owner.
- C. Coordinate construction schedule and operations with Architect.

1.8 SPECIFICATION SECTIONS APPLICABLE TO EVERY CONTRACT

- A. Unless otherwise noted, provisions of the sections listed below apply to every contract. Specific items of work listed under individual contract descriptions constitute exceptions.
- B. Section 01 2000 - Price and Payment Procedures.
- C. Section 01 2100 - Allowances.
- D. Section 01 2200 - Unit Prices.
- E. Section 01 2300 - Alternates.
- F. Section 01 2500 - Substitution Procedures.
- G. Section 01 3000 - Administrative Requirements.
- H. Section 01 3216 - Construction Progress Schedule.
- I. Section 01 4000 - Quality Requirements.
- J. Section 01 5000 - Temporary Facilities and Controls.
- K. Section 01 6000 - Product Requirements.
- L. Section 01 7000 - Execution and Closeout Requirements.
- M. Section 01 7800 - Closeout Submittals.

1.9 CONTRACT NO. ____ - GENERAL CONSTRUCTION

- A. Division 01 - General Requirements:
 - 1. Specification sections listed above.
- B. Provide all Work except Work specifically assigned to other contractors in this Section.
- C. Provide Work specified in Volume ____ of the Project Manual.
- D. Drawings _____.

- 1.10 CONTRACT NO. ____ - MASONRY
- A. Specification sections listed above as applicable to every contract.
 - B. Perform Work specified in Volume ____ of the project manual.
 - C. Division 04 - Masonry.
 - D. Drawings _____.
- 1.11 CONTRACT NO. ____ - FOODSERVICE EQUIPMENT
- A. Specification sections listed above as applicable to every contract.
 - B. Perform Work specified in Volume ____ of the project manual.
 - C. Section 11 4000 - Foodservice Equipment: Foodservice equipment.
 - D. Drawings _____.
- 1.12 CONTRACT NO. ____ - FIRE PROTECTION
- A. Specification sections listed above as applicable to every contract.
 - B. Perform Work specified in Volume ____ of the project manual.
 - C. Division 07 - Thermal and Moisture Protection:
 - 1. Section 07 8400 - Firestopping: Firestopping of piping penetrations.
 - D. Division 21 - Fire Suppression:
 - E. Drawings _____.
- 1.13 CONTRACT NO. ____ - PLUMBING
- A. Specification sections listed above as applicable to every contract.
 - B. Perform Work specified in Volume ____ of the project manual.
 - C. Division 22 - Plumbing:
 - 1. Section ____ - ____: Basic materials and methods.
 - 2. Section ____ - ____: Plumbing systems.
 - 3. Section ____ - ____: Plumbing fixtures.
 - D. Division 33 - Utilities:
- 1.14 CONTRACT NO. ____ - HEATING, VENTILATING, AND AIR CONDITIONING
- A. Specification sections listed above as applicable to every contract.
 - B. Division 23 - Heating, Ventilating, and Air Conditioning:
 - 1. Section ____ - ____: Basic materials and methods.

2. Section _____ - _____ : Noise and vibration control.
3. Section _____ - _____ : Insulation.
4. Section _____ - _____ : Air distribution.
5. Section _____ - _____ : Controls and instrumentation.

1.15 CONTRACT NO. _____ - ELECTRICAL

- A. Specification sections listed above as applicable to every contract.
- B. Division 26 - Electrical: Every section included in Project Manual.
- C. Division 33 - Utilities:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 1000

SECTION 01 2000 - PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.2 RELATED REQUIREMENTS

- A. Section 01 2100 - Allowances: Payment procedures relating to allowances.
- B. Section 01 2200 - Unit Prices: Monetary values of unit prices; Payment and modification procedures relating to unit prices.
- C. Section 01 7800 - Closeout Submittals: Project record documents.

1.3 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: AIA G703, edition stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.
- E. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the specification section. Identify site mobilization.
- F. Include in each line item, the amount of Allowances specified in this section. For unit cost Allowances, identify quantities taken from Contract Documents multiplied by the unit cost to achieve the total for the item.
- G. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- H. Revise schedule to list approved Change Orders, with each Application For Payment.

1.4 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Use Form AIA G702 and Form AIA G703, edition stipulated in the Agreement.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. Execute certification by signature of authorized officer.
- F. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
- H. Submit one electronic copy of each Application for Payment.
- I. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 01 3000.
 - 2. Construction progress schedule, revised and current as specified in Section 01 3000.
 - 3. Partial release of liens from major subcontractors and vendors.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question.

1.5 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation. Document any requested substitutions in accordance with Section 01 6000.
- C. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 - 1. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.
 - 2. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
 - 3. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- D. Substantiation of Costs: Provide full information required for evaluation.
 - 1. Provide the following data:
 - a. Quantities of products, labor, and equipment.

- b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 - 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 - 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- E. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
- F. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- G. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- H. Promptly enter changes in Project Record Documents.
- 1.6 APPLICATION FOR FINAL PAYMENT
- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
 - B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 7000.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2000

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.2 RELATED REQUIREMENTS

- A. Section 00 2113 - Instructions to Bidders: Restrictions on timing of substitution requests.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures, coordination.
- C. Section 01 6000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.3 DEFINITIONS

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 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. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
 - 2) Owner's, Architect's, and Contractor's names.
 - b. Substitution Request Information:
 - 1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
 - 2) Indication of whether the substitution is for cause or convenience.
 - 3) Issue date.
 - 4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 5) Description of Substitution.
 - 6) Reason why the specified item cannot be provided.
 - 7) Differences between proposed substitution and specified item.
 - 8) Description of how proposed substitution affects other parts of work.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Sustainable design features.
 - 6) Warranties.
 - 7) Other salient features and requirements.
 - 8) Include, as appropriate or requested, the following types of documentation:
 - a) Product Data:
 - b) Samples.
 - c) Certificates, test, reports or similar qualification data.
 - d) Drawings, when required to show impact on adjacent construction elements.
 - d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- 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.

3.2 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.
 2. 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):
 1. Submit substitution requests by completing the form attached to section 00 3000. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.3 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 1. Submit substitution requests by completing the form attached to section 00 3000. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. Architect will consider requests for substitutions only within 15 days after date of Agreement.
- C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- D. Submit request for Substitution for Convenience within 14 days of 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.
 - b. Other construction by Owner.
 - c. Other unanticipated project considerations.
- E. 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. When acceptance will require revisions to Contract Documents.

3.4 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.

3.5 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.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

END OF SECTION 01 2500

SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General administrative requirements.
- B. Web-based project software service.
- C. Preconstruction meeting.
- D. Progress meetings.
- E. Construction progress schedule.
- F. Progress photographs.
- G. Coordination drawings.
- H. Submittals for review, information, and project closeout.
- I. Number of copies of submittals.
- J. Requests for Interpretation (RFI) procedures.
- K. Submittal procedures.

1.2 RELATED REQUIREMENTS

- A. Section 01 6000 - Product Requirements: General product requirements.
- B. Section 01 7000 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 7800 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.

1.3 REFERENCE STANDARDS

- A. AIA G716 - Request for Information; 2004.

1.4 GENERAL ADMINISTRATIVE REQUIREMENTS

- A. Comply with requirements of Section 01 7000 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- B. Make the following types of submittals to Architect:
 - 1. Requests for Interpretation (RFI).

2. Requests for substitution.
3. Shop drawings, product data, and samples.
4. Test and inspection reports.
5. Design data.
6. Manufacturer's instructions and field reports.
7. Applications for payment and change order requests.
8. Progress schedules.
9. Coordination drawings.
10. Correction Punch List and Final Correction Punch List for Substantial Completion.
11. Closeout submittals.

1.5 PROJECT COORDINATOR

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 1000 - Summary.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
 1. Requests for Interpretation.
 2. Requests for substitution.
 3. Shop drawings, product data, and samples.
 4. Test and inspection reports.
 5. Design data.
 6. Manufacturer's instructions and field reports.
 7. Applications for payment and change order requests.
 8. Progress schedules.
 9. Coordination drawings.
 10. Correction Punch List and Final Correction Punch List for Substantial Completion.
 11. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 WEB-BASED PROJECT SOFTWARE SERVICE

- A. Web-Based Project Software Service: Provide, administer, and use web-based project software to host and manage project communication and documentation.
1. Include, at minimum, the following features:
 - a. Project directory, including Owner, Contractor, subcontractors, Architect, Architect's consultants, and other entities involved in the project. Include names of contact persons and contact information for each entity.
 - b. Access control for each entity and for each workflow process to determine each entity's digital rights to create, modify, view, and print documents.
 - c. Workflow planning, allowing customization of workflow for each project entity.
 - d. Creation, logging, tracking, and notification for project communications.
 - e. Tracking of project communication statuses in real time, including timestamped response log.
 - f. Procedures for viewing PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creation and distribution of meeting minutes.
 - j. Document management for drawings, specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility.
 - m. Creation of data analytics reports.
 - n. Creation and export of editable logs for software functions. Provide Owner, Architect, and Architect's consultants with rights and ability to download logs when requested.
 - o. _____.
 2. Provide up to 20 user licenses for use by Owner, Architect, Architect's consultants, and other entities involved in the project.
 3. Comply with the software service's current published licensing agreements.
 4. Training: Provide one-hour, web-based training session for users of software service. Further training is the responsibility of the user.
 - a. Representatives of Owner are scheduled and included in this training.
 5. Project Closeout: Architect determines when to terminate the software service for the project and is responsible for obtaining archive copies of files for Owner.

3.2 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
1. Owner.

2. Architect.
3. Contractor.
4. _____.
5. _____.

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. Submission of initial Submittal schedule.
6. Designation of personnel representing the parties to Contract, _____ and Architect.
7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
8. Scheduling.

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

3.3 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the work at maximum bi-monthly intervals.

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

C. Project Coordinator will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

D. Attendance Required:

1. Contractor.
2. Owner.
3. Architect.
4. Contractor's superintendent.
5. Major subcontractors.

E. 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. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.

11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Other business relating to work.

- F. 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.

3.4 CONSTRUCTION PROGRESS SCHEDULE

- A. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- B. 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.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

3.5 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Photography Type: Digital; electronic files.
- C. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- D. In addition to periodic, recurring views, take photographs of each of the following events:
- E. Views:
1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Substantial Completion.
 2. Consult with Architect for instructions on views required.
 3. Provide factual presentation.
 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
- F. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.
1. Delivery Medium: Via email.
 2. File Naming: Include project identification, date and time of view, and view identification.
 3. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
 4. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.6 COORDINATION DRAWINGS

- A. Provide information required by Project Coordinator for preparation of coordination drawings.
- B. Review drawings prior to submission to Architect.

3.7 REQUESTS FOR INTERPRETATION (RFI)

- A. Definition: A request seeking one of the following:
 - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
 - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 - 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 - 2. Prepare in a format and with content acceptable to Owner.
 - a. Use AIA G716 - Request for Information .
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 - 1. 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).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (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.
 - 3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
 - 1. Official Project name and number, and any additional required identifiers established in Contract Documents.

2. Owner's, Architect's, and Contractor's names.
 3. Discrete and consecutive RFI number, and descriptive subject/title.
 4. Issue date, and requested reply date.
 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven 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.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. 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. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 3. 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.

3.8 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
1. Submit at the same time as the preliminary schedule specified in Section - 01 3216 - Construction Progress Schedule.
 2. Coordinate with Contractor's construction schedule and schedule of values.
 3. Format schedule to allow tracking of status of submittals throughout duration of construction.

4. 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.
5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

3.9 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.

3.10 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.

3.11 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.

3.12 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. Documents for Review:
1. Larger Sheets, Not Larger Than 36 by 48 inches (910 by 1220 mm): Submit the number of opaque reproductions that Contractor requires, plus one copy that will be retained by Architect.
- C. 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.

3.13 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. Transmit using approved form, found in section 00 3000.
 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 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.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 6. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Send submittals in electronic format via email to Architect.
 - b. Upload submittals in electronic form to Electronic Document Submittal Service website.
 7. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.

8. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
9. Provide space for Contractor and Architect review stamps.
10. When revised for resubmission, identify all changes made since previous submission.
11. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
12. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
13. Submittals not requested will not be recognized or processed.

B. Product Data Procedures:

1. Submit only information required by individual specification sections.
2. Collect required information into a single submittal.
3. Submit concurrently with related shop drawing submittal.
4. 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.

3.14 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", or language with same legal meaning.
 - b. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
 2. Not Authorizing fabrication, delivery, and installation:
- 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 3216 - CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.2 RELATED SECTIONS

- A. Section 01 1000 - Summary: Work sequence.

1.3 REFERENCE STANDARDS

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.

1.4 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- 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.
- D. Submit updated schedule with each Application for Payment.
- E. Submit in PDF format.

1.5 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one years minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1.6 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.2 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

END OF SECTION 01 3216

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittals.
- B. Quality assurance.
- C. References and standards.
- D. Testing and inspection agencies and services.
- E. Contractor's construction-related professional design services.
- F. Contractor's design-related professional design services.
- G. Control of installation.
- H. Mock-ups.
- I. Tolerances.
- J. Manufacturers' field services.
- K. Defect Assessment.

1.2 RELATED REQUIREMENTS

- A. Section 01 2100 - Allowances: Allowance for payment of testing services.
- B. Section 01 3000 - Administrative Requirements: Submittal procedures.
- C. Section 01 6000 - Product Requirements: Requirements for material and product quality.

1.3 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2025a.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.

- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2025a.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.
- H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.4 DEFINITIONS

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

1.5 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
 - 1. Temporary sheeting, shoring, or supports.
 - 2. Temporary scaffolding.
 - 3. Temporary bracing.
 - 4. Temporary foundation underpinning.
 - 5. Temporary stairs or steps required for construction access only.
 - 6. Investigation of soil conditions to support construction equipment.

1.6 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
 - 1. Submit a Request for Interpretation to Architect if the criteria indicated are not sufficient to perform required design services.

- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:

1.7 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for Owner's information.
 - 1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
 - 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 - 2. Include required product data and shop drawings.
 - 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 - 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- D. 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.
- E. 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.

- F. 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.
- G. 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.
- H. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for Owner.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
 - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
 - 1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
- B. 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.

1.9 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.

1.10 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ services of an independent testing agency to perform certain specified testing; payment for cost of services will be derived from allowance specified in Section 01 2100; see Section 01 2100 and applicable sections for description of services included in allowance.
- B. Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 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.

3.2 MOCK-UPS

- A. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings and specifications. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- B. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- C. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- D. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- E. 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.

3.3 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.

3.4 TESTING AND INSPECTION

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:

1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work 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.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

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

3.6 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 4533 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Code-required special inspections.
- B. Testing services incidental to special inspections.
- C. Submittals.
- D. Manufacturers' field services.
- E. Fabricators' field services.

1.2 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements.

1.3 ABBREVIATIONS AND ACRONYMS

- A. AHJ: Authority having jurisdiction.
- B. IAS: International Accreditation Service, Inc.
- C. NIST: National Institute of Standards and Technology.

1.4 DEFINITIONS

- A. Code or Building Code: ICC (IBC), International Building Code, Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements and specifically, Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
 - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
 - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

1.5 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).
- C. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2025b.
- D. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- E. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- F. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2025a.
- G. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- H. ASTM E605/E605M - Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 2019 (Reapproved 2023).
- I. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- K. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- L. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
- M. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. SDI QA/QC - Standard for Quality Control and Quality Assurance for Installation of Steel Deck; 2022.

1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
 - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.

- C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
 - 1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Testing Agency is acceptable to AHJ.
- D. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.
 - i. Results of special inspection.
 - j. Compliance with Contract Documents.
- E. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, 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.

1.7 SPECIAL INSPECTION AGENCY

- A. Owner will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
- C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.8 TESTING AND INSPECTION AGENCIES

- A. Owner may employ services of an independent testing agency to perform additional testing and sampling associated with special inspections but not required by the building code.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.9 QUALITY ASSURANCE

- A. Special Inspection Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
- B. Testing Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

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

3.2 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION

- A. Structural Steel: Comply with quality assurance inspection requirements of ICC (IBC).
- B. Cold-Formed Steel Deck: Comply with quality assurance inspection requirements of SDI QA/QC.
- C. High-Strength Bolt, Nut and Washer Material:
 - 1. Verify identification markings comply with ASTM standards specified in the approved contract and to AISC 360, Section A3.3; periodic.
 - 2. Submit manufacturer's certificates of compliance; periodic.
- D. High-Strength Bolting Installation: Verify items listed below comply with AISC 360, Section M2.5.
 - 1. Snug tight joints; periodic.
 - 2. Pretensioned and slip-critical joints with matchmarking, twist-off bolt or direct tension indicator method of installation; periodic.
 - 3. Pretensioned and slip-critical joints without matchmarking or calibrated wrench method of installation; continuous.
- E. Structural Steel and Cold Formed Steel Deck Material:
 - 1. Structural Steel: Verify identification markings comply with AISC 360, Section M3.5; periodic.

2. Other Steel: Verify identification markings comply with ASTM standards specified in the approved Contract Documents; periodic.
3. Submit manufacturer's certificates of compliance and test reports; periodic.

F. Weld Filler Material:

1. Verify identification markings comply with AWS standards specified in the approved Contract Documents and to AISC 360, Section A3.5; periodic.
2. Submit manufacturer's certificates of compliance; periodic.

G. Welding:

1. Structural Steel and Cold Formed Steel Deck:
 - a. Complete and Partial Joint Penetration Groove Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
 - b. Multipass Fillet Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
 - c. Single Pass Fillet Welds Less than 5/16 inch (7.94 mm) Wide: Verify compliance with AWS D1.1/D1.1M; periodic.
 - d. Plug and Slot Welds: Verify compliance with AWS D1.1/D1.1M; continuous.
 - e. Single Pass Fillet Welds 5/16 inch (7.94 mm) or Greater: Verify compliance with AWS D1.1/D1.1M; continuous.
 - f. Floor and Roof Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.
2. Reinforcing Steel: Verify items listed below comply with AWS D1.4/D1.4M and ACI CODE-318, Section 3.5.2.
 - a. Verification of weldability; periodic.
 - b. Reinforcing steel resisting flexural and axial forces in intermediate and special moment frames as well as where it is referenced in older codes. Elements of special structural walls of concrete and shear reinforcement; continuous.
 - c. Shear reinforcement; continuous.
 - d. Other reinforcing steel; periodic.

H. Steel Frame Joint Details: Verify compliance with approved Contract Documents.

1. Details, bracing and stiffening; periodic.
2. Member locations; periodic.
3. Application of joint details at each connection; periodic.

3.3 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION

- A. Reinforcement, Including Prestressing Tendons, and Verification of Placement: Verify compliance with ACI CODE-318, Chapters 20, 25.2, 25.3, 26.6.1-26.6.3; periodic.
- B. Reinforcing Steel, Including Prestressing of Tendons and Placement: Verify compliance with approved Contract Documents and ACI CODE-318, Sections 3.5 and 7.1 through 7.7; periodic.
- C. Reinforcing Bar Welding: Verify compliance with AWS D1.4/D1.4M and ACI CODE-318, 26.6.4; periodic.
 1. Verify weldability of reinforcing bars other than those complying with ASTM A706/A706M; periodic.
 2. Inspect single-pass fillet welds, maximum 5/16 inch; periodic.

3. Inspect all other welds; continuous.
- D. Reinforcing Steel Welding: Verify compliance with AWS D1.4/D1.4M and ACI CODE-318, Section 3.5.2; periodic.
- E. Anchors Cast in Concrete: Verify compliance with ACI CODE-318; periodic.
- F. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved Contract Documents and ACI CODE-318, Sections 8.1.3 and 21.2.8 prior to and during placement of concrete; continuous.
- G. Anchors Post-Installed in Hardened Concrete: Verify compliance with ACI CODE-318.
 1. Adhesive Anchors: Verify horizontally or upwardly-inclined orientation installations resisting sustained tension loads - Section 17.8.2.4; continuous.
 2. Other Mechanical and Adhesive Anchors: Verify as per Chapter 17.8.2; periodic.
- H. Anchors Installed in Hardened Concrete: Verify compliance with ACI CODE-318, Sections 3.8.6, 8.1.3, and 21.2.8; periodic.
- I. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI CODE-318, Chapter 19, 16.4.3, 26.4.4; periodic.
- J. Design Mix: Verify plastic concrete complies with the design mix in approved Contract Documents and with ACI CODE-318, Chapter 4 and 5.2; periodic.
- K. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M, and ACI CODE-318, Chapter 26.5, 26.12, and record the following, continuous:
 1. Slump.
 2. Air content.
 3. Temperature of concrete.
- L. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M, and ACI CODE-318, Sections 5.6 and 5.8 and record the following, continuous:
 1. Slump.
 2. Air content.
 3. Temperature of concrete.
- M. Concrete and Shotcrete Placement: Verify application techniques comply with approved Contract Documents and ACI CODE-318, Chapter 26.5; continuous.
- N. Concrete and Shotcrete Placement: Verify application techniques comply with approved Contract Documents and ACI CODE-318, Sections 5.9 and 5.10; continuous.
- O. Specified Curing Temperature and Techniques: Verify compliance with ACI CODE-318, Chapter 26.5.3 through 26.5.5; periodic.
- P. Specified Curing Temperature and Techniques: Verify compliance with approved Contract Documents and ACI CODE-318, Sections 5.11 through 5.13; periodic.

- Q. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents and ACI CODE-318, Chapter 26.11.2, for the following:
 - 1. Post-tensioned concrete, prior to stressing of tendons; periodic.
 - 2. Beams and structural slabs, prior to removal of shores and forms; periodic.
- R. Concrete Strength in Situ: Verify concrete strength complies with approved Contract Documents and ACI CODE-318, Section 6.2, for the following.
 - 1. Prestressed members, prior to stressing of tendons; periodic.
 - 2. Beams and structural slabs, prior to removal of shores and forms; periodic.
- S. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI CODE-318, Chapter 26.11.1.2(b); periodic.
- T. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI CODE-318, Section 6.1.1; periodic.
- U. Welding of Reinforcing Bars: Conduct special inspections and verify Special Inspector's qualifications in accordance with requirements of AWS D1.4/D1.4M.
- V. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials comply with the quality standards of ACI CODE-318, the AHJ will require testing of materials in accordance with the appropriate standards and criteria in ACI CODE-318, Chapters 19 and 20.
- W. Materials: If the Contractor cannot provide sufficient data or documentary evidence that concrete materials comply with the quality standards of ACI CODE-318, the AHJ will require that the Special Inspector verify compliance with the appropriate standards and criteria in , Chapter 3.

3.4 SPECIAL INSPECTIONS FOR SOILS

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
 - 1. Design bearing capacity of material below shallow foundations; periodic.
 - 2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
 - 3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
 - 4. Subgrade, prior to placement of compacted fill verify proper preparation; periodic.
- B. Testing: Classify and test excavated material; periodic.

3.5 SPECIAL INSPECTIONS FOR SPRAYED FIRE RESISTANT MATERIALS

- A. Sprayed Fire Resistant Materials, General:
 - 1. Verify compliance of sprayed-fire resistant materials with specific fire-rated assemblies indicated in approved Contract Documents, and with applicable requirements of the building code.
 - 2. Perform special inspections after rough installation of electrical, mechanical, plumbing, automatic fire sprinkler and suspension systems for ceilings.

- B. Physical and visual tests: Verify compliance with fire resistance rating.
 - 1. Condition of substrates; periodic.
 - 2. Thickness of sprayed fire resistant material; periodic.
 - 3. Density of sprayed fire resistant material in pounds per cubic foot (kg per sq m); periodic.
 - 4. Bond strength (adhesion and cohesion); periodic.
 - 5. Condition of finished application; periodic.
- C. Structural member surface conditions:
 - 1. Inspect structural member surfaces before application of sprayed fire resistant materials; periodic.
 - 2. Verify preparation of structural member surfaces complies with approved Contract Documents and manufacturer's written instructions; periodic.
- D. Application:
 - 1. Ensure minimum ambient temperature before and after application complies with the manufacturer's written instructions; periodic.
 - 2. Verify area where sprayed fire resistant material is applied is ventilated as required by the manufacturer's written instructions during and after application; periodic.
- E. Thickness: Verify that no more than 10 percent of thickness measurements taken from sprayed fire resistant material are less than thickness required by fire resistance design in approved Contract Documents. In no case shall the thickness of the sprayed fire resistant material be less than the minimum below.
 - 1. Minimum Allowable Thickness: Tested according to ASTM E605/E605M, periodic.
 - 2. Floor, Roof and Wall Assemblies: Test thickness according to ASTM E605/E605M with no less than four measurements per 1,000 square feet (93 sq m) of sprayed area on each story of the structure or portion thereof; periodic.
 - 3. Structural Members: Test according to ASTM E605/E605M. Test no less than 25 percent of structural members on each story of the structure or portion thereof; periodic.
- F. Density: Verify density of sprayed fire resistant material is no less than density required by the fire resistance design in the approved Contract Documents.
- G. Bond Strength: Verify adhesive and cohesive bond strength of sprayed fire resistant materials is no less than 150 pounds per square foot (7.18 kPa) when in-place samples of the cured material are tested according to ASTM E736/E736M and as described below.

3.6 SPECIAL INSPECTIONS FOR WIND RESISTANCE

- A. Wind Resisting Components:
 - 1. Roof covering, roof deck, and floor framing connections; periodic.
 - 2. Exterior wall covering and wall connections to roof and floor diaphragms and framing; periodic.
- B. Structural Observations for Wind Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

3.7 STRUCTURAL OBSERVATIONS FOR STRUCTURES

- A. Provide Observations: For structure where one or more of the following conditions exist:
 - 1. The structure is classified as Risk Category IV.

3.8 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

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

3.9 TESTING AGENCY DUTIES AND RESPONSIBILITIES

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the work.

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

3.10 CONTRACTOR DUTIES AND RESPONSIBILITIES

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

3.11 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES

- A. When specified in individual specification sections, require material suppliers, assembly fabricators, or product manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION 01 4533

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Security requirements.
- E. Vehicular access and parking.
- F. Waste removal facilities and services.
- G. Project identification sign.
- H. Field offices.

1.2 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.

1.3 TEMPORARY UTILITIES - SEE SECTION 01 5100

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. New permanent facilities may be used.

1.4 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - 2. Internet Connections: Minimum of one; Cable modem or faster.

1.5 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. New permanent facilities located at Vibra may not be used during construction operations.
- C. Maintain daily in clean and sanitary condition.
- D. At end of construction, return facilities to same or better condition as originally found.

1.6 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 and to protect existing facilities and adjacent properties from damage from construction operations.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way.
- C. Provide protection for plants designated to remain. Replace damaged plants.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.7 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.

1.8 INTERIOR ENCLOSURES

- A. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:
 - 1. Maximum flame spread rating of 75 in accordance with ASTM E84.
- B. Paint surfaces exposed to view from Owner-occupied areas.

1.9 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.

1.10 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.

1.11 PROJECT IDENTIFICATION

- A. Provide project identification sign of design and construction indicated on drawings.
- B. Provide project identification sign of design, construction, and location approved by Owner.

1.12 FIELD OFFICES

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

1.13 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.
- D. Restore existing facilities used during construction to original condition.
- E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 5000

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Lists of products to be removed from existing building.
- B. Section 01 1000 - Summary: Identification of Owner-supplied products.
- C. Section 01 2500 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- D. Section 01 4000 - Quality Requirements: Product quality monitoring.

1.3 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.

PART 2 PRODUCTS

2.1 EXISTING PRODUCTS

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

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

2.2 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
- B. See Section 01 4000 - Quality Requirements, for additional source quality control requirements.

2.3 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.

2.4 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

3.1 SUBSTITUTION LIMITATIONS

- A. See Section 01 2500 - Substitution Procedures.

3.2 OWNER-SUPPLIED PRODUCTS

- A. See Section 01 1000 - Summary for identification of Owner-supplied products.
- B. 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.
- C. 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.

3.3 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.

3.4 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.
 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Store and protect products in accordance with manufacturers' instructions.
- D. Store with seals and labels intact and legible.
- E. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.
- F. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.

- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. 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 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Pre-installation meetings.
- C. Cutting and patching.
- 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.

1.2 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures, Electronic document submittal service.
- C. Section 01 4000 - Quality Requirements: Testing and inspection procedures.
- D. Section 01 5000 - Temporary Facilities and Controls: Temporary interior partitions.
- E. Section 01 7800 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- F. Section 01 7900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

1.3 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.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.

- 2. Integrity of weather exposed or moisture resistant element.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.4 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.
- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
 - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
 - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. 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.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers.
 - 2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
 - 3. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.
- I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.

1.5 COORDINATION

- A. See Section 01 1000 for occupancy-related requirements.

- B. 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.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.1 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 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.

3.2 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.

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

3.4 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Control datum for survey is that indicated on drawings.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.

- H. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- I. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
 - 4. Controlling lines and levels required for mechanical and electrical trades.
- J. Periodically verify layouts by same means.
- K. Maintain a complete and accurate log of control and survey work as it progresses.

3.5 GENERAL INSTALLATION REQUIREMENTS

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. 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.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

3.6 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
 - 2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.

1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
 2. Remove items indicated on drawings.
 3. Relocate items indicated on drawings.
 4. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 5. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, Telecommunications, and _____): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 4. Verify that abandoned services serve only abandoned facilities.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.

3. Where a change of plane of 1/4 inch (6 mm) or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
 4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

3.7 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
1. Complete the work.
 2. Fit products together to integrate with other work.
 3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- I. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.8 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.

3.9 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. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Prohibit traffic from landscaped areas.
- H. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 7900 - Demonstration and Training.

3.11 ADJUSTING

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

3.12 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
 - 1. Clean areas to be occupied by Owner prior to final completion before Owner occupancy.
- 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, gutters, 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.

3.13 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 - 1. Provide copies to Architect.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

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

3.14 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.

END OF SECTION 01 7000

SECTION 01 7800 - CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Materials transparency manual.
- D. Warranties and bonds.

1.2 RELATED REQUIREMENTS

- A. Section 00 7200 - General Conditions and 00 7300 - Supplementary Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 3000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 7000 - Execution and Closeout Requirements: Contract closeout procedures.

1.3 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 3 EXECUTION

2.1 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:
- F. Record 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.

2.2 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.

2.3 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. 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.

2.4 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. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. 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.
- E. 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.
 - 1. Include HVAC outdoor and exhaust air damper calibration strategy.
 - a. Include provisions which ensure that full closure of dampers can be achieved.
 - 2. Include Carbon Dioxide Monitoring Protocol.
 - 3. Include Carbon Monoxide Monitoring Protocol.
 - 4. Include Frost Mitigation Strategy for ventilation heat-recovery system.
- 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.

2.5 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. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- I. 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. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.

2.6 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. Include originals of each in operation and maintenance manuals, indexed separately on Table of Contents.
- C. Manual: Bind in commercial quality 8-1/2 by 11 inch (216 by 279 mm) three D side ring binders with durable plastic covers.
- D. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.

- E. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- F. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION 01 7800

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Conveying systems.
 - 6. Landscape irrigation.
 - 7. 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.

1.2 RELATED REQUIREMENTS

- A. Section 01 7800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
 - 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.
- D. Training Reports:
- 1. Identification of each training session, date, time, and duration.
 - 2. Sign-in sheet showing names and job titles of attendees.
 - 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

1.4 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

3.1 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
- 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

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

3.2 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- D. Provide training in minimum two hour segments.
- E. 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.
- F. 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.
- G. 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.
- H. 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 1000 - CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3000 - Cast-in-Place Concrete.
- C. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors and plates in cast-in-place concrete.
- D. Section 05 3100 - Steel Decking: Placement of steel anchors in composite decking.

1.3 REFERENCE STANDARDS

- A. ACI SPEC-117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- C. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- F. COE CRD-C 572 - Handbook for Concrete and Cement Corps of Engineers Specifications for Polyvinylchloride Waterstop; 1974.

PART 2 PRODUCTS

2.1 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct concrete that complies with design with respect to shape, lines, and dimensions.
- C. Chamfer outside corners of beams, joists, columns, and walls.
- D. Comply with applicable state and local codes with respect to design, fabrication, erection, and removal of formwork.

2.2 WOOD FORM MATERIALS

- A. Form Materials: At the discretion of the Contractor.

2.3 REMOVABLE PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gauge, 0.0598 inch (1.52 mm) thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Preformed Aluminum Forms: ASTM B221 (ASTM B221M), 6061-T6 alloy, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 2 inches (50 mm) thick.

2.4 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch (25 mm) in concrete surface.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
- C. Filler Strips for Chamfered Corners: Rigid plastic type; 3/4 x 3/4 inch minimum (____ x ____ mm) size; maximum possible lengths.
- D. Dovetail Anchor Slot: Galvanized steel, at least 22 gauge, 0.0299 inch (0.76 mm) thick, foam filled, release tape sealed slots, anchors for securing to concrete formwork.
- E. Flashing Reglets: Galvanized steel, at least 22 gauge, 0.0299 inch (0.76 mm) thick, longest possible lengths, with alignment splines for joints, foam filled, release tape sealed slots, anchors for securing to concrete formwork.

- F. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.
- G. Embedded Anchor Shapes, Plates, Angles and Bars: As specified in other Sections.
- H. Waterstops: PVC, complying with COE CRD-C 572.
 - 1. Configuration: Ribbed with center bulb, unless otherwise noted.
 - 2. Size: 6 inches by 3/8 inch thick, nontapered, unless otherwise noted.
- I. Waterstops: Bentonite and butyl rubber.
 - 1. Configuration: Rectangular or trapezoidal strip with adhesive bonding to concrete, unless otherwise noted.
 - 2. Size: 3/4 inch by 1 inch, unless otherwise noted.

PART 3 EXECUTION

3.1 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI SPEC-301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.
- E. Obtain approval before framing openings in structural members that are not indicated on drawings.
- F. Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing.
- G. Coordinate this section with other sections of work that require attachment of components to formwork.

3.2 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.
- B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
- C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.3 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Position recessed anchor slots for brick veneer masonry anchors to spacing and intervals specified in Division 0404 2613.
- E. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- F. Install waterstops in accordance with manufacturer's instructions, so they are continuous without displacing reinforcement.
- G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.4 FORM CLEANING

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

3.5 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI SPEC-117, unless otherwise indicated.
- B. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.
- C. Camber slabs and beams in accordance with ACI SPEC-301.

3.6 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and to verify that supports, fastenings, wedges, ties, and items are secure.

3.7 FORM REMOVAL

- A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- C. Store removed forms to prevent damage to form materials or to fresh concrete. Discard damaged forms.

END OF SECTION 03 1000

SECTION 03 2000 - CONCRETE REINFORCING

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories.
- B. Section 03 3000 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- A. ACI MNL-66 - ACI Detailing Manual; 2020.
- B. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2024.
- D. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2024.
- E. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
- F. CRSI (DA4) - Manual of Standard Practice; 2024.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI MNL-66 Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1.5 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.4/D1.4M and no more than 12 months before start of scheduled welding work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) (420 MPa).
 - 1. Deformed billet-steel bars.
- B. Steel Welded Wire Reinforcement (WWR): Plain type; ASTM A1064/A1064M.
 - 1. Form: Flat Sheets.
- C. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch (1.29 mm).
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.2 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is not permitted.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.1 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position.
- B. Do not displace or damage vapor barrier.
- C. Accommodate placement of formed openings.
- D. Comply with applicable code for concrete cover over reinforcement.

3.2 FIELD QUALITY CONTROL

- A. An independent testing agency, as specified in Section 01 4000 - Quality Requirements, will inspect installed reinforcement for compliance with contract documents before concrete placement.

END OF SECTION 03 2000

SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete for composite floor construction.
- B. Floors and slabs on grade.
- C. Concrete shear walls, elevator shaft walls, and foundation walls.
- D. Concrete foundations and anchor bolts for pre-engineered building.
- E. Joint devices associated with concrete work.
- F. Concrete curing.

1.2 RELATED REQUIREMENTS

- A. Section 03 1000 - Concrete Forming and Accessories: Forms and accessories for formwork.
- B. Section 03 2000 - Concrete Reinforcing.
- C. Section 07 9200 - Joint Sealants: Products and installation for sealants and joint fillers for saw cut joints and isolation joints in slabs.

1.3 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- C. ACI PRC-302.1 - Guide to Concrete Floor and Slab Construction; 2015.
- D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- E. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- F. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- G. ACI PRC-308 - Guide to External Curing of Concrete; 2016.
- H. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2024a.

- J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2024.
- K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2025.
- L. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- M. ASTM C150/C150M - Standard Specification for Portland Cement; 2024.
- N. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
- O. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2024a.
- P. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2024.
- Q. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- R. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2024.
- S. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2025a.
- T. ASTM C685/C685M - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing; 2024.
- U. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2020a.
- V. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2024.
- W. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- X. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.
- Y. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- Z. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.
- AA. 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; 2024.
- BB. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
- CC. NSF 61 - Drinking Water System Components - Health Effects; 2024.

DD. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
- D. Test Reports: Submit report for each test or series of tests specified.

1.5 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
- B. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- C. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.1 FORMWORK

- A. Comply with requirements of Section 03 1000.

2.2 REINFORCEMENT MATERIALS

- A. Comply with requirements of Section 03 2000.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type II - Moderate Portland type.
 - 1. Acquire cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
 - 1. Acquire aggregates for entire project from same source.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.4 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.

- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- E. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- F. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- G. Accelerating Admixture: ASTM C494/C494M Type C.
- H. Retarding Admixture: ASTM C494/C494M Type B.
- I. Water Reducing Admixture: ASTM C494/C494M Type A.

2.5 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 - 1. Sheet Material: ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs, not less than 10 mils thick unless other. Single-ply polyethylene is prohibited.
 - 2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.

2.6 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
- B. Epoxy Bonding System:
 - 1. Complying with ASTM C881/C881M and of Type required for specific application.
- C. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
 - 1. Configuration: As indicated on drawings.
- D. Slab Isolation Joint Filler: 1/2-inch (13 mm) thick, height equal to slab thickness, with removable top section forming 1/2-inch (13 mm) deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
- E. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with rectangular or round knockout holes for conduit or rebar to pass through joint form at 6 inches (150 mm) on center; ribbed steel stakes for setting.

2.7 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.

- B. Curing Compound, Naturally Dissipating: Clear, water-based, liquid membrane-forming compound; complying with ASTM C309.
- C. Curing and Sealing Compound, Moisture Emission-Reducing, Membrane-Forming: Clear, liquid sealer for application to newly-placed concrete; capable of providing adequate bond for flooring adhesives, initially and over the long term; with sufficient moisture vapor impermeability to prevent deterioration of flooring adhesives due to moisture emission.
 - 1. Use this product to cure and seal all slabs to receive adhesively applied flooring or roofing.
 - 2. Comply with ASTM C309 and ASTM C1315 Type I Class A.
 - 3. VOC Content: Less than 100 g/L.
- D. Moisture-Retaining Sheet: ASTM C171.
 - 1. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard (1.71 kg/sq m).
- E. Water: Potable, not detrimental to concrete.

2.8 CONCRETE MIX DESIGN

- A. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended or required by manufacturer.
- B. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated on drawings.
 - 2. Fly Ash Content: Maximum 15 percent of cementitious materials by weight.
 - 3. Water-Cement Ratio: Maximum 50 percent by weight.
 - 4. Total Air Content: 6 percent, determined in accordance with ASTM C173/C173M.
 - a. Do not use air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 - 5. Maximum Slump: 4 inches (100 mm), plus or minus 1 inch.
 - 6. Maximum Aggregate Size: 3/4 inch (19 mm).

2.9 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.
- C. Adding Water: If concrete arrives on-site with slump less than suitable for placement, do not add water that exceeds the maximum water-cement ratio or exceeds the maximum permissible slump.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
 - 1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.
 - 2. Use latex bonding agent only for non-load-bearing applications.
- D. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches (150 mm). Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.

3.3 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
- B. Place concrete for floor slabs in accordance with ACI PRC-302.1.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- E. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- F. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.
- G. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.4 SLAB JOINTING

- A. Locate joints as indicated on drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch (5 mm) thick blade and cut at least 1 inch (25 mm) deep but not less than one quarter (1/4) the depth of the slab.

- E. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.

3.5 FLOOR FLATNESS AND LEVELNESS TOLERANCES

- A. An independent testing agency, as specified in Section 01 4000, will inspect finished slabs for compliance with specified tolerances.
- B. Maximum Variation of Surface Flatness:
 - 1. Exposed Concrete Floors: 1/4 inch (6 mm) in 10 feet (3 m).
 - 2. Under Seamless Resilient Flooring: 1/4 inch (6 mm) in 10 feet (3 m).
 - 3. Under Carpeting: 1/4 inch (6 mm) in 10 feet (3 m).
- C. Correct the slab surface if tolerances are less than specified.
- D. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.6 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch (6 mm) or more in height. Provide finish as follows:
 - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.
- D. Concrete Slabs: Finish to requirements of ACI PRC-302.1 and as follows:
 - 1. Surfaces to Receive Thick Floor Coverings: "Wood float" as described in ACI PRC-302.1; thick floor coverings include quarry tile, ceramic tile, and Portland cement terrazzo with full bed setting system.
 - 2. Surfaces to Receive Thin Floor Coverings: "Steel trowel" as described in ACI PRC-302.1; thin floor coverings include carpeting, resilient flooring, seamless flooring, resinous matrix terrazzo, thin set quarry tile, and thin set ceramic tile.
 - 3. Other Surfaces to Be Left Exposed: Trowel as described in ACI PRC-302.1, minimizing burnish marks and other appearance defects.

3.7 CURING AND PROTECTION

- A. Comply with requirements of ACI PRC-308. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:

1. Slabs and Floors To Receive Adhesive-Applied Flooring: Curing compounds and other surface coatings are usually considered unacceptable by flooring and adhesive manufacturers. If such materials must be used, either obtain the approval of the flooring and adhesive manufacturers prior to use or remove the surface coating after curing to flooring manufacturer's satisfaction.
2. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
3. Final Curing: Begin after initial curing but before surface is dry.
 - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches (75 mm) and seal with waterproof tape or adhesive; secure at edges.
 - b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

3.8 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards (76 cu m) or less of each class of concrete placed.
- D. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- E. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.9 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

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

END OF SECTION 03 3000

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members.
- B. Base plates, shear stud connectors.
- C. Grouting under base plates.

1.2 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking: Support framing for small openings in deck.
- B. Section 05 5000 - Metal Fabrications: Steel fabrications affecting structural steel work.
- C. Section 07 8100 - Applied Fire Protection: Fireproof protection to framing and metal deck systems.

1.3 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; 2023, with Errata (2025).
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges; 2022, with Errata (2025).
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- E. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2024.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- I. ASTM A563/A563M - Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric); 2021a.
- J. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2022.

- K. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions; 2024.
- L. ASTM F959/F959M - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series; 2017a.
- M. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength; 2020.
- N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- O. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- Q. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
- R. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.
- S. SSPC-SP 3 - Power Tool Cleaning; 2024.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
 - 3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

1.5 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172 or that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU.
- D. Design connections not detailed on drawings 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

2.1 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade C.
- D. Pipe: ASTM A53/A53M, Grade B, Finish black.
- E. Shear Stud Connectors: Made from ASTM A108 Grade 1015 bars.
- F. Structural Bolts and Nuts: Carbon steel, ASTM A307, Grade A and galvanized in compliance with ASTM A153/A153M Class C.
- G. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563/A563M nuts and ASTM F436/F436M washers.
- H. Tension Control Bolts: Twist-off type; ASTM F3125/F3125M.
- I. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563/A563M nuts and ASTM F436/F436M Type 1 washers.
- J. Headed Anchor Rods: ASTM F1554 Grade 36, plain.
- K. Load Indicator Washers: Provide washers complying with ASTM F959/F959M at connections requiring high-strength bolts.
- L. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- M. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch (13.7 MPa).
 - 2. Minimum Compressive Strength at 28 Days: 5,000 pounds per square inch (9.8 MPa).
- N. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- O. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Develop required camber for members.

2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
 - 1. Galvanize structural steel members, exposed to exterior conditions and as indicated, to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating. (Provide minimum 530 g/sq m galvanized coating.)

2.4 SOURCE QUALITY CONTROL

- A. Provide shop testing and analysis of structural steel.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components and shear studs indicated on shop drawings.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.3 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

END OF SECTION 05 1200

SECTION 05 3100 - STEEL DECKING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof deck.
- B. Composite floor deck.
- C. Metal form deck.
- D. Supplementary framing for openings up to and including 18 inches (450 mm).
- E. Bearing plates and angles.
- F. Stud shear connectors.

1.2 RELATED REQUIREMENTS

- A. Section 03 2000 - Concrete Reinforcing.
- B. Section 03 3000 - Cast-in-Place Concrete: Concrete topping over metal deck.
- C. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches (450 mm) and shear stud connectors.
- D. Section 05 1200 - Structural Steel Framing: Placement of embedded steel anchors for bearing plates in cast-in-place concrete.
- E. Section 05 5000 - Metal Fabrications: Steel angle concrete stops at deck edges.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished; 2024.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- D. 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; 2024.
- E. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- F. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).

- G. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
- H. ICC-ES AC70 - Acceptance Criteria for Power-Actuated Fasteners Driven into Concrete, Steel and Masonry Elements; 2019, with Editorial Revision (2021).
- I. SDI (DM) - Publication No.30, Design Manual for Composite Decks, Form Decks, and Roof Decks; 2007.
- 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.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- C. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.

1.5 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints 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. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by the International Accreditation Service (IAS) Fabricator Inspection Program for Structural Steel in accordance with IAS AC172.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Cut plastic wrap to encourage ventilation.
- B. Separate sheets and store deck on dry wood sleepers; slope for positive drainage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Steel Deck:
 1. Canam Steel Corporation: www.canam-steeljoists.ws.
 2. New Millennium Building Systems: www.newmill.com/#sle.

3. Nucor-Vulcraft Group: www.vulcraft.com/#sle.

2.2 STEEL DECK

- A. All Deck Types: Select and design metal deck in accordance with SDI Design Manual.
 1. Calculate to structural working stress design and structural properties specified.
 2. Maximum Vertical Deflection of Floor Deck: 1/360 of span.
 3. Maximum Vertical Deflection of Form Deck: 1/360 of span.
- B. Roof Deck: Non-composite type, fluted steel sheet:
 1. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS.
 - a. Grade as required to meet performance criteria.
 2. Primer: Shop coat of manufacturer's standard primer paint over cleaned and phosphatized substrate.
 3. Deck profile, depth, and uncoated-steel thickness as indicated on drawings.
 4. Span Design: Triple span or more.
- C. Composite Floor Deck: Fluted steel sheet embossed to interlock with concrete:
 1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS), with G90/Z275 galvanized coating.
 - a. Grade as required to meet performance criteria.
 2. Deck profile, depth, and uncoated-steel thickness as indicated on drawings.
 3. Span Design: Triple span or more.
- D. Metal Form Deck: Corrugated sheet steel, with provision for ventilation of concrete:
 1. Ungalvanized Steel Sheet: ASTM A1008/A1008M, Designation SS.
 - a. Grade as required to meet performance criteria.
 2. Deck profile, depth, and uncoated-steel thickness as indicated on drawings.

2.3 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
- B. Stud Shear Connectors: Made from ASTM A108 Grade 1015 bars.
- C. Welding Materials: AWS D1.1/D1.1M.
- D. Fasteners: Galvanized hardened steel, self tapping.
- E. Powder Actuated Mechanical Fasteners: Steel; with knurled shank and forged ballistic point. Comply with applicable requirements of ICC-ES AC70.
- F. Weld Washers: Mild steel, uncoated, 3/4 inch (19 mm) outside diameter, 1/8 inch (3 mm) thick.
- G. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- H. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- I. Flute Closures: Closed cell foam rubber, 1 inch (25 mm) thick; profiled to fit tight to the deck.

2.4 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gauge, 0.0299 inch (0.76 mm) thick sheet steel; of profile and size as indicated; finished same as deck.
- B. Roof Sump Pans: Formed sheet steel, 14 gauge, 0.0747 inch (1.90 mm) minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches (38 mm) below roof deck surface, bearing flange 3 inches (75 mm) wide, sealed watertight.
- C. Floor Drain Pans: Formed sheet steel, 14 gauge, 0.0747 inch (1.90 mm) minimum thickness, flat bottom, sloped sides, recessed 1-1/2 inches (38 mm) below floor deck surface, bearing flange 3 inches (75 mm) wide, sealed watertight.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.2 INSTALLATION

- A. Erect metal deck in accordance with SDI Design Manual and manufacturer's instructions. Align and level.
- B. On concrete surfaces provide minimum 4 inch (100 mm) bearing.
- C. On steel supports provide minimum 1-1/2 inch (38 mm) bearing.
- D. Fasten deck to steel support members at ends and intermediate supports and parallel with the deck flute and at each transverse flute using methods indicated on drawings.
 - 1. Welding: Use fusion welds through weld washers.
- E. Weld deck in accordance with AWS D1.3/D1.3M.
- F. At deck openings from 6 inches (150 mm) to 18 inches (450 mm) in size, provide 2 by 2 by 1/4 inch (50 by 50 by 6 mm) steel angle reinforcement. Place angles perpendicular to flutes; extend minimum two flutes beyond each side of opening and fusion weld to deck at each flute.
- G. At deck openings greater than 18 inches (450 mm) in size, provide steel angle reinforcement. as specified in Section 05 1200.
- H. At floor edges, install concrete stops upturned to top surface of slab, to contain wet concrete. Provide stops of sufficient strength to remain stationary without distortion.
- I. At openings between deck and walls, columns, and openings, provide sheet steel closures and angle flashings to close openings.
- J. Close openings above walls and partitions perpendicular to deck flutes with single row of foam cell closures.

- K. Position roof drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- L. Position floor drain pans with flange bearing on top surface of deck. Fusion weld at each deck flute.
- M. Weld stud shear connectors through steel deck to structural members below.
- N. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.

END OF SECTION 05 3100

SECTION 05 4000 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Formed steel stud load bearing exterior wall framing.
- B. Exterior wall sheathing.
- C. Water-resistive barrier over sheathing.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking and miscellaneous framing.
- B. Section 07 2100 - Thermal Insulation: Insulation within framing members.
- C. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 09 2116 - Gypsum Board Assemblies: Cold-formed steel nonstructural framing.
- E. Section 09 2216 - Non-Structural Metal Framing.

1.3 REFERENCE STANDARDS

- A. AISI S100 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2016, with Supplement (2020).
- B. AISI S240 - North American Standard for Cold-Formed Steel Structural Framing; 2015, with Errata (2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- F. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- G. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).
- H. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2024.

- I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- J. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- K. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- L. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; 2016, with Editorial Revision (2021).
- M. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- N. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on cold-formed steel structural members; include material descriptions and base steel thickness.
- C. Product Data: Provide manufacturer's data on factory-made connectors and mechanical fasteners, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
- E. Steel Framing Industry Association (SFIA) Certification:
 - 1. Submit current documentation of contractor accreditation and installer certification. Keep copies of each on-site during and after installation, and present upon request.
- F. Design Data:
 - 1. Shop drawings signed and sealed by a professional structural engineer.
 - 2. Design calculations sufficient to demonstrate compliance with design criteria; signed and sealed by a professional structural engineer.
- G. Installation Drawings: Indicate dimensioned locations of cold-formed steel structural framing.
 - 1. Include materials.
- H. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before the start of scheduled welding work.

1.5 QUALITY ASSURANCE

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Designer Qualifications: Design framing system under direct supervision of a professional structural engineer experienced in designing this work and licensed in the State in which the Project is located.

- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M and dated no more than 12 months before start of scheduled welding work.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Structural Framing:
 - 1. CEMCO; _____: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich; _____: www.clarkdietrich.com/#sle.
 - 3. SCAFCO Corporation; _____: www.scafco.com/#sle.
 - 4. Steel Construction Systems; _____: www.steelconsystems.com/#sle.
 - 5. The Steel Network, Inc; _____: www.SteelNetwork.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Connectors:
 - 1. Same manufacturer as metal framing.

2.2 PERFORMANCE REQUIREMENTS

- A. Comply with requirements for Contractor's design-related professional design services indicated in Section 01 4000 - Quality Requirements.
- B. Design Requirements: Design cold-formed framing systems, components and connectors to withstand specified design loads in compliance with ICC (IBC), ASCE 7, AISI S100, and AISI S240.
- C. Design Criteria: As indicated on drawings and as follows: .
 - 1. Live load deflection meeting the following, unless otherwise indicated:
 - a. Exterior Walls: Maximum horizontal deflection under wind load of 1/180 of span.
 - b. Design nonaxial loadbearing framing to accommodate not less than 1 in (26 mm) vertical deflection.
 - 2. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 - 3. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.3 MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
 - 1. Structural Grade: As required to meet design criteria.
 - 2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.

2.4 STRUCTURAL FRAMING COMPONENTS

- A. Wall Studs and Track Sections: AISI S240; c-shaped studs and u-shaped track sections in stud-matching nominal width and compatible height.
 - 1. Thickness and Depth: Depth as indicated on the drawings; thickness and structural grade as required to meet design criteria.
- B. Jamb Studs: AISI S240; manufactured, engineered, c-shaped with wide flanges, designed to replace conventional double-stud framing at openings.
 - 1. Thickness and Depth: Depth as indicated on drawings; thickness and structural grade as required to meet specified design criteria.
- C. Headers: AISI S240; manufactured, engineered one-member or two-member assemblies, with wide flanges, designed to replace conventional box or nested header framing at openings.
 - 1. Structural Grade: As required to meet design criteria.
 - 2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.
 - 3. Jamb Mounting Clips: Manufacturer's standard.
 - 4. Cripple Stud Clips: Manufacturer's standard.

2.5 CONNECTIONS

- A. Performance Requirements: Provide connections in compliance with requirements of AISI S240.
- B. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S240.
 - 1. Structural Grade: As required to meet design criteria.
 - 2. Corrosion Protection Coating Designation: CP 60 in accordance with AISI S240.
- C. Structural Performance: Maintain load and movement capacity required by applicable building code and specified design criteria.
- D. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections at the following locations:
 - 1. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1 inch (26 mm).
 - 2. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1 inch (26 mm).
 - 3. Provide top track with long leg track and head of wall movement connectors; minimum track length of 10 feet (3048 mm).
- E. Fixed Connections: Provide nonmovement devices for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
- F. Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connectors at the following locations: as required by design.

2.6 MISCELLANEOUS CONNECTIONS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot-dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.
- C. Welding: Comply with AWS D1.1/D1.1M.

2.7 SHEATHING

- A. Glass-mat-faced gypsum board; ASTM C1177/C1177M, square long edges, 5/8 inch (15.9 mm) thick, Type X - fire-resistant.

2.8 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Galvanizing Repair: Touch up bare steel with zinc-rich paint in compliance with ASTM A780/A780M.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- E. Water-Resistive Barrier: See Section 07 2500.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.2 PREPARATION

- A. Structural Wall Foundations: For gaps between wall bottom track and top of foundation 1/4 inch (6.4 mm) or greater, level substrate with loadbearing shims or grout between track and foundation.

3.3 INSTALLATION - GENERAL

- A. Install structural members and connections in compliance with ASTM C1007.

3.4 INSTALLATION OF STUDS

- A. Install wall studs plumb and level.
- B. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- C. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
- D. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- E. Install intermediate studs above and below openings to align with wall stud spacing.
- F. Provide deflection allowance in stud track, directly below horizontal building framing at non-loadbearing framing.
- G. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- H. Touch-up field welds and damaged corrosion-protected surfaces zinc-rich paint in compliance with ASTM A780/A780M.

3.5 INSTALLATION OF WALL SHEATHING

- A. Install wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using self-tapping screws.
 - 1. Place water-resistive barrier horizontally over wall sheathing, weather lapping edges, and ends.

3.6 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide inspections for welding, mechanical fastening, and cold-formed steel light-frame construction in accordance with requirements of AISI S240.

3.7 TOLERANCES

- A. Studs - Vertical Alignment (Plumbness): 1/960 of span or 1/8 inch in 10 ft (3.2 mm in 3000 mm), in accordance with ASTM C1007.
- B. Studs - Maximum Variation from True Position: 1/8 inch (3.2 mm) in accordance with ASTM C1007.
- C. Stud Spacing: 1/8 inch (3.2 mm) from the designated spacing, provided that the cumulative error does not exceed the requirements of the finishing materials in accordance with ASTM C1007.

END OF SECTION 05 4000

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Shop fabricated steel items.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 1200 - Structural Steel Framing: Structural steel column anchor bolts.
- C. Section 05 3100 - Steel Decking: Bearing plates for metal deck bearing, including anchorage.
- D. Section 05 5100 - Metal Stairs.
- E. Section 05 5133 - Metal Ladders.
- F. Section 05 5213 - Pipe and Tube Railings.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- E. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- H. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- I. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019, with Editorial Revision (2025).
- 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.

1.4 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.

1.5 QUALITY ASSURANCE

- A. 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. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M Grade C cold-formed structural tubing.
- C. Plates: ASTM A36/A36M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- G. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

- J. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.2 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. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.3 FABRICATED ITEMS

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- C. Lintels: As detailed; prime paint finish.
 - 1. Galvanized at exterior applications and where indicated.
- D. Door Frames for Overhead Door Openings, Wall Openings, and ____: Channel sections; prime paint finish.
- E. Elevator Hoistway Divider Beams: Beam sections; prime paint finish.

2.4 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry. Galvanized at exterior applications and where indicated.
 - 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 Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements.

2.5 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

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 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.

3.3 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.

3.4 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 5100 - METAL STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.
- C. Handrails and guards.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of metal anchors in concrete.
- B. Section 04 2000 - Unit Masonry: Placement of metal fabrications in masonry.
- C. Section 05 5213 - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.

1.3 REFERENCE STANDARDS

- A. AISC 207 - Standard for Certification Programs; 2023.
- B. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2024b.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- 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; 2024.
- 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 F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- M. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.4 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.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Design Data: As required by authorities having jurisdiction.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 207.

1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 207.
 - 2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.1 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.

1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
 3. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
 - a. Stair Capacity: Uniform live load of 100 lb/sq ft (4.7 kPa) and a concentrated load of 300 lb (and a concentrated load of 14.4 kg) with deflection of stringer or landing framing not to exceed 1/360 of span.
 - b. Railing Assemblies: Comply with applicable local code.
 4. Dimensions: As indicated on drawings.
 5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 7. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
1. Architectural: All joints as inconspicuous as possible, whether welded or mechanical.
 - a. Welded Joints: Continuously welded and ground smooth and flush.
 - b. Mechanical Joints: Butted tight, flush, and hairline; concealed fastenings only.
 - c. Exposed Edges and Corners: Eased to small uniform radius.
 - d. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for highest quality gloss finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Architectural, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
1. Concrete Depth: 1-1/2 inches (38 mm), minimum.
 2. Tread Pan Material: Steel sheet.
 3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch (1.9 mm) minimum.
 4. Concrete Reinforcement: Welded wire mesh.
 5. Concrete Finish: For resilient floor covering.
- D. Risers: Same material and thickness as tread pans.
1. Nosing Depth: Not more than 1-1/2 inch (38 mm) overhang.
 2. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch (12 mm) wide.
- E. Stringers: Rolled steel channels.
1. Stringer Depth: 12 inches (305 mm).
 2. End Closure: Sheet steel of same thickness as risers welded across ends.

- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Finish: Shop- or factory-prime painted.
- H. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.3 HANDRAILS AND GUARDS

- A. Wall-Mounted Rails: See Section 05 5213.
- B. Guards: Pipe railings, see Section 05 5213.

2.4 MATERIALS

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
- C. Pipe: ASTM A53/A53M Grade B Schedule 40, black finish.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
 - 1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 - 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- E. Concrete Fill: Portland cement Type I, 3000 psi (20 MPa) 28 day strength, 2 to 3 inch (51 to 76 mm) slump.
- F. Concrete Reinforcement: Mesh type as detailed, galvanized.

2.5 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.
- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

2.6 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
 - 2. Number of Coats: One.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.
- B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

3.4 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).

END OF SECTION 05 5100

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SECTION 05 5113 - METAL PAN STAIRS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stairs with concrete treads.
- B. Structural steel stair framing and supports.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete fill in stair pans; mesh reinforcement for landings.
- B. Section 05 5000 - Metal Fabrications.
- C. Section 05 5213 - Pipe and Tube Railings: Metal handrails for the stairs specified in this section.
- D. Section 09 9123 - Interior Painting: Paint finish.

1.3 REFERENCE STANDARDS

- A. AISC 207 - Standard for Certification Programs; 2023.
- B. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2024b.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2024.
- F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- G. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- H. 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; 2024.

- 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 F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi, 144 ksi, and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2025.
- K. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- M. NAAMM AMP 510 - Metal Stairs Manual; 1992.
- N. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- O. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.4 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.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Design Data: As required by authorities having jurisdiction.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 207.

1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and dated no more than 12 months before start of scheduled welding work.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 207.
 - 2. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.

PART 2 PRODUCTS

2.1 METAL STAIRS - GENERAL

- A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.
 - 1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
 - 2. Structural Design: Provide complete stair and railing assemblies that comply with the applicable local code.
 - a. Stair Capacity: Uniform live load of 100 lb/sq ft (4.7 kPa) and a concentrated load of 300 lb (and a concentrated load of 14.4 kg) with deflection of stringer or landing framing not to exceed 1/360 of span.
 - 3. Dimensions: As indicated on drawings.
 - 4. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
 - 5. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
 - 6. Separate dissimilar metals using paint or permanent tape.
- B. Metal Jointing and Finish Quality Levels:
 - 1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
 - a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
 - b. Welds Exposed to View: Ground smooth and flush.
 - c. Mechanical Joints: Butted tight, flush, and hairline.
 - d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
 - e. Exposed Edges and Corners: Eased to small uniform radius.
 - f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.
- C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.2 METAL STAIRS WITH CONCRETE TREADS

- A. Jointing and Finish Quality Level: Commercial, as defined above.
- B. Risers: Closed.
- C. Treads: Metal pan with field-installed concrete fill.
 - 1. Concrete Depth: 1-1/2 inches (38 mm), minimum.
 - 2. Tread Pan Material: Steel sheet.
 - 3. Tread Pan Thickness: As required by design; 14 gauge, 0.075 inch (1.9 mm) minimum.

4. Pan Anchorage to Stringers: Welded to carrier angles welded to stringers.
 5. Concrete Reinforcement: As required for stair design..
 6. Concrete Finish: Steel troweled.
- D. Risers: Same material and thickness as tread pans.
1. Riser/Nosing Profile: Vertical riser with underside of nosing sloped up from bottom of tread pan at not less than 60 degrees from horizontal, with rounded top of nosing of minimum radius.
 2. Nosing Depth: Not more than 1 inch (25 mm) overhang.
 3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch (12 mm) wide.
- E. Stringers: Rolled steel channels.
1. Stringer Depth: 12 inches (305 mm).
 2. End Closure: Sheet steel of same thickness as risers welded across ends.
- F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
- G. Finish: Shop- or factory-prime painted.
- H. Under Side of Stair: Exposed to view, to be finished same as specified for other exposed to view surfaces.

2.3 HANDRAILS AND GUARDS

- A. Wall-Mounted Rails: See Section 05 5213.
- B. Guards: Pipe railings, see Section 05 5213.

2.4 MATERIALS

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M or ASTM A501/A501M structural tubing, round and shapes as indicated.
- C. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
- D. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation CS (commercial steel).
 2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel).
- E. Concrete Fill: Portland cement Type I, 3000 psi (20 MPa) 28 day strength, 2 to 3 inch (51 to 76 mm) slump.

2.5 ACCESSORIES

- A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, and galvanized to ASTM A153/A153M where connecting galvanized components.

- B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- D. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

2.6 FABRICATION

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
 - 1. Join components by welding unless otherwise indicated.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.7 SHOP FINISHING

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime Painting: Use specified shop- and touch-up primer.
 - 1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
 - 2. Number of Coats: One.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. When field welding is required, clean and strip primed steel items to bare metal.

3.3 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

- C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
- F. Obtain approval prior to site cutting or creating adjustments not scheduled.
- G. After erection, prime welds, abrasions, and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete.

END OF SECTION 05 5113

SECTION 05 5133 - METAL LADDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Prefabricated ladders.
- B. Prefabricated ship ladders.
- C. Ladder safety systems.

1.2 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- B. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- C. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
- D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- E. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- F. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- G. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

PART 2 PRODUCTS

2.1 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6061 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M .

2.2 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.

2.3 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. Finish: Mill finish aluminum.
 - 3. Manufacturers:
 - a. O'Keeffe's Inc; Model 501: www.okeeffes.com/#sle.
- B. Prefabricated Ship 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: Aluminum; 6063 alloy, T52 temper.
 - 3. Incline: 60 degrees.
 - 4. Finish: Mill finish aluminum.
 - 5. Manufacturers:
 - a. O'Keeffe's Inc; Model 523: www.okeeffes.com/#sle.

2.4 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Mill finish.
- B. Interior Aluminum Surfaces: Mill finish.

2.5 LADDER SAFETY SYSTEMS

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 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.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Perform field welding in accordance with AWS D1.1/D1.1M.
- D. Obtain approval prior to site cutting or making adjustments not scheduled.

3.4 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 05 5213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 04 2000 - Unit Masonry: Placement of anchors in masonry.
- C. Section 05 5113 - Metal Pan Stairs: Handrails other than those specified in this section.
- D. Section 05 5123 - Metal Service Stairs: Handrails other than those specified in this section.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. AISC 207 - Standard for Certification Programs; 2023.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- G. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- I. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021, with Errata (2023).
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

- L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
 - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- D. Designer's Qualification Statement.

1.5 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 207.

PART 2 PRODUCTS

2.1 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot (1095 N/m) applied to the top of the assembly and in any direction, without damage or permanent set.
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds (890 N) applied at any point on the top of the assembly and in any direction, without damage or permanent set.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 2. For anchorage to masonry, provide brackets to be embedded in masonry, for bolting anchors.
- G. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.2 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, galvanized finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.3 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Weld connections that cannot be shop welded due to size limitations.
1. Weld in accordance with AWS D1.1/D1.1M.
 2. Match shop welding and bolting.
 3. Clean welds, bolted connections, and abraded areas.
 4. Touch up shop primer and factory-applied finishes.
 5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.4 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm) per floor level, 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 5213

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sheathing.
- B. Preservative treated wood materials.
- C. Concealed wood blocking, nailers, and supports.
- D. Miscellaneous wood nailers, furring, and grounds.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Setting anchors in concrete.
- B. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- C. Section 07 2600 - Vapor Retarders: Vapor retarder over sheathing.
- D. Section 07 2700 - Air Barriers: Air barrier over sheathing.
- E. Section 07 6200 - Sheet Metal Flashing and Trim: Sill flashings.
- F. Section 07 7200 - Roof Accessories: Prefabricated roof curbs.
- G. Section 09 2116 - Gypsum Board Assemblies: Gypsum-based sheathing.

1.3 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2025.
- F. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. NELMA (SGR) - Standard Grading Rules for Northeastern Lumber; 2024.

- H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.
- I. PS 1 - Structural Plywood; 2023.
- J. PS 2 - Performance Standard for Wood Structural Panels; 2019.
- K. PS 20 - American Softwood Lumber Standard; 2025.
- L. SPIB (GR) - Standard Grading Rules; 2021.
- M. WCLIB (GR) - WCLB Standard Grading Rules for West Coast & Imported Softwood Lumber No.18; 2024.
- N. WWPA G-5 - Western Lumber Grading Rules; 2025.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing and application instructions.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
 - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

- A. Wall Sheathing: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Sheathing.
 - 2. Bond Classification: Exposure 1.
 - 3. Performance Category: As indicated.
 - 4. Span Rating: As indicated.
 - 5. Edges: Square.
- B. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch (19 mm) thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- C. Metal and Finish of Fasteners:

2.4 ACCESSORIES

- 1. Untreated Wood: Unfinished steel.
- B. Sill Gasket on Top of Foundation Wall: 3/8 inch (9.5 mm) thick, closed-cell plastic foam.
 - 1. Width: 5-1/2 inches (140 mm).
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
- C. Sill Flashing: See Section 07 6200.
- D. Subfloor Adhesives: Gap-filling construction adhesive for bonding wood structural panels to wood-based floor system framing; complying with ASTM D3498.
- E. Water-Resistive Barrier: See Section 07 2500.
- F. Vapor Retarder: See Section 07 2600.
- G. Air Barrier: See Section 07 2700.

PART 3 EXECUTION

3.1 PREPARATION

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

- B. Coordinate installation of rough carpentry members specified in other sections.

3.2 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.3 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to authorities having jurisdiction may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

3.4 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at each roof opening except where prefabricated curbs are specified and where specifically indicated otherwise; form corners by alternating lapping side members.

3.5 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring/Underlayment Combination: Glue and nail to framing; staples are not permitted.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches (610 mm) on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.6 TOLERANCES

- A. Framing Members: 1/4 inch (6 mm) from true position, maximum.
- B. Surface Flatness of Floor: 1/8 inch in 10 feet (1 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.
- C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet (2 mm/m) maximum, and 1/4 inch in 30 feet (7 mm in 10 m) maximum.

3.7 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.

3.8 CLEANING

- A. Waste Disposal: See Section 01 7419 - Construction Waste Management and Disposal.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.
- B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION 06 1000

SECTION 06 6100 - CAST POLYMER FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Solid surfacing fabrications.

1.2 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants.
- B. Section 09 9123 - Interior Painting: Field-applied painting of interior cast polymer fabrications.
- C. Section 09 3000 - Tiling: Setting materials for quartz surfacing applications.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings: Review conditions for installation, installation procedures, coordination of related work, and anchorages by others.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data for fabricated units.
- C. Shop Drawings: For each type of cast polymer, indicate:
 - 1. Plans and Elevations: Include dimensions and unit serial numbers; indicate location of fabricated units.
 - a. Drawing Scale: 1/4 inch to 1 foot (1:50), minimum.
 - 2. Details: Include connections and plumbing system accommodations.

- a. Drawing Scale: 1-1/2 inches to 1 foot (1:10), minimum.
- D. Delegated Design Documents: Structural design calculations signed and sealed by Engineer of Record for design of loadbearing columns; sufficient for submission to authorities having jurisdiction (AHJ).
- E. Test Reports: Indicate compliance with reference standard performance requirements.
- F. Manufacturer's Instructions: Indicate installation and handling instructions.
 - 1. Include templates for anchorages by others.
- G. Designer's Qualification Statement.
- H. Operation and Maintenance Data: Maintenance instructions, including recommended cleaning procedures and materials.
- I. Executed warranty.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of Professional Engineer experienced in design of this type of 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 minimum three years of documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver products to project site in original packages, containers, or bundles bearing brand name and identification.
- C. Store products under cover, elevated above grade, and in dry, well-ventilated areas not exposed to heat or sunlight. Protect from moisture damage.
- D. Handle products to prevent damage to edges, ends, or surfaces, and in accordance with manufacturer's written instructions.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for _____. Complete forms in Owner's name and register with manufacturer.
- C. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Solid Surface Fabrications:

1. Inpro; Prism Solid Surface Shower Walls: www.inprocorp.com.

2.2 REGULATORY REQUIREMENTS

A. Surface Burning Requirements:

1. Interior Use: Flame spread index of 75 or less and smoke-development index of 450 or less; Class B interior finish classification when tested in accordance with ASTM E84.

2.3 SOLID SURFACING FABRICATIONS

A. Solid Surfacing: Densified, homogeneous, nonporous castings fabricated into sheets; composed of acrylic resins, fillers, color chips, and pigment and performance-enhancing additives.

1. Standard Type: Comply with minimum performance and engineering properties of ISFA 2-01.

B. Applications: Wall panels.

1. Style: As indicated on drawings.
2. Back Wall Width: As indicated on drawings.
3. Side Wall Width: As indicated on drawings.
4. Height: 84 inches (2.13m).
5. Thickness: 1/4 inch (6.35 mm).
6. Edge Profile at Horizontal Joints: As indicated on drawings.
7. Edge Profile at Vertical Joints: As indicated on drawings.
8. Finish on Exposed Surfaces: Manufacturer's standard for application.
9. Color: As indicated on drawings.
10. Recessed Dishes: Recessed Toiletry Shelf, [12" x 18"], to be installed in between metal studs. Refer to manufacturers installation instructions.

2.4 FABRICATION

- A. Fabricate units with embedded anchors, stiffening ribs, and sufficient strength for handling and placement stresses.
- B. Fabricate cutouts where indicated.
- C. Radius corners and exposed edges of panel to have eased edges, as provided by manufacturer.
- D. Provide consistent finish over exposed surfaces matching approved samples.
- E. Fabricate components with joints tightly fitted and secured.

2.5 ACCESSORIES

A. Trim:

1. Inside Corner Silicone Sealant
 2. Outside Corner Trim Piece: Schluter Jolly
 3. Trim from base tile to prism panel: Schluter Jolly
- B. Recessed Dishes:
- C. Solid Surface Bonding Adhesive
- D. Adhesive Cartridge Dispenser.
- E. Adhesive Mixing Tips
- F. Silicone Adhesive/Sealant.
1. Pick Resistant Color Coordinated Caulk (Seala
- G. Adhesives: Type recommended by cast polymer manufacturer for application; not containing formaldehyde or volatile organic compounds.
1. Where visible in finished work, tint adhesive to match cast polymer exposed surface.
- H. Joint Sealants: Type recommended by cast polymer manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements are as indicated on shop drawings.
- B. Verify substrates are prepared to receive cast polymer fabrications.
- C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- D. Verify mechanical, electrical, and other building components affecting work of this section are placed and ready to receive work of this section.

3.2 PREPARATION

- A. Prepare substrates in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- A. Install anchoring devices in accordance with cast polymer manufacturer's setting templates.
- B. Install cast polymer units in accordance with manufacturer's written instructions.
- C. Align work plumb and level.
- D. Rigidly anchor to substrate to prevent misalignment.

3.4 TOLERANCES

- A. Maximum Variation from True Position: 1/4 inch (6.4 mm).
- B. Maximum Variation from Plumb: 1/4 inch in 10 feet (2 mm in 1 m).
- C. Maximum Variation from Level: 1/4 inch in 10 feet (2 mm in 1 m).

3.5 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Clean exposed surfaces of installed units in accordance with manufacturer's instructions.

3.6 PROTECTION

- A. Protect installed cast polymer units from subsequent construction operations.

END OF SECTION 06 6100

SECTION 07 1300 - SHEET WATERPROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-adhered rubberized asphalt sheet membrane.
- B. Self-adhered HDPE sheet membrane.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete substrate.
- B. Section 07 2100 - Thermal Insulation: Insulation used for protective cover.

1.3 ABBREVIATIONS

1.4 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- B. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
- C. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2025).
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- E. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2018.
- F. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2025.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- H. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2025).
- I. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for membrane.
- C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
- D. Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures above 40 degrees F (5 degrees C) for 24 hours before and during application and until liquid or mastic accessories have cured.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Contractor to correct defective Work within period of five years after Date of Substantial Completion; remove and replace materials concealing waterproofing at no extra cost to Owner.
- C. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water and _____, except where such failures are the result of structural failures of building. Hairline cracking of concrete due to temperature change or shrinkage is not considered a structural failure.

PART 2 PRODUCTS

2.1 SHEET WATERPROOFING APPLICATIONS

- A. Self-Adhered Rubberized Asphalt Sheet Membrane:
 - 1. Location: Below-Grade.
 - 2. Cover with drainage panel.
- B. Self-Adhered HDPE Sheet Membrane:
 - 1. Location: pre-Applied below concrete.
 - 2. Cover with protection board.

2.2 SHEET WATERPROOFING MATERIALS

- A. Self-Adhered Rubberized Asphalt Sheet Membrane:
1. Thickness: 60 mil, 0.060 inch (1.52 mm), minimum.
 2. Sheet Width: 3 feet (0.91 m), minimum.
 3. Tensile Strength:
 - a. Film: 5000 psi (34.5 MPa), minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches (50 mm) per minute.
 4. Elongation at Break: Greater than 200 percent, minimum, measured in accordance with ASTM D412.
 5. Water Vapor Permeance: 0.05 perm (2.9 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
 6. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 25 degrees F (minus 32 degrees C), 180 degree bend on 1 inch (25 mm) mandrel.
 7. Peel Adhesion to Concrete: 9 lb/inch (1.02 N/m), minimum, when tested in accordance with ASTM D903.
 8. Puncture Resistance: 60 lb (27.2 kg), minimum, in accordance with ASTM E154/E154M.
 9. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 200 feet (61 m) head of water applied in accordance with test method ASTM D5385/D5385M.
 10. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
 11. Products:
 - a. Mapei Corporation; Planiseal Membrane SA: www.mapei.com/#sle.
 - b. Sika Corporation; SikaShield S-60: www.usa.sika.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Self-Adhered HDPE Sheet Membrane: Thickness (46) Mil. Recommended by manufacturer for placement below concrete slabs and on outside face of below grade walls before placement of concrete.
1. Hydrostatic Pressure Resistance: Membrane resists leakage for at least one hour from pressure equivalent to 231 feet (70.4 m) head of water applied in accordance with test method ASTM D5385/D5385M.
 2. Elongation at Break: 500 percent, minimum, measured in accordance with ASTM D412.
 3. Tensile Strength, Film: 3,500 psi (24 MPa), minimum, measured in accordance with ASTM D412.
 4. Water Vapor Permeance: 0.01 perm (0.6 ng/(Pa s sq m)), maximum, measured in accordance with ASTM E96/E96M.
 5. Lateral Water Migration Resistance: Resists pressure of 231 ft (70 m) head of water, when tested in accordance with ASTM D5385/D5385M.
 6. Adhesives, Sealants, Tapes, and Accessories: As recommended by membrane manufacturer.
 7. Products:
 - a. GCP Applied Technologies; Preprufe 160R Plus/LT: www.gcpat.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.3 ACCESSORIES

- A. Seaming Materials: As recommended by membrane manufacturer.
- B. Membrane Sealant: As recommended by membrane manufacturer.
- C. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and waterproofing materials.
- D. Protection Board: Rigid insulation; see Section 07 2100.
- E. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
 - 1. Composition: Dimpled polystyrene, polyethylene, or polypropylene core; polypropylene filter fabric.
 - 2. Thickness: 1/4 inch (6.4 mm).
 - 3. Products:
 - a. Sika Corporation; Drainage Mat: www.usa.sika.com/#sle.
 - b. W. R. Meadows, Inc; Mel-Drain 5012: www.wrmeadows.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- F. Flexible Flashings: Type recommended by membrane manufacturer.
- G. Termination Bars: Aluminum; compatible with membrane and adhesives.
- H. Adhesives: As recommended by membrane manufacturer.
- I. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting work.
- B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- C. Verify that items penetrating surfaces to receive waterproofing are securely installed.
- D. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
- E. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces from damage not designated to receive waterproofing.
- B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.

- C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
- D. Fill nonmoving joints and cracks with a filler compatible with waterproofing materials.
- E. Seal moving cracks with sealant and nonrigid filler, using procedures recommended by sealant and waterproofing manufacturers.
- F. Prepare building expansion joints at locations as indicated on drawings.
- G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
- H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate in accordance with ASTM D5295/D5295M.
 - 1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
 - 2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in reference standard.
 - 3. Remove and replace areas of defective concrete; see Section 03 3000.
 - 4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in referenced standard.
 - 5. Test concrete surfaces as described in referenced standards, and verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.3 INSTALLATION - MEMBRANE

- A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
- B. Roll out membrane, and minimize wrinkles and bubbles.
- C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
- D. Overlap edges and ends, minimum 3 inches (76 mm), seal permanently waterproof by method recommended by manufacturer, and apply uniform bead of sealant to joint edge.
- E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
- G. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
- H. Seal membrane and flashings to adjoining surfaces.
 - 1. Install termination bar along edges.
- I. Composite Waterstop: Install composite waterstop according to manufacturer's instructions.

3.4 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

- A. Place drainage panel directly against membrane, butt joints, place to encourage drainage downward; scribe and cut boards around projections, penetrations, and interruptions.
- B. Place protection board directly against drainage panel; butt joints, and scribe and cut boards around projections, penetrations, and interruptions.

3.5 PROTECTION

- A. Do not permit traffic over unprotected or uncovered membrane.

END OF SECTION 07 1300

SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, and underside of floor slabs.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, and roof construction.
- C. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.
- B. Section 07 2700 - Air Barriers: Separate air barrier materials.
- C. Section 07 5300 - Elastomeric Membrane Roofing: Installation requirements for board insulation over low slope roof deck.

1.3 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024c.

1.4 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

2.1 APPLICATIONS

- A. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- B. Insulation in Metal Framed Walls: Batt insulation with separate vapor retarder.

2.2 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene (XPS) Board Insulation: Comply with ASTM C578 with either natural skin or cut cell surfaces.
 - 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value (RSI-value): Type IV, 5.0 (0.88), minimum, per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 - 5. Board Edges: Square.
 - 6. Type and Water Absorption: Type XII, 0.3 percent by volume, maximum, by total immersion.
 - 7. Products:
 - a. DuPont de Nemours, Inc: building.dupont.com/#sle.
 - b. Owens Corning Corporation: www.owenscorning.com/en-us/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. 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: As indicated in drawings..
 - 6. Board Edges: Square.

2.3 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Formaldehyde Content: Zero.
 - 5. Thermal Resistance: R-value (RSI-value) as indicated in drawings.
 - 6. Products:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.
 - b. Johns Manville: www.jm.com/#sle.

- c. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
 - 1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 2. Thermal Resistance: R-value (RSI-value) as indicated in drawings.
 - 3. Products:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. ROCKWOOL: www.rockwool.com/#sle.
 - c. Thermafiber, Inc; SAFB: www.thermafiber.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.4 ACCESSORIES

- A. Sheet Vapor Retarder: Clear polyethylene film for above grade application, 10 mil, 0.010 inch (0.25 mm) thick.
- B. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
 - 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
 - 2. Width: Are required for application.
- C. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 3-1/2 inches (89 mm).
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved in writing by manufacturer for up to 30 days of weather exposure.
- D. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 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.

3.2 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Apply adhesive to back of boards:
 - 1. Apply adhesive per manufacturers recommendations.
- B. Install boards horizontally on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.

- C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.3 BOARD INSTALLATION USING CLADDING AND CONTINUOUS INSULATION SUPPORTS

- A. Install supports in accordance with manufacturer's installation instructions.
- B. Install supports in compliance with system orientation, sizes, and locations as indicated on drawings and in accordance with approved shop drawings.
- C. Install supports to fill in exterior wall spaces without gaps or voids in insulation.
- D. Trim insulation neatly to fit spaces and provide a continuous thermal layer.

3.4 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Coordinate installation of insulation with other trades.
- B. Place insulation under slabs on grade after base for slab has been compacted.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- D. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.5 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over face of member
- F. Tape seal tears or cuts in vapor retarder.
- G. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane; tape seal in place.

3.6 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.

3.7 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.
- B. Replace all damaged insulation prior to concealment.

END OF SECTION 07 2100

SECTION 07 2400 - EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Composite wall and soffit cladding of rigid insulation and reinforced finish coating, Class PB.
- B. Drainage and water-resistive barriers behind insulation board.

1.2 RELATED REQUIREMENTS

- A. Section 07 6200 - Sheet Metal Flashing and Trim: Perimeter flashings.

1.3 REFERENCE STANDARDS

- A. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- C. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2024.
- D. ASTM C1397 - Standard Practice for Application of Class PB Exterior Insulation and Finish Systems (EIFS) and EIFS with Drainage; 2025.
- E. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2025.
- F. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity; 2025.
- G. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- 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).
- J. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2025.
- K. ASTM E2486/E2486M - Standard Test Method for Impact Resistance of Class PB and PI Exterior Insulation and Finish Systems (EIFS); 2022.

- L. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013 (Reapproved 2021).
- M. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- N. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).
- O. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).
- P. NFPA 259 - Standard Test Method for Potential Heat of Building Materials; 2023, with Errata.
- Q. NFPA 268 - Standard Test Method for Determining Ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source; 2022.
- R. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2025.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
- C. Shop Drawings: Indicate wall and soffit joint patterns, joint details, and molding profiles.
- D. Selection Samples: Submit manufacturer's standard range of samples illustrating available coating colors and textures.
- E. Verification Samples: Submit actual samples of selected coating on specified substrate, minimum 12 inches (300 mm) square, illustrating project colors and textures.
- F. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.5 QUALITY ASSURANCE

- A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
- B. EIFS Manufacturer Qualifications: Provide EIFS products other than insulation from the same manufacturer with qualifications as follows:
 - 1. Member in good standing of EIMA (EIFS Industry Members Association).
 - 2. Manufacturer of EIFS products for not less than 5 years.
- C. Installer Qualifications: Company specializing in the type of work specified and with at least three years of documented experience and approved by manufacturer.

1.6 MOCK-UPS

- A. Construct mock-up of typical EIFS application on specified substrate, size as indicated on drawings, and including flashings, joints, and edge conditions.
- B. Locate mock-up as indicated on drawings.
- C. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
- B. Storage: Store materials as directed by manufacturer's written instructions.

1.8 FIELD CONDITIONS

- A. Do not prepare materials or apply EIFS under conditions other than those described in the manufacturer's written instructions.
- B. Do not prepare materials or apply EIFS during inclement weather unless areas of installation are protected. Protect installed EIFS areas from inclement weather until dry.
- C. Do not install coatings or sealants when ambient temperature is below 40 degrees F (5 degrees C).
- D. Do not leave installed insulation board exposed to sunlight for extended periods of time.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design:
 - 1. Dryvit Systems, Inc; Dryvit Outsulation X EIFS, Class PB with Moisture Drainage: www.dryvit.com/#sle.
- B. Other Acceptable Exterior Insulation and Finish Systems Manufacturers:
 - 1. Substitutions: See Section 01 6000 - Product Requirements.

2.2 EXTERIOR INSULATION AND FINISH SYSTEM

- A. Exterior Insulation and Finish System: DRAINAGE type; reinforced finish coating on mechanically-fastened insulation board over sheet-type combination drainage layer/water-resistive barrier over substrate; provide a complete system that has been tested to show compliance with the following characteristics; include all components of specified system and substrate(s) in tested samples.
- B. Fire Characteristics:

1. Flammability: Pass, when tested in accordance with NFPA 285.
 2. Ignitibility: No sustained flaming when tested in accordance with NFPA 268.
 3. Potential Heat of Foam Plastic Insulation Tested Independently of Assembly: No portion of the assembly having potential heat that exceeds that of the insulation sample tested for flammability (above), when tested in accordance with NFPA 259 with results expressed in Btu per square foot (mJ/sq m).
- C. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf (299 Pa) differential pressure with tracer dye in the water spray; include in tested sample at least two vertical joints and one horizontal joint of same type to be used in construction; disassemble sample if necessary to determine extent of water penetration.
- D. Drainage Efficiency: Average minimum efficiency of 90 percent, when tested in accordance with ASTM E2273 for 75 minutes.
- E. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches (100 by 150 mm) in size.
- F. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with ICC-ES AC219 or ICC-ES AC235.
- G. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.
- H. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
- I. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
- J. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons (500 liters) of sand.
- K. Impact Resistance: Construct system to provide the following impact resistance without exposure of broken reinforcing mesh, when tested in accordance with ASTM E2486/E2486M:
1. Standard: 25 to 49 in-lb (2.83 to 5.54 J), for areas not indicated as requiring higher impact resistance.
 2. High: 90 to 150 in-lb (10.2 to 17 J), for areas indicated on the drawings.

2.3 MATERIALS

- A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.

1. Texture: Dryvit Systems, Inc, Standard Textures, with Dirt Pickup Resistance; Sandpebble DPR: www.dryvit.com/#sle.
 2. Texture: Dryvit Systems, Inc, Specialty Finish Options; Tibur Stone: www.dryvit.com/#sle.
 3. Substitutions: see section 01 6000 Product requirements
 4. Color: As selected by Architect from manufacturer's standard range.
- B. Base Coat: Fiber-reinforced, acrylic or polymer-based product compatible with insulation board and reinforcing mesh, Class PB.
- C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating, weight, strength, and number of layers as required to meet required system impact rating.
- D. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578, with natural skin surfaces.
1. Board Size: 48 by 96 inch (1220 by 2440 mm).
 2. Board Size Tolerance: 1/16 inch (1.5 mm) from square and dimension.
 3. Board Thickness: 2 inches (50 mm).
 4. Dimensional Stability: 2 percent, maximum.
 5. Board Edges: Square.
 6. Type and Thermal Resistance, R-value (RSI-value): Type X, 5.0 (0.88) per 1 inch (25.4 mm) thickness at 75 degrees F (24 degrees C) mean temperature.
 7. Type and Compressive Resistance: Type X, 15 psi (104 kPa), minimum.
 8. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E84.
- E. Drainage Layer or Spacers: Furnished or approved by EIFS manufacturer; capable of achieving specified drainage rate; not required to be water-resistive, air retarder, or vapor retarder.

2.4 ACCESSORIES

- A. Insulation Fasteners: Fastener and plate system appropriate for substrate and as recommended by EIFS manufacturer.
- B. Metal Flashings: See Section 07 6200.
- C. Trim: EIFS manufacturer's standard PVC or galvanized steel trim accessories, as required for a complete project and including starter track and drainage accessories.
- D. Sealant Materials: Compatible with EIFS materials and as recommended by EIFS manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with EIFS installation and is of a type and construction that is acceptable to EIFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.
- B. Verify that substrate surface is flat, with no deviation greater than 1/4 in (6 mm) when tested with a 10 ft (3 m) straightedge.

3.2 PREPARATION

- A. Install self-furring metal lath over solid substrates that are deemed unacceptable to receive adhesively applied insulation. Install in accordance with ASTM C1063, except for butt-lapping instead of overlapping.
 - 1. Attach to concrete and concrete masonry using corrosion-resistant power or powder actuated fasteners or hardened concrete stub nails not less than 3/4 inch (19 mm) long and with heads not less than 3/8 inch (9.5 mm) wide. Ensure that fasteners are securely attached to substrate and spaced at maximum 16 inches (406 mm) on center horizontally and 7 inches (178 mm) vertically.
- B. Apply primer to substrate as recommended by EIFS manufacturer for project conditions.

3.3 INSTALLATION - GENERAL

- A. Install in accordance with EIFS manufacturer's instructions and ASTM C1397.
 - 1. Where different requirements appear in either document, comply with the most stringent.
 - 2. Neither of these documents supercedes provisions of Contract Documents that defines contractual relationships between parties or scope of this work.

3.4 INSTALLATION - INSULATION

- A. Install in accordance with manufacturer's instructions.
- B. Install back wrap reinforcing mesh at all openings and terminations that are not to be protected with trim.
- C. On wall surfaces, install boards horizontally. On horizontal surfaces, install boards _____.
- D. Place boards in a method to maximize tight joints. Stagger vertical joints and interlock at corners. Butt edges and ends tight to adjacent board and to protrusions. Achieve a continuous flush insulation surface, with no gaps in excess of 1/16 inch (1.6 mm).
- E. Fill gaps greater than 1/16 inch (1.6 mm) with strips or shims cut from the same insulation material.
- F. Rasp irregularities off surface of installed insulation board.

- G. Mechanical Fastening: Space fasteners as recommended by EIFS manufacturer.

3.5 INSTALLATION - CLASS PB FINISH

- A. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of EIFS. Install reinforcing fabric as recommended by EIFS manufacturer.
 - 1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches (64 mm).
 - 2. Allow base coat to dry a minimum of 24 hours before next coating application.
- B. Install expansion joints at floor lines as recommended by EIFS manufacturer.
- C. Apply finish coat after base coat has dried not less than 24 hours, embed finish aggregate, and finish to a uniform texture and color.
- D. Finish Coat Thickness: As recommended by manufacturer.
- E. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.6 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Clean EIFS surfaces and work areas of foreign materials resulting from EIFS operations.

3.7 PROTECTION

- A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION 07 2400

SECTION 07 2500 - WEATHER BARRIERS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 07 2100 - Thermal Insulation: Weather barrier installed in conjunction with batt insulation.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

1.2 DEFINITIONS

- A. Weather Barriers: Materials or assemblies forming water-resistive barriers, air barriers, vapor retarders, or combination of one or more assemblies.
- B. Water-Resistive Barriers: Materials or assemblies installed behind exterior wall coverings; designed to prevent liquid water from further penetration into exterior wall assembly.

1.3 REFERENCE STANDARDS

- A. AATCC Test Method 127 - Test Method for Water Resistance: Hydrostatic Pressure; 2018, with Editorial Revision (2019).
- B. ASTM C1338 - Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings; 2025.
- 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 E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- F. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- G. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; 2015, with Editorial Revision (2020).

1.4 SUBMITTALS

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

- C. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.5 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.1 WATER-RESISTIVE BARRIERS

- A. Description: Materials or Assemblies installed behind exterior wall coverings; designed to prevent liquid water from further penetration into exterior wall assembly. Primary materials include fluid-applied sheets and coatings; accessory materials include flashings, seam tapes, perimeter tapes, and sealants.
- B. Water-Resistive Barrier Coating: Fluid-applied air and water-resistive coating for various exterior substrates.
 - 1. Air Permeance, Building Assembly Air Leakage Rate: Not greater than 0.04 cfm/sq ft (0.2 L/sq m) when tested at 1.57 psf (75 Pa) in accordance with ASTM E2357.
 - 2. Air Permeance, Building Material Air Leakage Rate: 0.004 cfm/sq ft (0.02 L/sec sq m) maximum leakage when tested at 1.57 psf (75 Pa) pressure difference in accordance with ASTM E2178.
 - 3. Water-Resistive Barrier over Sheathing Compliance: Complying with ICC-ES AC212.
 - 4. Water Vapor Permeance: Tested in accordance with ASTM E96/E96M.
 - a. Procedure A: Greater than 5 perms (287 ng/(Pa s sq m)).
 - b. Procedure B: Greater than 14 perms (804 ng/(Pa s sq m)).
 - 5. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 120 days of weather exposure.
 - 6. System Accessory Products: As recommended by coating manufacturer.

2.2 ACCESSORIES

- A. Seal and Perimeter Tapes: As recommended by water-resistive barrier manufacturer.
- B. Flashings and Sealants: As recommended by water-resistive barrier manufacturer for application.
- C. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrates and weather barrier materials.
 - 1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch (0.76 to 1.02 mm) nominal thickness.
 - 2. Color: Green.
- D. Flexible Flashing: Self-adhering sheet flashing complying with ASTM D1970/D1970M; waive slip resistance requirement if not installed on roof.
 - 1. Width: 3 inches (76.2 mm).

2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
3. Products:
 - a. DuPont de Nemours, Inc; FlexWrap: www.dupont.com/building/#sle.
 - b. Henry Company; FortiFlash: www.henry.com/#sle.
 - c. National Shelter Products, Inc; DRYline ATX Self-Adhering Flashing: www.nationalshelter.com/#sle.
 - d. W. R. Meadows, Inc; Air-Shield Butyl Flashing: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Apply sealants within recommended temperature range in accordance with manufacturer's installation instructions.
- C. Fluid-Applied Sheets:
 1. Prepare substrate in accordance with coating manufacturer's installation instructions; treat joints in substrate and between dissimilar materials as indicated.
 2. Apply flashing to seal with adjacent construction and to bridge joints in coating substrate.
- D. Openings and Penetrations in Exterior Water-Resistive Barriers:
 1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches (127 mm) onto water-resistive barrier and at least 6 inches (152 mm) up jambs; mechanically fasten stretched edges.
 2. At openings 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 (100 mm) wide; do not seal sill flange.
 3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches (230 mm) wide, and covering entire depth of framing.
 4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches (50 mm) beyond face of jambs; seal water-resistive barrier to flashing.

5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Owner's Inspection and Testing: Cooperate with Owner's testing agency.
 1. Allow access to work areas and staging.
 2. Notify Owner's testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
 3. Do not cover work of this section until testing and inspection is accepted.

3.5 PROTECTION

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

END OF SECTION 07 2500

SECTION 07 2600 - VAPOR RETARDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vapor retarders.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

1.3 DEFINITIONS

- A. Vapor Retarder: Airtight barrier made of material that is relatively water vapor impermeable, to degree specified, with seams and joints sealed to adjacent surfaces.
- B. Vapor Retarder Class: A measure of a material or assembly's ability to limit the amount of moisture that passes through that material or assembly. Vapor retarder class is defined using Procedure A, Desiccant Method at 73 degrees F (23 degrees C) and 50 percent Relative Humidity (RH), in accordance with ASTM E96/E96M and ICC (IBC)-2018, as follows:
 - 1. Class I: 0.1 perm or less.
 - 2. Class II: Greater than 0.1 perm to 1.0 perm.
 - 3. Class III: Greater than 1.0 perm to 10 perms.

1.4 REFERENCE STANDARDS

- A. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016 (Reapproved 2023).
- B. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- C. ICC (IBC)-2018 - International Building Code; 2018.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

PART 2 PRODUCTS

2.1 VAPOR RETARDERS

- A. Underslab Vapor Retarders: See Section 03 3000.
- B. Vapor Retarder Sheet: Polyethylene sheeting complying with ASTM D4397, clear colored.
 - 1. Thickness: 10 mil, 0.010 inch (0.254 mm), nominal.
 - 2. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches (50 mm) wide; compatible with sheet material.

2.2 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Vapor Retarder and Adjacent Substrates: As indicated, complying with vapor retarder manufacturer's installation instructions.
- B. Sill Plate Sealer: Closed-cell foam tape with rubberized adhesive membrane; bridges gap between foundation structure and sill plate or skirt board.
 - 1. Width: 3-1/2 inches (89 mm).
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
- C. Vapor Retarder Tape: Coated polyester film with acrylic adhesive backing; pressure sensitive.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Vapor Retarders: Install continuous airtight barrier over surfaces indicated, with sealed seams and sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Mechanically Fastened Sheets - Vapor Retarder On Interior:
 - 1. When insulation is installed within assembly, install vapor retarder over insulation.
 - 2. Anchor to wood framing using large-headed nails or staples at 12 to 18 inches (305 to 460 mm) on center along each framing member covered; cover fasteners with seam tape.

3. Anchor to metal framing using seam tape, adhering at least one-half of tape width to metal substrate.
4. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, providing an airtight seal.
5. Locate laps at framing members; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet in shingle fashion to shed water.
6. Seal entire perimeter to structure, window and door frames, and other penetrations.
7. Where conduits, pipes, wires, ducts, outlet boxes, and other items are installed within insulation cavity, pass vapor retarder sheet behind these items and over insulation to maintain airtight seal.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Owner's Inspection and Testing: Cooperate with Owner's testing agency.
 1. Allow access to work areas and staging.
 2. Notify Owner's testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
 3. Do not cover work of this section until testing and inspection is accepted.

3.5 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Repair damaged vapor retarder prior to concealment.

END OF SECTION 07 2600

SECTION 07 4113 - METAL ROOF PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 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; 2025.
- B. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2025.
- C. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; 2025.
- D. IAS AC472 - Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems; 2024.

1.3 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. Selection Samples: For each roofing system specified, submit color chips representing manufacturer's full range of available colors and patterns.
- 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.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section and with at least three years of documented experience.
 - 1. Accredited by IAS in accordance with IAS AC472.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.
- B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Finish Warranty: Provide 5-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in Owner's name and register with warrantor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Architectural Metal Roof Panel Manufacturers:
 - 1. ATAS International, Inc; Colonial Seam: www.atas.com/#sle.
 - 2. Berridge Manufacturing Company; Cee-Lock Panel: www.berridge.com/#sle.
 - 3. Elevate; Warranted Una-Clad UC- ____ Standing Seam Metal Roofing Panel: www.holcimelevate.com/#sle.
 - 4. MBCI, a Cornerstone Building Brands Company; 5V Crimp Panel: www.mbc.com/#sle.
 - 5. Petersen Aluminum Corporation; PAC T-250 Panel: www.pac-clad.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Metal Soffit Panels Manufacturers:
 - 1. Same manufacturers as roof panels.

2.2 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).

2.3 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. Zinc-coated steel complying with ASTM A653/A653M; minimum G60 (Z180) galvanizing.
 - b. Steel Thickness: Minimum 24 gauge, 0.024 inch (0.61 mm).
 - 2. Profile: Standing seam, with minimum 1-inch (25.4 mm) seam height; concealed fastener system for field seaming with special tool.
 - 3. Texture: Smooth.
 - 4. Length: Maximum possible length to minimize lapped joints. Where lapped joints are unavoidable, space laps so that each sheet spans over three or more supports.
 - 5. Width: Maximum panel coverage of 24 inches (610 mm).
- C. Metal Soffit Panels:
 - 1. Profile: Style as indicated, with venting provided.
 - 2. Color: As selected by Architect from manufacturer's standard line.

2.4 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.

2.5 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.
- B. Joints: Provide captive gaskets, sealants, or separator strips at panel joints to ensure weathertight seals, eliminate metal-to-metal contact, and minimize noise from panel movements.

2.6 FINISHES

2.7 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.
 - 3. Seam Sealant: Factory-applied, non-skinning, non-drying type.

- D. Underlayment for Wood Substrate: ASTM D226/D226M roofing felt, perforated type; covered by water-resistant rosin-sized building paper.

PART 3 EXECUTION

3.1 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.

3.2 PREPARATION

- A. Broom clean wood sheathing prior to installation of roofing system.
- B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to ensure that completed roof will be free of leaks.
- C. Remove protective film from surface of roof panels immediately prior to installation; strip film carefully to avoid damage to prefinished surfaces.
- D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by metal roof panel manufacturer.
- E. At locations where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.3 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. Install roofing felt and building paper slip sheet on roof sheathing before installing preformed metal roof panels; secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners; apply from eaves to ridge in shingle fashion, overlapping horizontal joints at least 2 inches (50 mm) and side and end laps at least 3 inches (75 mm); offset seams in building paper and seams in roofing felt.

- D. Roof Panels: Install metal roof panels in accordance with manufacturer's installation instructions, minimizing transverse joints except at junction with penetrations.

3.4 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.

3.5 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 5300 - ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Elastomeric roofing membrane application.
- B. Insulation, flat and tapered.
- C. Vapor retarder.
- D. Deck sheathing.
- E. Cover boards.
- F. Roofing cant strips, stack boots, roofing expansion joints, and walkway pads.

1.2 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking: Placement of acoustical insulation for deck flutes.
- B. Section 06 1000 - Rough Carpentry: Wood cant strips.

1.3 REFERENCE STANDARDS

- A. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2025.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- D. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2020).
- E. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2024.
- F. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- G. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015, with Editorial Revision (2022).
- H. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- I. FM (AG) - FM Approval Guide; Current Edition.

- J. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2025).
- K. NRCA (WM) - The NRCA Waterproofing Manual; 2021.
- L. UL (DIR) - Online Certifications Directory; Current Edition.
- M. UL (FRD) - Fire Resistance Directory; Current Edition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and paver layout.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.

- C. Store materials in weather protected environment, clear of ground and moisture.
- D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- E. Protect foam insulation from direct exposure to sunlight.

1.8 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather.
- B. Do not apply roofing membrane when ambient temperature is below 40 degrees F (5 degrees C) or above ____ degrees F (____ degrees C).
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two year period after Date of Substantial Completion.
- C. Provide 25 year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. EPDM Membrane Materials:
 - 1. Carlisle SynTec Systems; Sure-Tough EPDM: www.carlisle-syntec.com/#sle.
 - 2. GenFlex Roofing Systems, LLC; ____: www.genflex.com/#sle.
 - 3. Versico Roofing Systems; VersiGard EPDM: www.versico.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Insulation:
 - 1. Dow: www.dow.com/#sle.
 - 2. GAF: www.gaf.com/#sle.
 - 3. Owens Corning Corporation: www.owenscorning.com/en-us/#sle.
 - 4. ROCKWOOL: www.rockwool.com/#sle.
 - 5. Versico Roofing Systems; SecurShield Insulation: www.versico.com/#sle.
- C. Cover Boards:

1. Blue Ridge Fiberboard: www.blueridgefiberboard.com/#sle.
2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 ROOFING - UNBALLASTED APPLICATIONS

- A. Elastomeric Membrane Roofing: One ply membrane, mechanically fastened, over vapor retarder and insulation.
- B. Roofing Assembly Requirements:
 1. Roof-Ceiling Fire Resistance Rating: Comply with UL (FRD) certified Assembly Design No. ____.
 2. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
 3. Insulation Thermal Resistance (R-Value): ____ per inch, minimum; provide insulation of thickness required.
- C. Acceptable Insulation Types - Constant Thickness Application: Any type that meets requirements and is approved by membrane manufacturer for application.
- D. Acceptable Insulation Types - Tapered Application: Any of types specified.

2.3 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane: Ethylene-propylene-diene-monomer (EPDM); externally reinforced with fabric; complying with minimum properties of ASTM D4637/D4637M.
 1. Thickness: 60 mil, 0.060 inch (1.5 mm), minimum.
 2. Sheet Width: 76 inches (1,930 mm), maximum; factory fabricate into widest possible sheets.
 3. Color: Black.
 4. Tensile Strength: 1305 psi (9.0 MPa), minimum, measured in accordance with ASTM D412.
 5. Ultimate Elongation: 300 percent, minimum, measured in accordance with ASTM D412.
 6. Durometer Hardness, Type A: 30, minimum, in accordance with ASTM D2240.
 7. Tear Strength: 150 lbf per inch (26.3 kN/m), measured in accordance with ASTM D624.
 8. Water Vapor Permeability: .1 perm inch (____ ng/(Pa s m)), measured in accordance with ASTM E96/E96M.
 9. Brittleness Temperature: -49 degrees F (-45 degrees C), measured in accordance with ASTM D746.
- B. Seaming Materials: As recommended by membrane manufacturer.
- C. Membrane Fasteners: As recommended by and approved by membrane manufacturer.
- D. Vapor Retarder: Reinforced Kraft paper laminate, complying with requirements of fire rating classification; compatible with roofing and insulation materials.
 1. Fire-retardant adhesive.
- E. Flexible Flashing Material: Same material as membrane.

2.4 DECK SHEATHING

2.5 COVER BOARDS

- A. Cover Boards: Coated cellulosic fiberboard complying with ASTM C208.
 - 1. Classifications: Type II, Grade I.
 - 2. Board Thickness: 1/2 inch (12.7 mm).
 - 3. Board Size: 48 by 96 inches (1220 by 2440 mm).
 - 4. Insulation Thermal Resistance, R-value (RSI-value): 1.3 (0.23), nominal.

2.6 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
 - 1. Classifications:
 - a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 1 - 16 psi (110 kPa), minimum.
 - 3) Thermal Resistance, R-value (RSI-value): At 1-1/2 inches (38 mm) thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F (24 degrees C).
 - 2. Board Size: 48 by 96 inches (1220 by 2440 mm).
 - 3. Board Thickness: 1.5 inch (37.5 mm).

2.7 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Cant Strips: Wood, pressure preservative treated; see Section 06 1000.
- C. Sheathing Joint Tape: Paper type, ___ inches (___ mm) wide, self adhering.
- D. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches (152 mm) wide; self adhering.
- E. Insulation Fasteners: Appropriate for purpose intended.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- F. Membrane Adhesive: As recommended by membrane manufacturer.
- G. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
- H. Thinners and Cleaners: As recommended by adhesive manufacturer, compatible with membrane.
- I. Insulation Adhesive: As recommended by insulation manufacturer.
- J. Sealants: As recommended by membrane manufacturer.

- K. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Composition: Roofing membrane manufacturer's standard.
 - 2. Surface Color: Black.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.2 PREPARATION - METAL DECK

- A. Install preformed acoustical glass fiber insulation strips in roof deck flutes in accordance with manufacturer's instructions; see Section 05 3100.
- B. Install deck sheathing on metal deck.
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
 - 3. Tape joints.

3.3 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

- A. Install vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions.
 - 1. Extend vapor retarder under cant strips and blocking to deck edge.
 - 2. Install flexible flashing from vapor retarder to air seal material of wall construction, lap and seal to provide continuity of the air barrier plane.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Attachment of Insulation:
 - 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
 - 2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
- D. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.

- E. Lay subsequent layers of insulation with joints staggered minimum 6 inches (152 mm) from joints of preceding layer.
- F. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- G. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.
- H. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- I. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- J. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches (457 mm).
- K. Do not apply more insulation than can be covered with membrane in same day.

3.4 INSTALLATION - MEMBRANE

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches (76 mm). Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- D. Mechanical Attachment: Install membrane and mechanical attachment devices in accordance with manufacturer's instructions.
- E. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 4 inches (102 mm) onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to nailing strips.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Coordinate installation of roof drains and sumps and related flashings.

3.5 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Remove bituminous markings from finished surfaces.
- C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- D. Repair or replace defaced or damaged finishes caused by work of this section.

3.6 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION 07 5300

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry for wood nailers, curbs and blocking.
- B. Section 07 7123 - Manufactured Gutters and Downspouts for premanufactured metal gutters, downspouts and accessories.

1.3 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 A755/A755M - Standard Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products; 2018.
- C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- D. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2024).
- E. CDA A4050 - Copper in Architecture - Handbook; Current Edition.
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples, ___ by ___ inches (___ by ___ mm) in size, illustrating metal finish color.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.
- B. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop is to be listed as able to fabricate required details as tested and approved.

1.6 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.
- C. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.7 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 SHEET MATERIALS

2.3 PREPAINTED, METALLIC-COATED STEEL SHEETS

- A. Description: Factory-applied coatings applied to metallic-coated steel sheet substrates prior to fabrication by coil coating; topcoat systems consist of primers and organic topcoats on exposed, top side of sheet; washcoats on bottom, unexposed sheet side.
- B. Comply with ASTM A755/A755M.
- C. Metallic-Coated Steel Sheet Substrates:
- D. Substrate Preparation for Prefinishing: Clean and prepare substrate surfaces in accordance with coating manufacturer's recommendations for substrate type and application.
- E. Washcoats or Backercoats: Provide washcoats or backercoats in accordance with organic coating manufacturer's recommendations.
- F. Primer Coats: Provide basecoat primers in accordance with coating manufacturer's recommendations for substrate type, topcoat, and application.
- G. Superior Performance Organic Coating System: Provide thermally cured 70-percent PVDF or FEVE fluoropolymer systems in accordance with AAMA 2605, tested for weathering for 10 years with 5 delta units maximum of color change.
- H. Application: Coping Caps, Parapet Caps, Cleats, Flashing, Counterflashing, Ledge Flashing, Sill Flashing, Fascia, Drip Fascia, Edge Fascia, Gutters, Downspouts, Scuppers, Trim, and Edge Trim.
 1. Coating System: High-performance organic coating system.
 2. Color: As selected by Architect from manufacturer's standard colors.

2.4 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch (13 mm); miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18-inch (450 mm) long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches (50 mm) over roofing gravel. Return and brake edges.

2.5 FLASHING

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.

2.6 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Slip Sheet: Rosin-sized sheathing paper.
- C. Primer Type: Zinc chromate.
- D. Concealed Sealants: Non-curing butyl sealant.
- E. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- F. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.

PART 3 EXECUTION

3.1 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.

3.2 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).

3.3 INSTALLATION

- A. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.
- B. Apply plastic cement compound between metal flashings and felt flashings.
- C. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- D. Seal metal joints watertight.

3.4 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 7100 - ROOF SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured roof specialties, including copings, fascias, and gravel stops.

1.2 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. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- C. NRCA (RM) - The NRCA Roofing Manual; 2025.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Roof Edge Flashings and Copings:
 - 1. Architectural Products Co: www.archprod.com/#sle.
 - 2. ATAS International, Inc: www.atas.com/#sle.
 - 3. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
 - 4. Metal-Era Inc: www.metalera.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Control and Expansion Joint Covers:
 - 1. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 2. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
 - 3. Johns Manville: www.jm.com/#sle.
 - 4. Metal-Era Inc: www.metalera.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- C. Counterflashings:
 - 1. ATAS International, Inc: www.atas.com/#sle.
 - 2. Hickman Edge Systems: www.hickmanedgesystems.com/#sle.
 - 3. Metal-Era Inc: www.metalera.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 COMPONENTS

- A. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.

1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
 2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
 3. Profile: To match existing.
 4. Outside Face Height: To match existing .
 5. Inside Face Height: 4 inches (102 mm).
 6. Material: Formed steel sheet, galvanized, 22 gauge, 0,03 inch (0.75 mm) thick, minimum.
 7. Finish: 70 percent polyvinylidene fluoride.
 8. Color: Custom, to match existing.
- B. Counterflashings: Factory fabricated and finished sheet metal that overlaps top edges of base flashing by at least 4 inches (102 mm), and designed to snap into through-wall flashing or reglets with lapped joints.
1. Material: Stainless steel sheet, 24 gauge, 0.025 inch (0.64 mm) thick, minimum.
 2. Finish: Unfinished metal.

2.3 FINISHES

- A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system; color as indicated.

2.4 ACCESSORIES

- A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
- B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
- B. Seal joints within components when required by component manufacturer.
- C. Anchor components securely.
- D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

- E. Coordinate installation of flashing flanges into reglets.

END OF SECTION 07 7100

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Rooftop mounted guardrails.
- B. Roof hatches.

1.2 RELATED REQUIREMENTS

- A. Other Division 07 Sections: For roofing material and construction.

1.3 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Ladders; Current Edition.
- B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- C. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.

1.4 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. Snow Guards: Submit construction details, material descriptions, dimensions of individual components and profiles, and finishes. Submit design calculations for loadings and spacings based on manufacturer testing.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.
 - 2. Ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 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.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for _____. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 ROOFTOP MOUNTED GUARDRAILS

- A. Rooftop Mounted Guardrails Manufacturers:
 - 1. Babcock-Davis: www.babcockdavis.com/#sle.
 - 2. EDGE Fall Protection: www.edgefallprotection.com/#sle.
 - 3. Safety Rail Company; SRC360 Mobile Safety Rail System: www.safetyrailcompany.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Non-Penetrating Rooftop Mounted Guardrails:
 - 1. Provide top and mid railings that comply with 29 CFR 1910.29.
 - 2. Structural Load: 200 lb (90.7 kg), minimum, in any direction with components in compliance with 29 CFR 1926.502.
 - 3. Height: 42 inches (1067 mm), minimum.
 - 4. Railings: 1-5/8 inches (41.3 mm) minimum outside diameter, hot-rolled, welded tubing, free of sharp edges and snag points.
 - 5. Steel Surface Finish: Hot-dip zinc galvanized, with color as selected by Architect.

2.2 ROOF HATCHES AND VENTS

- A. Roof Hatch Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; Diamond Series Roof Hatches, Model ____: www.activarecp.com/#sle.
 - 2. Acudor Products Inc; Galvanized Steel Roof Hatch: www.acudor.com/#sle.
 - 3. Babcock-Davis; Personnel: www.babcockdavis.com/#sle.
 - 4. Best Access Doors; Series BA-FRHTB - Fire-Rated Roof Hatch, Thermally Broken: www.bestaccessdoors.com/#sle.
 - 5. Bilco Company; Type TB (various types and special size): www.bilco.com/#sle.
 - 6. Nystrom, Inc; ____: www.nystrom.com/#sle.
 - 7. PS DOORS; Slidewise Roof Hatch: www.psddoors.com/#sle.
 - 8. Substitutions: See Section 01 6000 - Product Requirements.
- B. Roof Hatches and Smoke Vents: Factory-assembled aluminum frame and cover, complete with operating and release hardware.

1. Style: Provide flat metal covers unless otherwise indicated.
 2. Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.
 3. Size: As indicated on drawings; single-leaf style unless otherwise indicated.
 4. For Ships Ladder Access: Single leaf; 30 by 54 inches (762 by 1372 mm).
- C. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
- D. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf (475 kPa) load.
 2. Hinges: Heavy duty pintle type.
 3. Hold open arm with vinyl-coated handle for manual release.
 4. Latch: Upon closing, engage latch automatically and reset manual release.
 5. Manual Release: Pull handle on interior.
 6. Locking: Padlock hasp on interior.

2.3 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
 2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
- B. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
1. Railing Size: 30 by 54 inches (762 by 1372 mm).
 2. Railing: Comply with 29 CFR 1910.23 for ladder safety, with safety factor of two.
 3. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
 4. Posts and Rails: Galvanized steel tubing.
 5. Gate: Same material as railing; automatic closing with latch.
 6. Finish: Manufacturer's standard, factory-applied.
 7. Fasteners: Stainless steel, Type 316.

PART 3 EXECUTION

3.1 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.

3.2 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.

3.3 INSTALLATION

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

3.4 CLEANING

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

3.5 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 8100 - APPLIED FIRE PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Applied fire protection of interior structural steel not exposed to damage or moisture.

1.2 RELATED REQUIREMENTS

- A. Section 01 8113.14 - Sustainable Design Requirements - LEED v4 BD+C: VOC restrictions and other LEED requirements.
- B. Section 05 1200 - Structural Steel Framing.
- C. Section 05 3100 - Steel Decking.
- D. Section 07 8400 - Firestopping.
- E. Section 09 2116 - Gypsum Board Assemblies: Gypsum board fireproofing.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. ASTM E736/E736M - Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members; 2019 (Reapproved 2023).
- C. ASTM E760/E760M - Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members; 1992 (Reapproved 2023).
- D. ASTM E937/E937M - Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members; 1993 (Reapproved 2023).

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with placement of ceiling hanger tabs, mechanical component hangers, and electrical components.
- B. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data: Provide data indicating product characteristics.

- C. Test Reports: Reports from reputable independent testing agencies for proposed products, indicating compliance with specified criteria, conducted under conditions similar to those on project, as follows:
 - 1. Bond strength.
 - 2. Bond impact.
 - 3. Compressive strength.
 - 4. Fire tests using substrate materials similar those on project.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

1.6 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

1.7 FIELD CONDITIONS

- A. Do not apply fireproofing when temperature of substrate material and surrounding air is below 40 degrees F (4 degrees C) or when temperature is predicted to be below said temperature for 24 hours after application.
- B. Provide ventilation in areas to receive fireproofing during application and 24 hours afterward, to dry applied material.
- C. Provide temporary enclosure to prevent spray from contaminating air.
- D. Do not allow roof traffic during installation of roof fireproofing and drying period.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a two year period after Date of Substantial Completion.
 - 1. Include coverage for fireproofing to remain free from cracking, checking, dusting, flaking, spalling, separation, and blistering.
 - 2. Reinstall or repair failures that occur within warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Applied Fire Protection:
 - 1. GCP Applied Technologies: www.gcpat.com/#sle.
 - 2. Isolatek International Corp: www.isolatek.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 APPLIED FIRE PROTECTION ASSEMBLIES

- A. Provide assemblies as indicated on drawings.
- B. UL listings with a Load Restriction are not allowed.

2.3 MATERIALS

- A. Applied Fire Protection Material for Interior Applications, Concealed: Manufacturer's standard factory mixed material, which when combined with water is capable of providing indicated fire resistance, and complying with following requirements:
 - 1. Composition: Gypsum-based; not mineral-fiber-based.
 - 2. Bond Strength: 150 pounds per square foot (7.2 kPa), minimum, when tested in accordance with ASTM E736/E736M when set and dry.
 - 3. Dry Density: As required by fire resistance design.
 - 4. Compressive Strength: 8.33 pounds per square inch (57.4 kPa), minimum.
 - 5. Effect of Impact on Bonding: No cracking, spalling or delamination, when tested in accordance with ASTM E760/E760M.
 - 6. Corrosivity: No evidence of corrosion, when tested in accordance with ASTM E937/E937M.
 - 7. Surface Burning Characteristics: Maximum flame spread index of 0 (zero) and maximum smoke developed index of 0 (zero), when tested in accordance with ASTM E84.

2.4 ACCESSORIES

- A. Primer Adhesive: Of type recommended by applied fire protection manufacturer.
- B. Metal Lath: Expanded metal lath; minimum weight of 1.7 psf (8 kg/sq m), galvanized finish.
- C. Water: Clean, potable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive fireproofing. Repair existing fireproofing using same method as original installation or trowel installation techniques recommended by manufacturer.
- B. Verify that clips, hangers, supports, sleeves, and other items required to penetrate fireproofing are in place.
- C. Verify that ducts, piping, equipment, or other items that would interfere with application of fireproofing have not been installed.
- D. Verify that voids and cracks in substrate have been filled.
- E. Verify that projections have been removed where fireproofing will be exposed to view as a finish material.

3.2 PREPARATION

- A. Perform tests as recommended by fireproofing manufacturer in applications where adhesion of fireproofing to substrate is in question.
- B. Remove incompatible materials that could effect bond by scraping, brushing, scrubbing, or sandblasting.
- C. Prepare substrates to receive fireproofing in strict accordance with instructions of fireproofing manufacturer.
- D. Apply fireproofing manufacturer's recommended bonding agent on primed steel.
- E. Protect surfaces not scheduled for fireproofing and equipment from damage by overspray, fall-out, and dusting.
- F. Close off and seal duct work in areas where fireproofing is being applied.

3.3 APPLICATION

- A. Install metal lath over structural members as indicated or as required by UL Assembly Design Numbers.
- B. Apply primer adhesive in accordance with manufacturer's instructions.
- C. Apply fireproofing in uniform thickness and density as necessary to achieve required ratings.

3.4 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 4000 - Quality Requirements.
- B. Inspect installed fireproofing after application and curing for integrity, prior to its concealment.
- C. Ensure that actual thicknesses, densities, and bond strengths meet requirements for specified ratings and requirements of authorities having jurisdiction (AHJ).
- D. Repair or replace applied fireproofing at locations where test results indicate fireproofing does not meet specified requirements.
- E. Re-inspect installed fireproofing for integrity of fire protection, after installation of subsequent Work.

3.5 CLEANING

- A. Remove excess material, overspray, droppings, and debris.
- B. Remove fireproofing from materials and surfaces not required to be fireproofed.

END OF SECTION 07 8100

SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of joints and penetrations in fire-resistance-rated and smoke-resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.2 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2024.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2024.
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. FM (AG) - FM Approval Guide; Current Edition.
- H. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- I. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 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. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's qualification statement.

- G. Installer's qualification statement.

1.4 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.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Trained by manufacturer.

1.5 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop/#sle.
 - 2. Hilti, Inc: www.hilti.com/#sle.
 - 3. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

2.3 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.
- B. Firestopping at Uninsulated Metallic Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Caulk or putty.
- C. Firestopping at Combustible Pipe and Conduit Penetrations, of diameter 4 inches (100 mm) or less: Any material meeting requirements.
- D. Firestopping at Cable Penetrations, not in Conduit or Cable Tray: Caulk or putty.
- E. Firestopping at Control Joints (without Penetrations): Any material meeting requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 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.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Install labeling required by code.

3.4 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.

3.5 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 07 8400

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Nonstaining silicone joint sealants.
 - 2. Urethane joint sealants.
 - 3. Mildew-resistant joint sealants.
 - 4. Butyl joint sealants.
 - 5. Latex joint sealants.
 - 6. Joint sealant accessories.

1.3 RELATED REQUIREMENTS

- A. Section 07 9513.13 - Interior Expansion Joint Cover Assemblies.
- B. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.4 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. Backing material recommended by sealant manufacturer.
 - 3. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 - 4. Sample product warranty.
- B. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- C. Sustainable Design Documentation: For sealants and primers, submit VOC content and emissions documentation; see Section 01 6116.
- D. Samples for Initial Selection: Manufacturer's color cards consisting of physical sample strips of cured sealants showing the full range of colors available for each product exposed to view.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field-Adhesion-Test Reports: For each sealant application tested.
- C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 - 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 - 2. Disintegration of joint substrates from causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Sealants and Primers: Provide products with acceptable levels of volatile organic compound (VOC) content; see Section 01 6116.
- C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 MANUFACTURERS

- A. Source Limitations: Obtain joint sealants from single manufacturer for each sealant type.
- B. Subject to compliance with requirements, provide products by the following manufacturers, or approved equal:
 - 1. Adfast USA Inc: www.adfastcorp.com/#sle.
 - 2. Bostik Inc: www.bostik-us.com/#sle.
 - 3. Dow: www.dow.com/#sle.
 - 4. Everkem Diversified Products, Inc: www.everkemproducts.com/#sle.
 - 5. Franklin International, Inc: www.titebond.com/#sle.
 - 6. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/#sle.
 - 7. Pecora Corporation: www.pecora.com/#sle.
 - 8. Sika Corporation: www.usa.sika.com/#sle.
 - 9. Soudal, Inc.: www.soudalusa.com
 - 10. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 11. W. R. Meadows, Inc: www.wrmeadows.com/#sle.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

2.4 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT.

2.5 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.6 BUTYL JOINT SEALANTS

- A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

2.7 LATEX JOINT SEALANTS

- A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.8 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

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

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
 - e.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

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

3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform one test for each 1000 feet (30480 cm) of joint length thereafter or one test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - 3. Inspect tested joints and report on the following:
 - a. Whether sealants filled joint cavities and are free of voids.
 - b. Whether sealant dimensions and configurations comply with specified requirements.
 - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
- B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
 - a. Control and expansion joints in unit masonry.
 - b. Joints between metal panels.
 - c. Joints between different materials listed above.
 - d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - e. Control and expansion joints in ceilings and other overhead surfaces.
 - f. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in tile flooring.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, P, 25, T, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Tile control and expansion joints.
 - c. Vertical joints on exposed surfaces of walls and partitions.
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Urethane, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
 1. Joint Locations:
 - a. Control joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Acrylic latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated on Drawings.
 2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Concealed mastics.
 1. Joint Locations:
 - a. Aluminum thresholds.
 - b. Sill plates.
 - c. ???Insert other joints???
 - d. Other joints as indicated on Drawings.
 2. Joint Sealant: Butyl-rubber based ???Insert joint sealant???
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 9200

SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 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 and frames.
- E. Hollow metal borrowed lites glazing frames.

1.2 RELATED REQUIREMENTS

- A. Section 08 1416 - Flush Wood Doors.
- B. Section 08 7100 - Door Hardware.
- C. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- D. Section 09 9113 - Exterior Painting: Field painting.
- E. Section 09 9123 - Interior Painting: Field painting.

1.3 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. HMMA: Hollow Metal Manufacturers Association.
- C. NAAMM: National Association of Architectural Metal Manufacturers.
- D. NFPA: National Fire Protection Association.
- E. SDI: Steel Door Institute.
- F. UL: Underwriters Laboratories.

1.4 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; 2024.

- C. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2024.
- 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; 2025.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- 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; 2024.
- 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; 2024.
- 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; 2024.
- Q. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.
- 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; 2025.
- T. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- U. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- V. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- W. UL (DIR) - Online Certifications Directory; Current Edition.
- X. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

- Y. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.

1.5 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.
- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Provide hollow metal doors and frames from SDI Certified manufacturer: <https://steeldoors.org/sdi-certified/#sle>.
- 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.

1.7 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

2.1 MANUFACTURERS

- A. Hollow Metal Doors and Frames: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 3. The MPI Group, LLC.: www.metalproductsinc.com
 - 4. Steelcraft, an Allegion brand; ____: www.allegion.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.2 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 (galvanized) 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 (galvanized) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvanized) 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.

2.3 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 galvanized coating; ASTM A653/A653M.
 2. Door Core Material: Polystyrene, 1 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: Maximum assembly U-value of 0.37.
 4. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
 5. Top Closures: Flush with top of faces and edges.
 6. Door Face Sheets: Flush.

7. Weatherstripping: Refer to Section 08 7100.
8. 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 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 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.
 - e. Zinc Coating: A 40 /ZF 120 galvanized coating; ASTM A653/A653M. Provide galvanized interior doors at wet locations and as indicated in drawings.
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 Face Sheets: Flush.
5. Door Finish: Factory primed and field finished.

C. Fire-Rated Doors:

1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B, 500,000 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. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.
 - b. Maximum Air Leakage: 3.0 cfm/sq ft (0.02 cu m/sec/sq m) of door opening at 0.10 inch w.g. (24.9 Pa) pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 - c. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
 - d. Label: Include the "S" label on fire-rating label of door.
5. Door Core Material: Manufacturers standard rated door core material/construction in compliance with requirements.
6. Door Thickness: 1-3/4 inches (44.5 mm), nominal.
7. Door Face Sheets: Flush.
8. Door Finish: Factory primed and field finished.

2.4 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.

- C. 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.
- D. Interior Door Frames, Non-Fire Rated: Face welded type.
 - 1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch (150 mm), maximum, above floor at 45 degree angle.
 - 2. Frame Metal Thickness: 16 gauge, 0.053 inch (1.3 mm), minimum.
 - 3. Frame Finish: Factory primed and field finished.
- E. 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.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Transom Bars: Fixed, of profile same as jamb and head.
- I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches (102 mm) high to fill opening without cutting masonry units.
- K. Frames Wider than 48 inches (1219 mm): Reinforce with steel channel fitted tightly into frame head, flush with top.

2.5 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch (0.4 mm) dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 1. Fire-Rated Frames: Comply with fire rating requirements indicated.

2.6 ACCESSORIES

- A. Glazing: As specified in Section 08 8000, field installed.
- B. Frame Anchors: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

1. Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
 2. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
 3. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
- C. Removable Stops: Formed sheet steel, square profile, butted corners; prepared for countersink style tamper proof screws.
1. Form corner of stops with butted hairline joints.
 2. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 3. Multiple Glazed Lites: Provide fixed and removable stops so that each lite is capable of being removed independently.
- D. Astragals and Edges for Double Doors: Pairs of door astragals, and door edge sealing and protection devices.
1. UL listed products in compliance with requirements of authorities having jurisdiction.
 2. Provide surface mounted astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
 3. Edge Type: Beveled edge
 4. Provide non-corroding fasteners at exterior locations.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. 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.
- G. 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. Omit silencers on frames with seals or weatherstripping.
- H. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.1 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.

3.2 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 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.
 - 1. Hollow-Metal Frame Installation: Comply with ANSI/SDI A250.11.
 - 2. Non-Fire-Rated Steel Door Installation: Comply with ANSI/SDI A250.8.
 - 3. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- B. Install fire rated units in accordance with NFPA 80.
- C. Coordinate frame anchor placement with wall construction.
 - 1. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
 - 2. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- D. Solidly pack mineral-fiber insulation inside frames installed in metal stud or concrete construction.
- E. Fully insulate exterior hollow metal frames with spray foam or batt insulation prior to installation. Insulate per NFPA 80 and manufacturer's guidelines.
- F. Grout frames in masonry construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
- G. 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.
- H. Comply with glazing installation requirements of Section 08 8000.
- I. Coordinate installation of electrical connections to electrical hardware items.
- J. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - 1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- K. Touch up damaged factory primer finishes.

3.4 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.

3.5 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.6 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION 08 1113

SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush wood doors; flush configuration; fire-rated and non-rated.

1.2 RELATED REQUIREMENTS

- A. Section 08 1213 - Hollow Metal Frames.
- B. Section 08 7100 - Door Hardware.
- C. Section 08 8000 - Glazing.
- D. Section 09 9300 - Staining and Transparent Finishing: Field finishing of doors.

1.3 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- D. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- 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. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- H. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- I. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- J. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- K. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.
- L. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).

1.4 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.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- E. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Warranty, executed in Owner's name.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Woodwork Quality Assurance Program:
 - 1. Provide labels indicating that the installed 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 quality assurance program.
 - 3. Provide designated labels on installed products as required by quality assurance program.
 - 4. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.6 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; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.7 WARRANTY

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

1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 1. Forte Opening Solutions; Cendura Standard Wood Veneer Doors:
www.forteopenings.com/#sle.
 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Doors: See drawings for locations and additional requirements.
 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), AWMAC/WI (NAAWS) or WDMA I.S. 1A.
 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- C. Interior Doors: 1-3/4 inches (44 mm) thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location, except where otherwise indicated.
 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. Smoke and Draft Control Doors(Indicated as " SR " on the Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft (0.01524 cu m/s/sq m) of door opening at 0.10 inch wg (24.9 Pa) pressure at both ambient and elevated temperatures for "S" label; if necessary, provide additional gasketing or edge sealing.

2.2 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. 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.

2.3 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

2.4 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 1. Provide solid blocks at lock edge for hardware reinforcement.

2. Provide solid blocking for other throughbolt hardware.

- C. Where supplementary protective edge trim is required, install trim after veneer facing has been applied full-width.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.5 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:
- B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:

2.6 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 1113.
- B. Glazing: See Section 08 8000.
- C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- D. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.1 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.

3.2 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.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 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.
- E. Coordinate installation of glazing.

3.3 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.4 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION 08 1416

SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. UL (FRD) - Fire Resistance Directory; Current Edition.

1.3 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.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Fire-Rated Wall-Mounted Units:
 - 1. Location: Provide 30 doors - location TBD.
 - 2. Wall Fire-Rating: As indicated on drawings.
 - 3. Size: 12 by 12 inches (305 by 305 mm).
 - 4. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
- B. Fire-Rated Ceiling-Mounted Units:
 - 1. Location: Provide 30 doors - location TBD.
 - 2. Ceiling Fire-Rating: As indicated on drawings.
 - 3. Size: 12 by 12 inches (305 by 305 mm).
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.2 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group, Inc. - JL Industries; _____ :
www.activarcpg.com/#sle.
 - a. Multipurpose Access Panel: Activar/JL Industries TM.
 - 2. ACUDOR Products Inc; FW-5050-ACF: www.acudor.com/#sle.
 - 3. Best Access Doors: www.bestaccessdoors.com/#sle.
 - a. Universal Access Panel Drywall: Best Access Doors; Series BA-UAP.
 - 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. Material: Steel.
 - 2. Door Style: Single thickness with rolled or turned in edges.
 - 3. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - 4. Steel Finish: Primed.
 - 5. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
 - 6. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 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 3313 - COILING COUNTER DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated coiling counter doors and operating hardware.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Rough openings.
- B. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.3 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
- C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- D. Manufacturer's Installation Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.

1.5 QUALITY ASSURANCE

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

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for counterbalance shaft assembly. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Coiling Counter Doors:
 - 1. Clopay: www.clopaydoor.com/#sle.
 - 2. Overhead Door Corporation; Counter Door - Model 650: www.overheaddoor.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 COILING COUNTER DOORS

- A. Coiling Counter Metal Doors, Non-Fire-Rated: Stainless steel slat curtain.
 - 1. Mounting: Between jambs, within prepared opening.
 - 2. Nominal Slat Size: 1-1/4 inches (32 mm) wide.
 - 3. Slat Profile: Flat, perforated.
 - 4. Finish, Stainless Steel: No. 4 - Brushed.
 - 5. Guides: Formed track; same material and finish unless otherwise indicated.

2.3 COMPONENTS

- A. Metal Curtain Construction: Interlocking, single-thickness slats.
 - 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 - 2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
 - 3. Stainless Steel Slats: ASTM A666/A666M, Type 304; minimum thickness 22 gauge, 0.03 inch (0.8 mm).
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
 - 1. Stainless Steel Guides: ASTM A666, Type 304, rollable temper.
- C. Lock Hardware:
 - 1. Latching Mechanism: Inside mounted, adjustable keeper, spring activated latch bar feature to keep in locked or retracted position.
 - 2. Latch Handle: Manufacturer's standard.
- D. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of holding position at mid-travel; with adjustable spring tension; requiring 25 lb (10 kg) nominal force to operate.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that adjacent construction is suitable for door installation.

- B. Verify that door opening is plumb, header is level, and dimensions are correct.
- C. Notify Architect of any unacceptable conditions or varying dimensions.
- D. Commencement of installation indicates acceptance of substrate and door opening conditions.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.3 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch (1.5 mm).
- C. Maximum Variation From Level: 1/16 inch (1.5 mm).
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft (3 mm per 3 m) straight edge.

3.4 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.5 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION 08 3313

SECTION 08 4229 - AUTOMATIC ENTRANCES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sliding type packaged power-operated door assemblies.
- B. Controllers, actuators and safety devices.

1.2 RELATED REQUIREMENTS

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.

1.4 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/BHMA A156.38 - Low Energy Power Operated Sliding and Folding Doors; 2019.
- C. 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.
- D. BHMA A156.10 - Power Operated Pedestrian Doors; 2024.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate layout and dimensions; head, jamb, and sill conditions; elevations; components, anchorage, recesses, materials, and finishes, electrical characteristics and connection requirements.
 - 2. Identify installation tolerances required, assembly conditions, routing of service lines and conduit, and locations of operating components and boxes.

- C. Product Data: Include system components, sizes, features, and finishes.
- D. Maintenance Data: Include manufacturer's parts list and maintenance instructions for each type of hardware and operating component.
- E. Executed warranty.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience, and a member of AAADM.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for _____. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sliding Automatic Entrance Door Assemblies:
 - 1. ASSA ABLOY Entrance Solutions; Besam SL500: www.besam-usa.com/#sle.
 - 2. Stanley Access Technologies; DuraFit Telescoping Automatic Doors: www.stanleyaccess.com/#sle.

2.2 POWER OPERATED DOORS

- A. Power Operated Doors: Provide products that comply with NFPA 101 and requirements of authorities having jurisdiction; provide equipment selected for actual door weight and for light pedestrian traffic, unless otherwise indicated.
 - 1. Sliding and Folding Door Operators: In the event of power failure, provide for manual open, close, and break-away operation of door leaves.
 - 2. Packaged Door Assemblies: Provide components by single manufacturer, factory-assembled, including doors, frames, operators, actuators, and safeties.
 - a. Finish exposed equipment components to match door and frame finish.
 - 3. Air Leakage: Maximum of 1.0 cfm/sf (5.0 L/sec/sq m) of wall area, when tested in accordance with ASTM E283/E283M at 1.57 psf (75 Pa) pressure differential across assembly.
- B. Sliding and Folding Doors with Full Power Operators: Comply with BHMA A156.10; safeties required; provide break-away operation unless otherwise indicated; in the event of break-away operation, interrupt power operation.
 - 1. Force Required to Swing Break-Away Panel: 50 pound-force (220 N), maximum, measured at 1 inch (25 mm) from the latch edge of the door at any point in the closing cycle.

2.3 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. Comply with ADA Standards for egress requirements.
- B. Door and Sidelight Construction: Heavy duty interlocked extruded aluminum tubular stile and rail sections, through-rod bolted construction with steel corner support at hinge stile of carrier-suspended swinging panels or mechanically fastened corners with welded reinforcing brackets to reduce sag in sliding or breakout mode.
 - 1. Door Thickness: 1-3/4 inch (44.5 mm), nominal.
 - 2. Stile Design:
 - 3. Top Rail Height: 4 inch (102 mm), nominal.
 - 4. Bottom Rail Height: 4 inch (102 mm), nominal.
 - 5. Glazing Stops: Manufacturer's standard snap-on extruded aluminum square stops with preformed resilient glazing gaskets.
 - 6. Glazing Stop Width: Manufacturers standard.
 - 7. Glazing Thickness: 1/4 inch (6 mm).

2.4 CONTROLLERS, ACTUATORS, AND SAFETIES

- A. Controller: Provide microprocessor operated controller for each door.
- B. Comply with BHMA A156.10 for actuator and safety types and zones.
- C. Photo-Electric Actuator/Safety: Horizontal single ray device, with aluminum housing for light source and relay units.

2.5 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Characteristics:
- B. 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.
- C. Disconnect Switch: Factory mount disconnect switch in control panel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that electric power is available, at the correct location, and is of the correct characteristics.

3.2 INSTALLATION

- A. Install equipment in accordance with manufacturer's written instructions, except where more stringent requirements are specified.

3.3 ADJUSTING

- A. Adjust entrances for correct function and smooth operation, without binding or scraping and without excessive noise; lubricate operating hardware and other moving parts.

3.4 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Remove temporary protection; clean exposed surfaces.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7900 - Demonstration and Training for additional requirements.
- B. Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.6 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Provide service and maintenance of operating equipment for one year from Date of Substantial Completion, at no extra charge to Owner.

END OF SECTION 08 4229

SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront systems.
- B. Aluminum framed entrance doors.
- C. Weatherstripping.

1.2 RELATED REQUIREMENTS

- A. Section 08 4229 - Automatic Entrances.
- B. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- C. Section 08 8000 - Glazing: Glass and glazing accessories.

1.3 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; 2025.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum; 2025.
- D. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- 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).

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

1.5 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.
- 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.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
 - 1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
 - a. North American Contractor Certification (NACC) for glazing contractors.

1.7 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.

1.8 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 to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Aluminum-Framed Storefronts:
 - 1. CMI Architectural; www.cmiarch.com
 - 2. Kawneer North America; _____: www.kawneer.com/#sle.
 - 3. Oldcastle BuildingEnvelope; _____: www.oldcastlebe.com/#sle.
 - 4. Tubelite, Inc; _____: www.tubeliteinc.com/#sle.
 - 5. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed above.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.2 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style, Thermally-Broken (Exterior Wall Locations):
 - 1. Screw spline assembly construction.
 - 2. Basis of Design: Kawneer; Trifab VG Series 601T storefront.
 - 3. Basis of Design: Oldcastle; 6000 XT Series storefront
- B. Center-Set Style, Not Thermally-Broken (Interior Wall Locations):
 - 1. Screw spline assembly construction.
 - 2. Mullion Dimensions: 2 inches wide by 4-1/2 inches deep (50 mm wide by 114 mm deep).
- C. Provide taller profile system and sidelight base mullions as indicated in drawings.
- D. Provide inside- or outside-glazed systems as required for system performance.

2.3 BASIS OF DESIGN -- FRAMING FOR MONOLITHIC GLAZING

- A. Center-Set Style, Non-Thermally-Broken (Interior Locations):
 - 1. Screw-spline construction.
 - 2. Basis of Design: Kawneer; Trifab VG Series 450 storefront
- B. Provide taller profile system and sidelight base mullions as indicated in drawings.

2.4 BASIS OF DESIGN -- SWINGING DOORS

- A. Swinging Entrance Doors, General:
 - 1. Unless otherwise indicated, swing doors to be provided by same manufacturer as storefront framing system.
 - 2. Unless otherwise indicated, swing doors to be finished to match storefront framing.
 - 3. Refer to drawings for locations and sizes of aluminum entrance door leafs.
 - 4. Provide infill stops as required for glazing thicknesses indicated in drawings.
- B. Standard Swinging Entrance Doors, Non-Thermally-Broken:
 - 1. Basis of Design: Kawneer 350 Standard Entrance door.
 - 2. Basis of Design: Tubelite Standard Medium Stile entrance door.
 - 3. Thickness: 1-3/4 inches (43 mm).

4. Glazing types as indicated in drawings.
 5. Glazing stops: Square.
 6. Door stile design: Medium stile, 3-1/2 inch nominal width.
 7. Bottom door rail height: Manufacturer's standard.
 8. Provide intermediate horizontal rail at height indicated in drawings.
 - a. Rail dimension 3-1/2 inches, nominal.
 9. Locations: At all locations.
- C. Swinging Entrance Doors, Thermally-Broken:
1. Basis of Design: Kawneer 'Insulpur' 500T Thermal Entrances
 2. Basis of Design: Tubelite Thermal=Block Medium Stile entrance door.
 3. Stiles to be constructed with thermal isolation breaks.
 4. Thickness: 2-1/4 inches (57.1 mm).
 5. Glazing stops: Square.
 6. Door stile design: Wide stile, 5 inch nominal width.
 7. Bottom door rail height: 6-1/2 inches, nominal.
 8. Provide intermediate horizontal rail at height indicated in drawings.
 - a. Rail dimension 6 inches, nominal.
 9. Locations: At all exterior wall locations.
- D. Substitutions: See Section 01 6000 - Product Requirements.
1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.5 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 Position: Centered (front to back).
 2. Finish: Class I color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 3. Finish Color: Black.
 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.

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. 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.
4. Overall U-value Including Glazing, Fixed Fenestration: U-0.29, maximum.
5. Overall U-value Including Glazing, Operable Fenestration: U-0.36, maximum.
6. Overall U-value Including Glazing, Entrance Doors: U-0.63, maximum.

2.6 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, with thermal breaks, drainage holes and internal weep drainage system as required for application.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
- B. Glazing: See Section 08 8000.

2.7 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. Exposed Aluminum Sheet Closures: 20 gauge, 0.032 inch (0.81 mm) minimum thickness; finish to match framing members.
- E. Sealant for Setting Thresholds: Non-curing butyl type.
- F. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- G. Glazing Accessories: See Section 08 8000.

2.8 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils (0.018 mm) thick.

2.9 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.
- F. Automatic Door Operators and Actuators: See Section 08 4229.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.2 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 hardware using templates provided.
 - 1. See Section 08 7100 for hardware installation requirements.
 - 2. See Section 08 4229 for operator and actuator installation requirements.
- K. Install glass and infill panels using glazing method required to achieve performance criteria; see Section 08 8000.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 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).

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.
- B. 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.
- C. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.5 ADJUSTING

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

3.6 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.

3.7 PROTECTION

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

END OF SECTION 08 4313

SECTION 08 7100 - DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hardware for wood, aluminum, and hollow metal doors.
- B. Hardware for fire-rated doors.
- C. Electrically operated and controlled hardware.
- D. Lock cylinders for doors that hardware is specified in other sections.
- E. Thresholds.
- F. Weatherstripping and gasketing.

1.2 RELATED REQUIREMENTS

- A. Section 08 4313 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
- B. Section 08 7113 - Power Door Operators.
- C. Section 28 1000 - Access Control: Electronic access control devices.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. BHMA (CPD) - Certified Products Directory; Current Edition.
- C. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- D. BHMA A156.2 - Bored and Preassembled Locks and Latches; 2022.
- E. BHMA A156.3 - Exit Devices; 2025.
- F. BHMA A156.4 - Door Closers and Pivots; 2024.
- G. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- H. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
- I. BHMA A156.7 - Template Hinge Dimensions; 2022.
- J. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
- K. BHMA A156.15 - Release Devices - Closer Holder, Electromagnetic and Electromechanical; 2021.

- L. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.
- M. BHMA A156.22 - Standard for Gasketing; 2021.
- N. BHMA A156.31 - Electric Strikes and Frame Mounted Actuators; 2024.
- O. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- P. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- Q. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.
- R. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.
- S. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- T. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- U. ITS (DIR) - Directory of Listed Products; Current Edition.
- V. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- W. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- X. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Y. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2025.
- Z. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- AA. UL (DIR) - Online Certifications Directory; Current Edition.
- BB. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- CC. UL 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- C. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- D. Keying Requirements Meeting:

1. Schedule meeting at project site prior to Contractor occupancy.
2. Attendance Required:
 - a. Contractor.
 - b. Owner.
 - c. Hardware Installer.
3. Agenda:
 - a. Establish keying requirements.
 - b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.
4. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - a. Access control requirements.
 - b. Key control system requirements.
5. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.
6. Deliver established keying requirements to manufacturers.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- C. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
 3. List groups and suffixes in proper sequence.
 4. Provide complete description for each door listed.
 5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 6. Include account of abbreviations and symbols used in schedule.
- D. Shop Drawings - Electrified Door Hardware: Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC).
 2. Elevations: Submit front and back elevations of each door opening showing electrified devices with connections installed and an operations narrative describing how opening operates from either side at any given time.
 3. Diagrams: Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- F. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- G. Keying Schedule:
 - 1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- H. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
- I. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Lock Cylinders: Ten for each master keyed group.
 - 3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.6 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 for commercial door hardware with at least three years of documented experience.
- C. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) and Electrified Hardware Consultant (EHC) to assist in work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in Owner's name and register with manufacturer.
 - 1. Closers: Five years, minimum.
 - 2. Exit Devices: Three years, minimum.
 - 3. Locksets and Cylinders: Three years, minimum.
 - 4. Other Hardware: Two years, minimum.

PART 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Provide door hardware products that comply with the following requirements:
 - 1. Applicable provisions of federal, state, and local codes.
 - 2. Accessibility: ADA Standards and ICC A117.1.
 - 3. Applicable provisions of NFPA 101.
 - 4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR), ITS (DIR), testing firm acceptable to authorities having jurisdiction, or _____ as suitable for application indicated.
 - 6. Hardware for Smoke and Draft Control Doors (Indicated as "S" on Drawings): Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
 - 7. Listed and certified compliant with specified standards by BHMA (CPD).
 - 8. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
 - 9. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
 - 10. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.
- D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.
 - 1. See Section 28 1000 for additional access control system requirements.
- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
- F. Fasteners:
 - 1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
 - 2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
 - a. Self-drilling (Tek) type screws are not permitted.
 - 3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
 - 4. Provide wall grip inserts for hollow wall construction.

5. Provide spacers or sex bolts with sleeves for through bolting of hollow metal doors and frames.
6. Fire-Rated Applications: Comply with NFPA 80.
 - a. Provide wood or machine screws for hinges mortised to doors or frames, strike plates to frames, and closers to doors and frames.
 - b. Provide steel through bolts for attachment of surface mounted closers, hinges, or exit devices to door panels unless proper door blocking is provided.
7. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

2.2 HINGES

- A. Manufacturers:
 1. Best, dormakaba Group: www.bestaccess.com/#sle.
 2. McKinney; an Assa Abloy Group company; ____: www.assaabloydss.com/#sle.
 3. Hager Companies; ____: www.hagerco.com/#sle.
 4. Ives, an Allegion brand: www.allegion.com/us/#sle.
 5. BEST, dormakaba Group; ____: www.bestaccess.com/#sle.
- B. Hinges: Comply with BHMA A156.1, Grade 1.
 1. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
 - a. Provide hinge width required to clear surrounding trim.
 2. Provide hinges on every swinging door.
 3. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
 4. Provide non-removable pins on exterior outswinging doors.
 5. Provide non-removable pins on interior outswinging doors at locations as indicated.
 6. Provide power transfer hinges where electrified hardware is mounted in door leaf.
 7. Provide following quantity of butt hinges for each door:
 - a. Doors From 60 inches (1.5 m) High up to 90 inches (2.3 m) High: Three hinges.
 - b. Doors over 90 inches (2.3 m) High: One additional hinge per each additional 30 inches (762 mm) in height.

2.3 EXIT DEVICES

- A. Manufacturers:
 1. Von Duprin, an Allegion brand; ____: www.allegion.com/us/#sle.
- B. Exit Devices: Comply with BHMA A156.3, Grade 1.
 1. Lever design to match lockset trim.
 2. Provide cylinder with cylinder dogging or locking trim.
 3. Provide exit devices properly sized for door width and height.
 4. Provide strike as recommended by manufacturer for application indicated.
 5. Provide UL (DIR) listed exit device assemblies for fire-rated doors and panic device assemblies for non-fire-rated doors.

2.4 ELECTRIC STRIKES

- A. Manufacturers:

- B. Electric Strikes: Comply with BHMA A156.31, Grade 1.
 - 1. Provide UL (DIR) listed burglary-resistant electric strike; style to suit locks.
 - 2. Provide non-handed 24 VDC electric strike suitable for door frame material and scheduled lock configuration.
 - 3. Provide transformer and rectifier as necessary for complete installation.

2.5 LOCK CYLINDERS

- A. Manufacturers:
- B. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
 - 1. Provide standard and full size interchangeable core (FSIC) type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
 - 2. Provide cylinders from same manufacturer as locking device.
 - 3. Provide cams and/or tailpieces as required for locking devices.
 - 4. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.

2.6 CYLINDRICAL LOCKS

- A. Manufacturers:
- B. Cylindrical Locks (Bored): Comply with BHMA A156.2, Grade 1, 4000 Series.
 - 1. Bored Hole: 2-1/8 inch (54 mm) diameter.
 - 2. Latchbolt Throw: 1/2 inch (12.7 mm), minimum.
 - 3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
 - 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.
 - 5. Provide lockset or latchset with function as specified in door hardware schedule.
 - 6. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.7 MORTISE LOCKS

- A. Manufacturers:
- B. Mortise Locks: Comply with BHMA A156.13, Grade 1, Security, 1000 Series.
 - 1. Latchbolt Throw: 3/4 inch (19 mm), minimum.
 - 2. Deadbolt Throw: 1 inch (25.4 mm), minimum.
 - 3. Backset: 2-3/4 inch (70 mm) unless otherwise indicated.
 - 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Finish: To match lock or latch.
 - 5. Provide lockset or latchset with function as specified in door hardware schedule.
 - 6. Trim: Provide lever handle or pull trim on outside of each lock, unless otherwise indicated.

2.8 COORDINATORS

- A. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
 - 1. Type: Bar, unless otherwise indicated.
 - 2. Material: Stainless steel, unless otherwise indicated.
 - 3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.9 REMOVABLE MULLIONS:

- A. BHMA A156.3 extruded aluminum.
- B. When used with panic exit devices on paired doors, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing in accordance with UL 305. Use only mullions that have been tested with exit devices to be used.

2.10 CLOSERS

- A. Manufacturers; Surface Mounted:
 - 1. LCN, an Allegion brand; ____: www.allegion.com/us/#sle.
- B. Closers: Comply with BHMA A156.4, Grade 1.
 - 1. Type: Surface mounted to door.
 - 2. Provide accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
 - 3. Provide closers with functions as specified in door hardware schedule.
 - 4. Provide door closer on each exterior door.
 - 5. Provide door closer on each fire-rated and smoke-rated door.
 - a. Spring hinges are not an acceptable self-closing device, unless otherwise indicated.
 - 6. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
 - 7. At corridor entry doors, mount closer on room side of door.
 - 8. At outswinging exterior doors, mount closer on interior side of door.

2.11 POWER DOOR OPERATORS

- A. See Section 08 7113.

2.12 PROTECTION PLATES

- A. Manufacturers:
 - 1. Burns Manufacturing, Inc.: www.burnsmfg.com
 - 2. Hager Companies; ____: www.hagerco.com/#sle.
 - 3. Hiawatha, Inc, an Activar Construction Products Group company; ____: www.activarcpg.com/hiawatha/#sle.

4. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
 5. Trimco; _____: www.trimcohardware.com/#sle.
 6. Substitutions: See Section 01 6000 - Product Requirements.
- B. Protection Plates: Comply with BHMA A156.6.
- C. Metal Properties: Stainless steel material.
1. Metal, Standard Duty: Thickness 0.050 inch (1.27 mm), minimum.
- D. Edges: Beveled, on four sides unless otherwise indicated.
- E. Fasteners: Countersunk screw fasteners.
- F. Plate Width: Provide plates that are 2 inches (51 mm) less door width (LDW) on single doors and 1 inch (25 mm) LDW on each leaf of paired doors..
- G. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16" are provided for labeled doors, the plate shall be labeled.

2.13 KICK PLATES

- A. Manufacturers:
1. Burns Manufacturing, Inc.: www.burnsmfg.com
 2. Hiawatha, Inc, an Activar Construction Products Group company; _____: www.activarcpg.com/hiawatha/#sle.
 3. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
 4. Trimco; _____: www.trimcohardware.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
1. Height: 10 inch (254 mm).

2.14 MOP PLATES

- A. Manufacturers:
1. Burns Manufacturing, Inc.: www.burnsmfg.com
 2. Hiawatha, Inc, an Activar Construction Products Group company; _____: www.activarcpg.com/hiawatha/#sle.
 3. Ives, an Allegion brand; _____: www.allegion.com/us/#sle.
 4. Trimco; _____: www.trimcohardware.com/#sle.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Mop Plates: Provide along bottom edge of push side of doors to provide protection from cleaning liquids and equipment damage to door surface.
1. Height: 4 inch (102 mm).

2.15 ELECTROMAGNETIC DOOR HOLDERS

- A. Manufacturers:
 - 1. LCN, an Allegion brand; SEM 7800 Series: www.allegion.com/us/#sle.
- B. Electromagnetic Door Holders: Comply with BHMA A156.15.
 - 1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
 - 2. Holding Force, Standard Duty: 40 lbs-force (177 N), minimum.
 - 3. Voltage: 12 VDC, and provide power supplies by same manufacturer as holders.
 - 4. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

2.16 WALL STOPS

- A. Manufacturers:
 - 1. Burns Manufacturing, Inc.; 570 Series: www.burnsmfg.com
 - 2. Hager Companies; 230 Series: www.hagerco.com/#sle.
 - 3. Ives, an Allegion brand; WS406 Series: www.allegion.com/us/#sle.
 - 4. Trimco; ____: www.trimcohardware.com/#sle.
- B. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
 - 1. Type: Bumper, concave, wall stop.
 - 2. Material: Aluminum housing with rubber insert.

2.17 WEATHERSTRIPPING AND GASKETING

- A. Manufacturers:
 - 1. Pemko; an Assa Abloy Group company; ____: www.assaabloydss.com/#sle.
 - 2. National Guard Products, Inc; ____: www.ngpinc.com/#sle.
 - 3. Reese Enterprises, Inc; ____: www.reeseusa.com/#sle.
 - 4. Zero International, Inc; ____: www.zerointernational.com/#sle.
- B. Weatherstripping and Gasketing: Comply with BHMA A156.22.
 - 1. Head and Jamb Type: Adjustable.
 - 2. Door Sweep Type: Encased in retainer.
 - 3. Material: Aluminum, with brush weatherstripping.

2.18 FINISHES

- A. Finishes: Identified in Section 08 0671 - Door Hardware Schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

- B. Verify that electric power is available to power operated devices and of correct characteristics.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
- B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.
- C. Install hardware for smoke and draft control doors in accordance with NFPA 105.
- D. Use templates provided by hardware item manufacturer.
- E. Do not install surface mounted items until application of finishes to substrate are fully completed.
- F. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list, unless noted otherwise on drawings.
 - 1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
 - 2. For Aluminum-Framed Storefront Doors and Frames: See Section 08 4313.
 - 3. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
 - 4. Mounting heights in compliance with ADA Standards:
- G. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.3 ADJUSTING

- A. Adjust work under provisions of Section 01 7000 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.4 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.5 PROTECTION

- A. Protect finished Work under provisions of Section 01 7000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION 08 7100

SECTION 08 7100.13 - DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preliminary schedule of door hardware sets for swinging doors as indicated on drawings.

1.2 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware: Requirements to comply with in coordination with this section.
- B. Section 08 7113 - Power Door Operators: Requirements for power door operators.

1.3 REFERENCE STANDARDS

- A. BHMA A156.18 - Standard for Materials and Finishes; 2020.

1.4 SUBMITTALS

- A. Comply with submittal requirements as indicated in Section 08 7100.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Only manufacturers listed in Door Hardware Schedule or Section 08 7100 are considered acceptable, unless noted otherwise.
- B. Obtain each type of door hardware as indicated from a single manufacturer and single supplier.
- C. Products are listed and certified compliant with specified standards by BHMA (CPD).
- D. Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 08 7100.
 - 1. BUR - Burns Manufacturing, Inc.
 - 2. GLY - Glynn Johnson.
 - 3. HES - HES.
 - 4. IVE - Ives.
 - 5. LCN - LCN.
 - 6. REE - Reese
 - 7. SCH - Schlage.
 - 8. VON - Von Duprin.
 - 9. ZRO - Zero Industries, Inc.

2.2 DESCRIPTION

- A. Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.
 - 1. Necessary items that are not included in a Hardware Set should be added and have the appropriate additional hardware as required for proper application and functionality.
 - 2. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
 - 3. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.

2.3 LOCK FUNCTION CODES

- A. Function Codes for Cylindrical Locks: Complying with BHMA A156.5.
 - 1. Code F75; Passage: Latch retracted by knobs/levers at all times.
 - 2. Code F76; Privacy Lock: Outside knob/lever locked by pushbutton on inside knob/lever. Rotating inside knob/lever or closing door releases/unlocks button. Emergency release in outside knob/lever.
 - 3. Code F80; Communicating Lock: Deadlocking latch bolt by levers except when either lever is locked by key in its own cylinder.
 - 4. Code F84; Classroom Lock: Outside knob/lever locked/unlocked by key in outside knob/lever. Inside knob/lever always free. Deadlocking latchbolt.
 - 5. Code F86; Storeroom Lock: Outside knob/lever always locked/rigid. Latchbolt retracted by key in outside knob/lever or by rotating inside knob/lever. Inside knob/lever always free. Deadlocking latchbolt.
 - 6. Code F109; Entry/Office Lock: Turn/Push button locking. Pushing and turning button on inside locks outside knob/lever requiring use of a key until button is manually unlocked. Push button locking. Pushing button locks the outside knob/lever until unlocked by key or by turning the inside knob/lever. Inside knob/lever always free.
 - 7. Code F110; Classroom Security Lock: Key cylinder both sides. Outside lever locked/unlocked by key in either lever. Inside lever always free.
- B. Function Codes for Exit Devices: Complying with BHMA A156.3.
 - 1. Code 01; Exit Device: Exit only/no trim.
 - 2. Code 03; Exit Device: Entrance by trim when latchbolt is retracted by key (pullside). Unit is locked when the key is removed.
 - 3. Code 08; Exit Device: Entrance by knob/lever. Key (pullside) locks/unlocks knob/lever.

2.4 FINISHES

- A. Finishes: Complying with BHMA A156.18.
 - 1. Code 626: Satin chromium plated over nickel, with brass or bronze base material (former US equivalent US26D).
 - 2. Code 628: Clear anodized aluminum.
 - 3. Code 630: Satin stainless steel, with stainless steel 300 series base material (former US equivalent US32D).
 - 4. Code 652: Satin chromium plated over nickel, with steel base material (former US equivalent US26D).

5. Code 689: Aluminum painted, with any base material (former US equivalent US28).

PART 3 EXECUTION

3.1 DOOR HARDWARE SCHEDULE

- A. Organize listing of door hardware components within each hardware set in compliance with 10-Part scheduling sequence indicated in DHI (H&S), unless otherwise indicated.
- B. **HARDWARE SCHEDULE NOTES:**
1. Wall stop or overhead stop to be provided where scheduled as installation configuration warrants.
 2. ADD door seal set to all smoke- or fire-resistance rated doors - see Door Schedule. Gasketing to be ZRO 188S or approved equal, length as required.
 3. All doors specified without weatherstripping, gaskets or seals shall have frame silencers. Provide IVE SR64 or approved equal, minimum 3 per door (2 for double doors).
 4. Interface electric strike or latch retraction release operation with door security / lockdown system and power operator where indicated

3.2 **HARDWARE SET #01, #01A: TOILET ROOMS**

- A. Provide for each interior Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F76	PRIVACY LOCK	ND40S	626	SCH
1 EA		CLOSER ^A	4011	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	626	GLY
1EA		ARMOR PLATE	8400 LDW B4E	630	IVE

- B. **FUNCTION:** ANSI Function F76 – Lever with emergency release recessed slot outside; push button in lever inside; springlatch. In unlocked state latch is retracted by either lever. Outside lever is made inoperative by pushing button on inside lever. Rotating inside lever retracts latch and releases button unlocking outside lever; closing door also unlocks preventing lockout. Emergency unlock: an emergency key or small, flat screwdriver inserted in outside lever and turned releases button to unlock. Inside lever always free for immediate egress.

- C. **NOTES:**

1. ^A **Set #01A:** DELETE closer this door.

3.3 **HARDWARE SET #02, 02A: OFFICES**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F109	ENTRANCE LOCK	ND53	626	SCH
1 EA		WALL STOP	WS406CVX	626	IVE

OR		OVERHEAD STOP	90S	630	GLY

- B. FUNCTION: ANSI Function F109 – Outside lever is locked or unlocked by push/turn button on inside; Entrance by key only when locked – Inside lever is always unlocked.

C. NOTES:

1. ^ASet #02A: ADD closer LCN 4011 this door.

3.4 **HARDWARE SET #03: LATCH ONLY**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F75	PASSAGE LATCH	ND10	626	SCH
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	900S	630	GLY

- B. FUNCTION: ANSI Function F75 – Latch retracted by either lever at all times.

3.5 **HARDWARE SET #04, #04A: STORAGE ROOMS**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F86	STOREROOM LOCK	ND80	626	SCH
1 EA		CLOSER ^A	4011	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
1 EA		KICK PLATE	8400 10"x2" LDW	630	IVE

- B. FUNCTION: ANSI Function F86 – Outside lever is always locked; Entrance by key only – Inside lever is always unlocked.

C. NOTES:

1. ^ASet #04A: DELETE closer this door.

3.6 **HARDWARE SET #05: INTERIOR EGRESS DOORS - POWERED**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
		POWER TRANSFER HINGE	VDE-EPT-10		VON
1 EA	08	ELEC PANIC DEVICE	QEL-99L	626	VON
1 EA		CYLINDER	90S		SCH
1 EA		POWER OPERATOR	4642	689	LCN

1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
1 EA		KICK PLATE	8400 10"x2" LDW	630	IVE
		CARD READER			
		POWER SUPPLY			
		WIRING DIAGRAM			

- B. FUNCTION: Lever panic hardware with electric latch retraction. Outside lever locked and unlocked by outside key. Latch electrically retracted by intercom or door access system for push/pull operation. Inside push pad retracts latch for egress.

3.7 **HARDWARE SET #05A: INTERIOR EGRESS DOORS - MANUAL**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	08	PANIC DEVICE	QEL-99L	626	VON
1 EA		CYLINDER	90S		SCH
1 EA		CLOSER	4041	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
1 EA		KICK PLATE	8400 10"x2" LDW	630	IVE
		CARD READER			
		POWER SUPPLY			
		WIRING DIAGRAM			

- B. FUNCTION: Lever panic hardware with electric latch retraction. Outside lever locked and unlocked by outside key. Latch electrically retracted by intercom or door access system for push/pull operation. Inside push pad retracts latch for egress.

3.8 **HARDWARE SET #06: CORRIDOR DOORS, ELEC STRIKE**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F86	STOREROOM LOCK	ND80	626	SCH
1 EA		ELECTRIC STRIKE	5200-630-LBM		HES
1 EA		CLOSER	4041-EDA	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
		CARD READER			
		POWER SUPPLY			
		WIRING DIAGRAM			

- B. FUNCTION: ANSI Function F86 – Outside lever is always locked; Entrance by key or when door is released by electric strike. Inside lever is always unlocked.

3.9 **HARDWARE SET #06A: CORRIDOR DOORS, MANUAL**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F86	STOREROOM LOCK	ND80	626	SCH
1 EA		CLOSER	4011	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY

- B. FUNCTION: ANSI Function F86 – Outside lever is always locked; Entrance by key only – Inside lever is always unlocked.

3.10 **HARDWARE SET #07: LATCH ONLY WITH CLOSER**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F75	PASSAGE LATCH	ND10	626	SCH
1 EA		CLOSER	4011	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY

- B. FUNCTION: ANSI Function F75 – Latch bolt retracted by either lever at all times.

3.11 **HARDWARE SET #08: CLASSROOMS**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F110	CLASSROOM SECURITY LOCK	ND78	626	SCH
1 EA		CLOSER	4041-EDA	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY

- B. FUNCTION: ANSI Function F110: Outside lever locked/unlocked by key in either lever. Inside lever always free. Deadlocking latchbolt.

3.12 **HARDWARE SET #09: RECEPTION ENTRANCES**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR

EA		HINGES	AS REQUIRED	652	IVE
1 EA	F86	STOREROOM LOCK	ND80	626	SCH
1 EA		ELECTRIC STRIKE	5200-630-LBM		HES
1 EA		CLOSER	4041-EDA	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
		CARD READER			
		POWER SUPPLY			
		WIRING DIAGRAM			

- B. FUNCTION: ANSI Function F86 – Outside lever is always locked; Entrance by key or when door is released by electric strike. Inside lever is always unlocked.

3.13 **HARDWARE SET #10: CONTROLLED ACCESS TO CORRIDORS**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	F80	COMMUNICATING LOCK	ND72	626	SCH
1 EA		ELECTRIC STRIKE	5200-630-LBM		HES
1 EA		CLOSER	4041-EDA	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
1 EA		CARD READER			
1 EA		REX WAVE DEVICE			
		POWER SUPPLY			
		WIRING DIAGRAM			

- B. FUNCTION: ANSI Function F80: Key Clinder both sides. Either lever locked or unlocked by key in that lever; Door opened by key either side, or when released by electric strike. Note: Both levers can be locked at same time to prevent access from either direction.

3.14 **HARDWARE SET #11: INTERIOR EMERGENCY EXIT**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	08	PANIC DEVICE	99L	626	VON
1 EA		CYLINDER	90S		SCH
1 EA		CLOSER	4041	689	LCN
1 EA		WALL STOP	WS406CVX	626	IVE
OR		OVERHEAD STOP	90S	630	GLY
1 EA		KICK PLATE	8400 10"x2" LDW	630	IVE

- B. FUNCTION: Lever panic hardware. Outside lever locked and unlocked by outside key. Inside push pad retracts latch for egress.

3.15 **HARDWARE SET #12: EXTERIOR EMERGENCY EXIT ONLY**

- A. Provide for each Single (SGL) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA	01	PANIC DEVICE	99-EO	626	VON
1 EA		CLOSER	4041-EDA	689	LCN
1 EA		OVERHEAD STOP	100S	630	GLY
1 EA		DOOR SWEEP	8198	628	ZER
1SET		WEATHERSTRIP	429	BLK	ZER
1 EA		RAIN DRIP	142	628	ZER
1 EA		THRESHOLD	S282-A	MILL	REE

- B. FUNCTION: Egress panic hardware. No entry from exterior. Inside push pad retracts latch for egress.

3.16 **HARDWARE SET #21: ENTRANCE VESTIBULE DOORS - INTERIOR**

A. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA		POWER TRANSFER HINGE	VDE-EPT-10		VON
2 EA	03	ELEC PANIC DEVICE	QEL-99L	626	VON
2 EA		CYLINDER	90S		SCH
1 EA		REMOVABLE MULL	KR 5654	628	VON
1 EA		POWER OPERATOR	4642	689	LCN
2 EA		PUSH PLATES			LCN
1 EA		CLOSER	4041-EDA	689	LCN
2 EA		OVERHEAD STOP	100S	630	GLY
2 EA		KICK PLATE	8400 10"x2" LDW	630	IVE
		CARD READER			
		POWER SUPPLY			
		WIRING DIAGRAM			

- B. FUNCTION: Lever panic hardware with electric latch retraction. Entrance by outside key. Door locks when key is removed. Latch electrically retracted by door access system for push/pull operation. Inside push pad retracts latch for egress.

3.17 **HARDWARE SET #22: SECONDARY EXIT VESTIBULE DOORS - EXTERIOR**

A. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
2 EA	03	PANIC DEVICE	99-L	626	VON
2 EA		CYLINDER	90S		SCH
1 EA		REMOVABLE MULL	KR 5654	628	VON
2 EA		CLOSER	4041-EDA	689	LCN
2 EA		OVERHEAD STOP	100S	630	GLY
2 EA		KICK PLATE	8400 10"x2" LDW	630	IVE
2 EA		DOOR SWEEP	8198	628	ZER
2 SETS		WEATHERSTRIP	429	BLK	ZER
1 EA		RAIN DRIP	142	628	ZER
EA		THRESHOLD	S282-A	MILL	REE

- B. FUNCTION: Lever panic hardware. Entrance by outside key only. Door locks when key is removed. Inside push pad retracts latch for egress.

3.18 **HARDWARE SET #23: SECONDARY EXIT VESTIBULE DOORS - INTERIOR**

A. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
2 EA		PUSH/PULL BAR	422x26C	630	BUR
2 EA		CLOSER	4041-EDA	689	LCN
2 EA		OVERHEAD STOP	100S	630	GLY
2 EA		KICK PLATE	8400 10"x2" LDW	630	IVE

B. FUNCTION: No lock or latch. Free ingress and egress at all times.

3.19 **HARDWARE SET #26: ENTRANCE VESTIBULE DOORS - WILDER**

A. Provide for each Pair (PR) door(s).

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		HINGES	AS REQUIRED	652	IVE
1 EA		POWER TRANSFER HINGE	VDE-EPT-10		VON
2 EA	08	ELEC PANIC DEVICE	QEL-99NL	626	VON
2 EA		CYLINDER	90S		SCH
2 EA		DOOR PULL	VP4241 24"	630	BUR
1 EA		REMOVABLE MULL	KR 5654	628	VON
1 EA		POWER OPERATOR	4642	689	LCN
2 EA		PUSH PLATES ^A			LCN
1 EA		CLOSER	4041-EDA	689	LCN
2 EA		OVERHEAD STOP	100S	630	GLY
2 EA		KICK PLATE	8400 10"x2" LDW	630	IVE
2 EA		DOOR SWEEP	8198	628	ZER
2 SETS		WEATHERSTRIP	429	BLK	ZER
1 EA		RAIN DRIP	142	628	ZER
EA		THRESHOLD	S282-A	MILL	REE
		CARD READER			
		POWER SUPPLY			
		WIRING DIAGRAM			

B. FUNCTION: Lever panic hardware with electric latch retraction. Ingress by outside key. Latch electrically retracted by door access system for push/pull operation. Inside push pad retracts latch for egress.

3.20 **HARDWARE SET #30: SLIDING WOOD (BARN) DOORS**

A. All hardware is specified in Section 08 1473.13 - Sliding Aluminum-Framed Wood Doors.

UNITS	LOCK	ITEM	DESCRIPTION	FINISH	MFR
EA		FRAME/SLIDE ASSY	AS REQUIRED		
1 EA		OFFICE LOCK			
2 EA		PULLS			

B. FUNCTION: Thumbturn privacy lock on office side of door, with keyway on hallway side.

END OF SECTION 08 7100.13

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Monolithic glazing units.
- C. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- B. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
- C. Section 08 4313 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
- D. Section 08 8813 - Fire-Rated Glazing.

1.3 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- D. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- F. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- G. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.
- H. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- I. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- J. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.

- K. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.4 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 and ICC's IBC by qualified engineer, using the following design criteria:
 - 1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on location, exposure category, basic wind speed, and heights above grade indicated on drawings.
 - a. Building Importance Factor: 1.0
 - 2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 - 3. Maximum Lateral Deflection: For glass supported on all four edges, limit center of glass deflection at design wind pressure to not more than 1/50 times the short-side length of 1", whichever is less.
 - 4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data on All Specified 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 inch (304 by 304 mm) in size of glass units.
 - 1. Provide samples of size sufficient to represent graphics or pattern to be supplied, no less than 8 inches square.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

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

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Glass Fabricators:
 - 1. GGI - General Glass International: www.generalglass.com/#sle.
 - 2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com/#sle.
 - 3. Viracon, Inc: www.viracon.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Float Glass Manufacturers:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 - 2. Guardian Glass, LLC: www.guardianglass.com/#sle.
 - 3. Pilkington North America Inc: www.pilkington.com/na/#sle.
 - 4. Saint Gobain North America: www.saint-gobain.com/#sle.
 - 5. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
 - 6. Substitutions: See Section 01 6000 - Product Requirements.

2.2 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. 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.

2.3 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.4 INSULATING GLASS UNITS

- A. Manufacturers:
 1. Glass: Any of the manufacturers specified for float glass.
- B. Insulating Glass Units, General: Types as indicated and located on drawings.
 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. Warm-Edge Spacers: Low-conductivity thermoplastic with desiccant warm-edge technology design.
 - a. Spacer Width: As required for specified insulating glass unit.
 - b. Spacer Height: Manufacturer's standard.
 4. Spacer Color: Black.
 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: Black.
 6. Purge interpane space with dry air, hermetically sealed.
- C. Type IG-11 - Insulating Glass Units: Tinted vision glass, double glazed.
 1. Applications: Exterior glazing unless otherwise indicated.
 2. Space between lites filled with argon.
 3. Outboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 - a. Tint: Graylite II.
 - b. Coating: Low-E (passive type), on #2 surface.
 4. Warm-edge spacer.
 5. Inboard Lite: Annealed float glass, 1/4 inch (6.4 mm) thick, minimum.
 6. Total Thickness: 1 inch (25.4 mm).
 7. Visible Light Transmittance (VLT): _____ percent, nominal.
 8. Shading Coefficient: .35, nominal.
 9. Solar Heat Gain Coefficient (SHGC): .35, nominal.
 10. Visible Light Reflectance, Outside: _____ percent, nominal.

- D. Type IG-20 - Insulating Glass Units: Clear safety glazing.
1. Applications, exterior glazing unless otherwise indicated:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 2. Space between lites filled with argon.
 3. Glass Type: Same as Type IG-10 except use fully tempered float glass for both outboard and inboard lites.
 4. Total Thickness: 1 inch (25.4 mm).
 5. Warm-edge spacer.
 6. Visible Light Transmittance (VLT): _____ percent, nominal.
 7. Shading Coefficient: _____, nominal.
 8. Solar Heat Gain Coefficient (SHGC): _____, nominal.
- E. Type IG-30 - 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: Greylite II.
 - b. Coating: Same as on vision units, on #2 surface.
 4. Warm-edge spacer.
 5. 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: _____.
 6. Total Thickness: 1 inch (25.4 mm).

2.5 SINGLE-PANE GLAZING UNITS

- A. Type G-1 - Monolithic Vision Glazing:
1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch (6.4 mm), nominal.
- B. Type G-2 - Tempered Monolithic Safety Glazing: Non-fire-rated.
1. Applications: Interior glazing unless otherwise indicated.
 2. Provide at the following locations, except where fire-rated glass is indicated or required.
 - a. Glazed lites in doors.
 - b. Glazed sidelights to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 3. Glass Type: Fully tempered safety glass as specified.
 4. Tint: Clear.
 5. Thickness: 1/4 inch (6.4 mm), nominal.

2.6 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

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- C. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 INSTALLATION, GENERAL

- A. Install glazing of Types designated in locations indicated in drawings.
- B. 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.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

3.4 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.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Monitor and report installation procedures and unacceptable conditions.

3.6 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.

3.7 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 08 8813 - FIRE-RATED GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire-rated glazing units.
- B. Glazing compounds.

1.2 RELATED REQUIREMENTS

- A. Section 08 1113 - Hollow Metal Doors and Frames: Glazed lites in doors, borrowed lites, and transoms.
- B. Section 08 1416 - Flush Wood Doors: Glazed lites in doors.
- C. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

1.3 DEFINITIONS

- A. Fire-Resistance-Rated Glazing (FRG-): Glazing that prevents spread of fire and smoke and radiant heat and complies with requirements for rated walls and rated openings; capable of blocking radiant heat.
- B. Fire-Protection-Rated Glazing (FPG-): Glazing that prevents spread of fire and smoke and complies with requirements for rated openings; incapable of blocking radiant heat.

1.4 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- G. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2024.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.

- I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.
- K. GANA (SM) - GANA Sealant Manual; 2008.
- L. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- M. ITS (DIR) - Directory of Listed Products; Current Edition.
- N. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- O. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2022.
- P. UL (DIR) - Online Certifications Directory; Current Edition.
- Q. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- R. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- S. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- T. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data on 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. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Samples: Two samples 12 by 12 inch (305 by 305 mm) in size of glass units.
- F. Certificate: Certify that products of this section meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.

- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of type specified in this section.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty for Laminated Glass: Provide 5-year manufacturer warranty coverage for delamination, including providing products to replace failed units, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
 - 1. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
- C. Manufacturer's Special Warranty for Tempered Glazing Units with Clear Intumescent Interlayer: Provide 5-year manufacturer warranty coverage to replace units that deteriorate, providing products to replace failed units, and commencing on the Date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.
 - 1. Deterioration of tempered glazing units with clear intumescent interlayer is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning glass contrary to manufacturer's written instructions. Evidence of failure is air bubbles within units, or obstruction of vision by contamination or deterioration of intumescent interlayer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire-Resistance-Rated Glass:
 - 1. Fabricators:
 - a. McGrory Glass, Inc: www.mcgrory.com/#sle.
 - b. Technical Glass Products: www.fireglass.com/#sle.
 - 2. Manufacturers:
 - a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL: www.safti.com/#sle.
 - b. Pilkington North America Inc; ____: www.pilkington.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fire-Protection-Rated Glass:
 - 1. Fabricators:
 - a. McGrory Glass, Inc: www.mcgrory.com/#sle.
 - b. Technical Glass Products: www.fireglass.com/#sle.
 - 2. Manufacturers:
 - a. McGrory Glass, Inc: www.mcgrory.com/#sle.

- b. SAFTIFIRST, a division of O'Keeffe's Inc: www.safti.com/#sle.
- c. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Provide type and thickness of exterior glazing assemblies to support assembly dead loads and 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 lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 - 3. Glass thicknesses listed are minimum.
- C. Fully Tempered Safety Glass: Comply with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

2.3 GLASS MATERIALS

- A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction
- B. 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 FT - Fully Tempered Type: Comply with ASTM C1048.
 - a. Comply with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
- C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 - 1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
 - 2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch (0.762 mm) thick, minimum.

2.4 GLAZING UNITS

- A. Type FRG-1 - Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flames, smoke, and blocks radiant heat, as required to achieve indicated fire rating period exceeding 45 minutes.
 - 1. Applications:
 - a. Glazing in fire-rated door assembly.
 - b. Glazing in fire-rated window assembly.

- c. Glazing in sidelites, borrowed lites, and other glazed openings in fire-rated wall assemblies.
 - d. Other locations as indicated on drawings.
- 2. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
- 3. Safety Glazing Certification: 16 CFR 1201 Category II.
- 4. Glazing Method: As required for fire rating.
- 5. Fire Rating Period: As indicated on drawings.
- 6. Markings for Fire-Resistance-Rated Glazing Assemblies: Provide permanent markings on fire-resistance-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
 - a. "W" - meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
 - b. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
 - d. "T" - meets temperature rise of not more than 450 degrees F (250 degrees C) above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
 - e. "XXX" - placeholder that represents fire rating period, in minutes.
- B. Type FPG-1 - Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire rating period as indicated on drawings.
 - 1. Applications:
 - a. Glazing in fire-resistance-rated door assembly.
 - b. Glazing in fire-resistance-rated window assembly.
 - c. Other locations as indicated on drawings.
 - 2. Glass Type: As required for listed fire-resistance rating..
 - 3. Provide products listed by ITS (DIR) or UL (DIR) and approved by authorities having jurisdiction.
 - 4. Safety Glazing Certification: 16 CFR 1201 Category II.
 - 5. Glazing Method: As required for fire rating.
 - 6. Fire-Rating Period: As indicated on drawings.
 - 7. Markings for Fire-Protection-Rated Glazing Assemblies: Provide permanent markings on fire-protection-rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction
 - a. "D" - meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - b. "OH" - meets fire window assembly criteria, including hose stream test of NFPA 257 or UL 9 fire test standards.
 - c. "H" - meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire tests standards.
 - d. "XXX" - placeholder that represents fire-rating period, in minutes.
 - 8. Basis of Design Products:
 - a. Substitutions: See Section 01 6000 - Product Requirements.

2.5 GLAZING COMPOUNDS

- A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.6 ACCESSORIES

- A. Setting Blocks: Aluminum silicate, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Continuous by one half the height of glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape: Flexible tape made from spun calcium-magnesium-silica fibers in binder; designed to remain stable at temperatures up to 2,012 degrees F (1,100 degrees C).
 - 1. Thickness: As recommended by framing manufacturer for glazing application.
- D. Glazing Gaskets: Flexible intumescent seals.

2.7 SOURCE QUALITY CONTROL

- A. Glass: For each glass type, obtain from single source from single manufacturer.
- B. Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.
- C. Provide shop inspection and testing for fire-rated glass.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that minimum required face and edge clearances are 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.
- D. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 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 referenced glazing standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with contaminating substances that may result from construction operations including, but not limited to weld spatter, fire-safing, plastering, mortar droppings, etc.

3.4 FIELD QUALITY CONTROL

- A. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.

3.5 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 four days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.6 PROTECTION

- A. After installation, mark pane with '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 8813

SECTION 09 2116 - GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal stud wall framing.
- B. Gypsum sheathing.
- C. Cementitious backing board.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Structural steel stud framing.
- B. Section 06 1000 - Rough Carpentry: Exterior gypsum sheathing.
- C. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- D. Section 07 2100 - Thermal Insulation: Acoustic insulation.
- E. Section 07 2500 - Weather Barriers: Water-resistive barrier over sheathing.
- F. Section 07 2600 - Vapor Retarders: Vapor-impermeable membranes.
- G. Section 07 2700 - Air Barriers: Air- and water-resistive barrier over sheathing.
- H. Section 07 9200 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.
- I. Section 09 2216 - Non-Structural Metal Framing.

1.3 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
- D. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

- E. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.
- F. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.
- G. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- H. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing; 2025.
- I. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- J. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.
- K. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2024.
- L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- M. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- N. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- O. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2025.
- P. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide data on gypsum board, accessories, and joint finishing system.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company: www.americangypsum.com/#sle.
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.
 - 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 4. Gold Bond Building Products, LLC provided by National Gypsum Company: www.goldbondbuilding.com/#sle.
 - 5. PABCO Gypsum: www.pabcogypsum.com/#sle.
 - 6. USG Corporation: www.usg.com/#sle.
 - 7. 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 whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required at all locations.
 - 3. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch (16 mm).
 - b. Ceilings: 5/8 inch (16 mm).
 - 5. Paper-Faced Products:
 - a. USG Corporation; Sheetrock Brand Firecode X Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 6. Mold-Resistant, Paper-Faced Products:
 - a. USG Corporation; Sheetrock Brand Mold Tough Firecode SCX Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Abuse Resistant Wallboard:
 - 1. Application: Classrooms and common spaces.
 - 2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 4. Soft Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 5. Hard Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 7. Type: Fire-resistance-rated Type X, UL or WH listed.
 - 8. Thickness: 5/8 inch (16 mm).
 - 9. Edges: Tapered.

10. Paper-Faced Products:
 - a. USG Corporation; Sheetrock Brand Mold Tough AR Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- D. Impact Resistant Wallboard:
1. Application: Corridors and other high-traffic areas.
 2. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 3. Indentation: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
 4. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 5. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 7. Type: Fire-resistance-rated Type X, UL or WH listed.
 8. Thickness: 5/8 inch (16 mm).
 9. Edges: Tapered.
 10. Paper-Faced Products:
 - a. USG Corporation; Sheetrock Brand Mold Tough VHI Firecode X Panels 5/8 in. (15.9 mm): www.usg.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- E. Backing Board For Wet Areas:
1. Application: Surfaces behind tile in wet areas, including tub and shower surrounds.
 2. Application: Horizontal surfaces behind tile in wet areas including countertops.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch (16 mm).
 - b. Products:
 - 1) USG Corporation; Durock Cement Board: www.usg.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- F. 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. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Type: Regular and Type X, in locations indicated.
 5. Type X Thickness: 5/8 inch (16 mm).
 6. Regular Board Thickness: 1/2 inch (13 mm).
 7. Edges: Tapered.
 8. Products:
 - a. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.

- b. Substitutions: See Section 01 6000 - Product Requirements.
- G. Exterior Sheathing Board: See Section 06 1000.
- H. Shaftwall and Coreboard: Type X; 1 inch (25 mm) thick by 24 inches (600 mm) wide, beveled long edges, ends square cut.
 - 1. Paper-Faced Type: Gypsum shaftliner board or gypsum coreboard as defined ASTM C1396/C1396M; water-resistant faces.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. Paper-Faced Products:
 - a. USG Corporation; Sheetrock Brand Gypsum Liner Panels 1 in. (25.4 mm) SLX: www.usg.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.2 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: See Section 07 2100.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
- C. Vapor Retarder: See Section 07 2600.
- D. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
 - 1. Corner Beads: Low profile, for 90 degree outside corners.
 - 2. L-Trim with Tear-Away Strip: Sized to fit 5/8-inch (16 mm) thick gypsum wallboard.
 - 3. Expansion Joints:
 - a. Fire-Resistance Rated: 1 hour when joint system tested in accordance with UL 2079.
 - b. Type: V-shaped PVC with tear away fins.
 - c. Type: V-shaped metal with factory-installed protective tape.
 - d. Type: Off-angle inside corner expansion.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Paper Tape: 2 inch (50 mm) wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 2. Joint Compound: Drying type, vinyl-based, ready-mixed.
- F. 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.
- G. 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.
- H. Nails or staples are not an acceptable fastening method.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Verify recess-mounted items and installed and in correct configuration.

3.2 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.
 - 1. On walls over sixteen feet high, screw-attach studs to runners top and bottom.

3.3 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place continuous bead at perimeter of each layer of gypsum board.
 - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.4 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. Cut board neatly to minimize gap around recess-mounted devices.
- C. Install abuse- and impact-resistant gypsum board to 72 inches (1830 mm) minimum above finish floor.
- D. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 - 1. Seal joints, cut edges, and holes with water-resistant sealant.
- F. Cementitious Backing Board: Install over steel framing members where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- G. Installation on Metal Framing: Use screws for attachment of gypsum board.
 - 1. Adhesive attachment may be utilized where layer is installed directly over masonry or concrete substrate.
- H. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and according to ASTM C840 and GA-216
 - 1. Not more than 30 feet (10 meters) apart on walls and ceilings over 50 feet (16 meters) long.
 - 2. Install wall control joints up from corners of openings as indicated on Drawings and as directed by Architect.
 - 3. Install control joints in fire-resistance rated walls according to GA-234.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.6 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B. 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 3: Walls to receive textured wall finish.
 - 3. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 4. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - 5. Level 0: Surfaces indicated to be finished in later stage of project.
- C. 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).
- D. Fill and finish around recess-mounted access panels, expansion joint assemblies and other devices without perimeter trim.
- E. Ensure edge of GWB finish will be fully concealed by device trims.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.7 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.

3.8 PROTECTION

- A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION 09 2116

SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking within stud framing.
- B. Section 07 2100 - Thermal Insulation: Acoustic insulation.

1.3 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 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; 2025.
- E. ASTM A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members; 2015.
- F. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.
- H. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- I. 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.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

- C. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.5 QUALITY ASSURANCE

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. CEMCO; ____: www.cemcosteel.com/#sle.
 - 2. ClarkDietrich; ____: www.clarkdietrich.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FRAMING MATERIALS

- A. Steel Sheet: ASTM A1003/A1003M, subject to the ductility limitations indicated in AISI S220.
 - 1. Structural Grade: As required to meet design criteria.
- B. Non-Loadbearing Framing System Components: AISI S220; sheet steel, of size and properties necessary for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf (L/240 at 240 Pa).
 - 1. Studs: C-shaped with flat faces.
 - a. Products:
 - 1) CEMCO; CT Studs: www.cemcosteel.com/#sle.
 - 2) ClarkDietrich; ProSTUD: www.clarkdietrich.com/#sle.
 - 3) MarinoWARE; ViperStud Drywall Framing: www.marinoware.com/#sle.
 - 4) MBA Building Supplies; ProSTUD: www.mbastuds.com/#sle.
 - 5) Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Runners: U-shaped, sized to match studs.
 - 3. Ceiling Channels: U-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch (22 mm).
 - 5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch (12 mm) channel depth.
 - a. Products:
 - 1) ClarkDietrich; RC Deluxe Resilient Channel: www.clarkdietrich.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- C. Shaft Wall Studs and Accessories: AISI S220; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
 - 1. Products:
 - a. Same manufacturer as other framing materials.

- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws, and anti-friction bushings, preventing 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.
- E. Non-Loadbearing Framing Accessories:
 - 1. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - a. Materials: ASTM A36/A36M formed sheet steel support member with factory-welded ASTM A1003/A1003M steel plate base.
 - 2. Bracing and Bridging: ASTM A653/A653M G90 (Z275) galvanized steel; for lateral bracing of wall studs with slots for engaging on-module studs.
 - 3. Framing Connectors: ASTM A653/A653M steel clips; secures cold rolled channel to wall studs for lateral bracing.
 - 4. Fasteners: ASTM C1002 self-piercing self-tapping screws.
 - 5. Anchorage Devices: Powder actuated.
 - 6. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness as required for STC.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.2 INSTALLATION OF STUD FRAMING

- A. Install non-structural members in accordance with ASTM C754.
- B. Extend partition framing to structure in all locations.
- C. 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. Align and secure top and bottom runners at 24 inches (600 mm) on center.
- E. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- F. Install studs vertically at 16 inches (400 mm) on center unless indicated otherwise in Drawings.
- G. Align stud web openings horizontally.
- H. Secure studs to tracks using crimping method. Do not weld.
- I. Stud splicing is not permissible.

- J. Fabricate corners using a minimum of three studs.
- K. Install double studs at wall openings, door and window jambs, not more than 2 inches (50 mm) from each side of openings.
- L. Brace stud framing system rigid.
- M. Coordinate erection of studs with requirements of door frames; install supports and attachments.
- N. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- O. Blocking: Use wood blocking secured to studs. Provide blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and opening frames.
 - 1. Utilize fire-retardant treated wood blocking as required.
- P. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches (150 mm).

3.3 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed them in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- E. Space main carrying channels at maximum 72 inches (1 800 mm) on center, and not more than 6 inches (150 mm) from wall surfaces. Lap splice securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches (50 mm) from perimeter walls, and rigidly secure. Lap splices securely.
- H. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches (600 mm) past each opening.
- I. Laterally brace suspension system.

3.4 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet (3 mm in 3 m).

B. Maximum Variation From Plumb: 1/8 inch in 10 feet (3 mm in 3 m).

END OF SECTION 09 2216

SECTION 09 3000 - TILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Tile for shower receptors.
- D. Cementitious backer board as tile substrate.
- E. Ceramic trim.
- F. Non-ceramic trim.

1.2 RELATED REQUIREMENTS

- A. Section 03 5400 - Cast Underlayment: Hydraulic and cementitious underlayments where required by TCNA (HB) or TCNA (HB-GP) method specified.
- B. Section 07 9200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- C. Section 07 9513 - Expansion Joint Cover Assemblies: Expansion joint components.
- D. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- E. Section 09 2116 - Gypsum Board Assemblies: Tile backer board.
- F. Section 22 4017 - Bathtubs and Showers: Shower receptors.

1.3 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2024.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- C. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar; 2023.
- D. 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.

- E. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
- F. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
- G. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation; 2019.
- H. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- I. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
- J. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2024).
- K. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- L. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials; 2021.
- M. 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).
- N. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2024.
- O. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane; 2017 (Reapproved 2022).
- P. ASTM D4551 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane; 2022.
- Q. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- R. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- S. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.
- U. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation; 2023.

1.4 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. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples for Initial Selection: For tile, grout, and accessories involving color selection.
- E. Product Certificates: For each type of product.
- F. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.
- G. Installer's qualification statement.
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation; www.tile-assn.com/#sle
 - 2. Submit documentation of completion of apprenticeship and certification programs.
- H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- 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 Tile: 3 percent of each size, color, and surface finish combination.
 - 3. Extra Grout: 3 percent of amount installed for each type, composition, and color indicated.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
 - 1. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).
- B. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 - 2. Installer Certification:
 - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
 - b. Advanced Certifications for Tile Installers (ACT): Certification in installation of membranes, mortar bed (mud) floors, mortar (mud) walls, shower receptors, large format tile, gauged porcelain tile/panels/slabs, and grouts.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.

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

1.7 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F (10 degrees C) and below 100 degrees F (38 degrees C) during installation and curing of setting materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tile:
 - 1. Crossville: www.crossville.com.
 - 2. Virginia Tile; virginiatile.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
 - 4. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- B. Setting Materials:
 - 1. Bostik Inc: www.bostik.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
 - 3. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.
- C. Grout:
 - 1. Bostik Inc: www.bostik.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
 - 3. Source Limitations: Furnish products produced by single manufacturer and obtained from single supplier.

2.2 PERFORMANCE REQUIREMENTS

- A. Floor Tile: Provide tile for flooring applications with minimum wet Dynamic Coefficient of Friction (DCOF) of 0.42 when tested in accordance with ANSI A326.3.

2.3 TILE

- A. Porcelain Mosaic Tile, Type CTF-2:
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: 2 by 2 inch (51 by 51 mm), nominal.
 - 3. Shape: Square.
 - 4. Surface Finish: Cross-Sheen (UPS).
 - 5. Color: As indicated on drawings.
 - 6. Products:
 - a. Crossville; Portugal: www.crossville.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

- B. Porcelain Tile, Type CTF-1: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: 24 by 24 inch (609.6 by 609.6 mm), nominal.
 - 3. Thickness: 3/8 inch (9.5 mm).
 - 4. Surface Finish: Cross Sheen (UPS).
 - 5. Color: As indicated on drawings.
 - 6. Trim Units: Matching cove base and cove shapes in sizes indicated on drawings.
 - 7. Products:
 - a. Crossville ; Portugal: www.crossville.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Porcelain Tile, Type CTW-1: ANSI A137.1 standard grade.
 - 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 - 2. Size: [12 by 24] inch ([305 by 609.6] mm) , nominal.
 - 3. Thickness: 3/8 inch (9.5 mm).
 - 4. Surface Finish: Cross Sheen (UPS).
 - 5. Color: As indicated on drawings.
 - 6. Products:
 - a. Crossville ; Alaska: www.crossville.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.4 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: Satin nickel anodized, style and dimensions as indicated on drawings, set with tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall tile.
 - b. Inside and outside wall corners.
 - c. Transition between floor finishes of different heights.
 - d. Thresholds at door openings.
 - e. Floor-to-wall joints.
 - 2. Products:
 - a. Schluter-Systems; As indicated on drawings: www.schluter.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.5 SETTING MATERIALS

- A. Cementitious Underlayments: See Section 03 5400.
- B. Provide setting and grout materials from same manufacturer.
- C. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
 - 1. Products:
 - a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
 - b. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
 - c. Bostik; PM: www.bostik.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

- D. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 - 1. Products:
 - a. ARDEX Engineered Cements; A 38: www.ardexamericas.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: www.laticrete.com/#sle.
 - c. Bostik Mud-In-A-Bag: www.bostik.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.

2.6 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Urethane Grout: ANSI A118.3 chemical resistant and water-cleanable urethane grout.
 - 1. Color: As indicated on drawings.
 - 2. Products:
 - a. Bostik TruColor Rapid Cure: <https://www.bostik.com/>.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.7 MAINTENANCE MATERIALS

- A. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.8 ACCESSORY MATERIALS

- A. Waterproofing Membrane Showers: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
 - 1. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber.
 - b. Products:
 - 1) LATICRETE International, Inc; HYDRO BAN: www.laticrete.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
- B. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch (11 mm) thick; 2-inch (51 mm) wide coated glass fiber tape for joints and corners.
- C. Mesh Tape: 2 inch (50 mm) wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

- B. Verify subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive tile.
- C. Verify wall surfaces are smooth and flat within tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- D. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- E. 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.
 - 3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- F. Verify that concrete substrates for tile floors installed with adhesives or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - 1. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - 2. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
- G. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Vacuum clean surfaces and damp clean.
- B. Seal substrate surface cracks with filler.
- C. Install cementitious backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to feather edge.
- D. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.
- E. See Section 03 5400 for installation of cementitious underlayment.

3.3 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108/A118/A136, manufacturer's instructions, and TCNA (HB) or TCNA (HB-GP) recommendations, as applicable.
- B. Lay tile to pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Do not interrupt tile pattern through openings.
- C. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that face of tiles are flush.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints, unless otherwise indicated.
 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints.
 - E. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
 - F. Cut and fit tile to penetrations through tile, leaving sealant joint space. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile. Form corners and bases neatly. Align floor joints.
 - G. 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.
 - H. Form internal angles square and external angles bullnosed.
 - I. Install non-ceramic trim in accordance with manufacturer's instructions.
 - J. Install thresholds where indicated on drawings.
 - K. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
 - L. Sound tile after setting. Replace hollow sounding units.
 - M. Keep control and expansion joints free of mortar, grout, and adhesive.
 - N. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
 - O. Grout tile joints unless otherwise indicated on drawings. Use standard grout unless otherwise indicated on drawings.
 - P. 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.

3.4 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method , unless otherwise indicated on drawings.
 1. Where waterproofing, cleavage, or crack isolation membrane is indicated on drawings, with standard grout or no mention of grout type, install in accordance with TCNA (HB) Method F121.
- B. Mortar Bed Thickness: 5/8 inch (15.9 mm), unless otherwise indicated on drawings.

3.5 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244.

3.6 CLEANING

- A. Clean tile and grout surfaces.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned.
 - 3. Protect metal surfaces and plumbing fixtures from effects of cleaning.
 - 4. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Do not permit traffic over finished floor surface for 4 days after installation.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 SCHEDULES

- A. Refer to drawings for tile installation locations.
 - 1. Prior to beginning installation, notify Architect if tile type locations, patterns, or setting methods are not clearly understood.

END OF SECTION 09 3000

SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 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. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- D. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023, with Editorial Revision (2024).
- E. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- F. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- H. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- I. 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; 2024a.
- J. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.3 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.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- 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 Acoustical Units: Quantity equal to 5 percent of total installed.

1.5 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

2.1 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Suspension Systems:
 - 1. Same as for acoustical tiles/panels.
 - 2. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Rating: In accordance with test procedures in ASTM E119 and complying with the following:
- B. Surface Burning Characteristics: Class A in accordance with ASTM E84.

2.3 ACOUSTICAL UNITS

- A. Acoustical Panels ACT-1: Mineral fiber with membrane-faced overlay, with the following characteristics:
 - 1. Classification: ASTM E1264 Type A.
 - 2. Size: 24 by 24 inches (610 by 610 mm).
 - 3. Thickness: 7/8 inch (22 mm).
 - 4. Light Reflectance: 88 percent, in accordance with ASTM E1264.
 - 5. Noise Reduction Coefficient (NRC) Range: Up to 0.75 in accordance with ASTM E1264.

6. Articulation Class (AC): 170, in accordance with ASTM E1264.
 7. Ceiling Attenuation Class (CAC): Up to 40, in accordance with ASTM E1264.
 8. Panel Edge: Square.
 9. Color: White.
 10. Suspension System: Exposed grid.
 11. Products:
 - a. Armstrong World Industries, Inc; Ultima: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Acoustical Panels, Type ACT-2: Mineral fiber with scrubbable finish, with the following characteristics:
1. Classification: ASTM E1264 Type A.
 - a. Pattern: G - smooth.
 2. Size: 24 by 24 inches (610 by 610 mm).
 3. Thickness: 3/4 inch (19 mm).
 4. Light Reflectance: 86 percent, in accordance with ASTM E1264.
 5. Noise Reduction Coefficient (NRC) Range: Up to 0.70, in accordance with ASTM E1264.
 6. Ceiling Attenuation Class (CAC): 40, in accordance with ASTM E1264.
 7. Panel Edge: Square.
 8. Color: White.
 9. Suspension System, Gasketed: Exposed grid.
 10. Products:
 - a. Armstrong World Industries: Prelude XL.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.4 SUSPENSION SYSTEMS

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold-down clips, stabilizer bars, clips, and splices as required.
1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension System, Type ACT-1: Hot-dip galvanized steel grid with steel cap.
1. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 2. Profile: Tee; 15/16 inch (24 mm) face width.
 3. Finish: Baked enamel.
 4. Color: White.
 5. Products:
 - a. Armstrong World Industries, Inc; Prelude: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Exposed Suspension System, Type ACT-2: Aluminum grid and cap; factory-applied closed-cell foam gaskets.
1. Structural Classification: Light-duty, when tested in accordance with ASTM C635/C635M.
 2. Finish: Baked enamel.

3. Products:
 - a. Armstrong World Industries; Gasketed Option: www.armstrongceilings.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.5 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.
 1. Size: As required for installation conditions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.3 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions, 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.
- 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.

3.4 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- F. Where round obstructions occur, provide preformed closures to match perimeter molding.

3.5 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet (3 mm in 3 m).
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.6 CLEANING

- A. Clean surfaces.
- B. Replace damaged or abraded components.

END OF SECTION 09 5100

SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient base.
- B. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 09 6516 - Resilient Sheet Flooring.
- B. Section 09 6519 - Resilient Tile Flooring.

1.3 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021 (Reapproved 2025).

1.4 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. 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 Wall Base: 10 linear feet (3.0 linear meters) for every 500 linear feet (152 m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 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).

1.6 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

2.1 RESILIENT BASE

- A. Resilient Base - (RB-1): ASTM F1861, Class 1, Group I, Type TS, rubber, vulcanized thermoset; Style B, Cove. Provide Style C where indicated in Drawings.
 - 1. Manufacturers:
 - a. Johnsonite, a Tarkett Company; Baseworks Thermoset Rubber:
www.johnsonite.com
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Height: 4 inches (100 mm).
 - 3. Thickness: 0.125 inch (3.2 mm).
 - 4. Length: Roll.
 - 5. Corners: Job-formed or preformed.
 - 6. Color: As indicated on drawings.

2.2 ACCESSORIES

- A. Adhesives: Waterproof; types recommended by flooring manufacturer.
- B. Moldings, Transition and Edge Strips: Rubber.
 - 1. Description: Rubber carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, and reducer strip for resilient floor covering.
 - 2. Profiles: As indicated in Drawings.
 - 3. Color: As selected from manufacturer's full range.
- C. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that wall and floor surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient accessories.
- B. Cementitious Stair Surfaces: Verify that substrates are ready for resilient tread installation by testing for moisture and alkalinity (pH).
 - 1. Test in accordance with Section 09 0561.

3.2 PREPARATION

- A. Prepare floor and wall substrates as recommended by resilient accessory and adhesive manufacturers.
- B. Clean substrate.
- C. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION - GENERAL

- A. Install in accordance with manufacturer's written instructions. Install accessories in longest pieces as practicable.
- B. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - 2. Fit joints and butt seams tightly.
 - 3. Inspect installations and reinstall any resilient base or accessory that has detached from substrate.
- C. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Do not locate seams in transition or edge strips within obvious walking paths.
 - 1. Resilient Strips: Attach to substrate using adhesive.

3.4 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches (45 mm) between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units. Do not cut the base toe at outside corners.
- C. Do not seam base within 6 inches of a field-formed outside corner. Locate seams in wall base at inside corners where possible
- D. Install base on solid backing. Bond tightly to wall and floor surfaces. Install without excessive bulging, bucking or gaps to flooring surface.
- E. Scribe and fit to door frames and other interruptions.

3.5 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

END OF SECTION 09 6513

SECTION 09 6516 - RESILIENT SHEET FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- B. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- C. Section 09 6513 - Resilient Base and Accessories: Resilient base, transitions, stair treads.
- D. Section 09 6519 - Resilient Tile Flooring

1.3 REFERENCE STANDARDS

- A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers; 1998 (Reapproved 2023).
- B. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2021.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- D. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing; 2004 (Reapproved 2021).
- E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.4 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. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- G. 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: 5% of each type and color.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent firm specializing in performing concrete slab moisture testing and inspections of the type specified in this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.7 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

2.1 SHEET FLOORING

- A. Vinyl Sheet Flooring - Type RSF-1: Transparent or translucent vinyl wear layer over interlayer and backing.
 - 1. Manufacturers:
 - a. Patcraft; Pursue Sheet: www.patcraft.com .
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Wear Layer Thickness: 0.020 inch (0.50 mm) minimum.
 - 3. Total Thickness: 0.080 inch (2.0 mm) minimum.

4. Sheet Width: 78.72 inch (2000 mm) minimum.
5. Seams: Heat welded.
6. Color: As indicated on drawings.

2.2 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Adhesive for Vinyl Flooring:
 1. As required by manufacturer

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 0561.
 2. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 3. Conduct tests by an independent testing agency acceptable to Owner.
 - a. See Section 09 0561.
 4. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
 5. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is fully cured.
- E. Clean substrate.

- F. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - 2. Fit joints and butt seams tightly.
 - 3. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 - 2. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.4 INSTALLATION - SHEET FLOORING

- A. Seal seams by heat welding.
- 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.

3.5 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 6516

SECTION 09 6519 - RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied resilient flooring.
- C. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- D. Section 09 6513 - Resilient Base and Accessories: Resilient base, transitions, stair treads.
- E. Section 09 6516 - Resilient Sheet Flooring

1.3 REFERENCE STANDARDS

- A. ASTM D6329 - Standard Guide for Developing Methodology for Evaluating the Ability of Indoor Materials to Support Microbial Growth Using Static Environmental Chambers; 1998 (Reapproved 2023).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2025.
- C. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2021.
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.

1.4 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. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- 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. Extra Flooring Material: 100 square feet (9.29 square meters) of each type and color.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F (13 degrees C) and 90 degrees F (72 degrees C).
- D. Do not double stack pallets.

1.7 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

2.1 TILE FLOORING

- A. Vinyl Tile - Type RTF-1, RTF-2, RTF-3. RTF-4: Printed film type, with transparent or translucent wear layer; acoustic interlayer or backing.
 - 1. Manufacturers:
 - a. Interface;Luxury Vinyl Tile; <https://www.interface.com/US/en-US.html>.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. Minimum Requirements: Comply with ASTM F1700, Class III.
 - 3. Plank Tile Size: 25cm by 1m
 - 4. Wear Layer Thickness: 22 mil.
 - 5. Total Thickness: 0.18 inch (4.5 mm).

6. Color: As indicated on drawings.

2.2 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Adhesive for Vinyl Flooring:
 1. As indicated by manufacturer:
- D. Moldings, Transition and Edge Strips: See Section 09 6513 - Resilient Base and Accessories.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 0561.
 2. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 3. Conduct tests by an independent testing agency acceptable to Owner.
 - a. See Section 09 0561.
 4. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
 5. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- C. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 0561.
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is fully cured.
- E. Clean substrate.

3.3 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.
 - 2. Fit joints and butt seams tightly.
- D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
 - 1. Metal Strips: Attach to substrate before installation of flooring using stainless steel screws.
 - 2. Resilient Strips: Attach to substrate using adhesive.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Install flooring in recessed floor access covers, maintaining floor pattern.

3.4 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Install plank tile with a random offset of at least 6 inches (152 mm) from adjacent rows.

3.5 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.6 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION 09 6519

SECTION 09 6700 - FLUID-APPLIED FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fluid-applied resinous flooring.
- B. Integral cove base.
- C. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 03 3000- Cast-in-Place Concrete
- C. Section 03 3900- Concrete Curing
- D. Section 07 9200 - Joint Sealants: Sealing joints between fluid-applied flooring and adjacent construction and fixtures.
- E. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- F. Section 22 1006 - Plumbing Piping Specialties: Recessed plumbing access cover frames.

1.3 REFERENCE STANDARDS

- A. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2025.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- E. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.4 SUBMITTALS

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

- B. Product Data: Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.
- D. Samples For Selection: Submit two samples, 3 by 3 inch (75 by 75 mm) in size illustrating color, pattern and texture for each floor material for each color specified.
- E. Samples for Verification of Color and Texture: For each resinous flooring system required and for each color and texture specified, 3 by 3 inch (75 by 75 mm) in size, applied to a rigid backing by Installer for this Project.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and application rate for each coat.
- H. Manufacturer's Qualification Statement.
- I. Applicator's Qualification Statement.
- J. Maintenance Data: Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

1.5 QUALITY ASSURANCE

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review manufacturer's written instructions for substrate preparation and environmental conditions affecting resinous flooring installation.
 - 2. Review details of integral cove bases.
 - 3. Review manufacturer's written instructions for installing resinous flooring systems.
 - 4. Review protection measures for adjacent construction and installed flooring, floor drainage requirements, curbs, base details, and so forth.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, for each system from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.
- C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 10 years documented experience.
- D. Applicator Qualifications: Company specializing in performing the work of this section.
 - 1. Approved by manufacturer.
- E. System shall be in compliance with requirements of United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store resin materials in a dry, secure area.
- C. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- C. Maintain minimum temperature in storage area of 55 degrees F (13 degrees C).
- D. Store materials in area of installation for minimum period of 24 hours prior to installation.
- E. Maintain ambient temperature required by manufacturer 72 hours prior to, during, and 24 hours after installation of materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fluid-Applied Flooring:
 - 1. Sherwin-Williams Industrial Floor Coating : <https://industrial.sherwin-williams.com>.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FLUID-APPLIED FLOORING SYSTEMS

- A. Fluid-Applied Flooring, General.
 - 1. Floorscore Certification: Resinous flooring system must be "Floorscore" certified.
- B. Fluid-Applied Flooring Type RES-1: Self leveling broadcast quartz, Urethane topcoat.
 - 1. Basis of Design System: Sherwin Williams ; Polycrete SLB .
 - a. Topping: Sherwin-Williams Poly-Crete SL resin, hardener and SL aggregate.
 - b. The aggregate shall be Sherwin-Williams Flintshot quartz aggregate
 - c. Topcoat: Sherwin-Williams Poly-Crete TF PLUS resin, hardener and powder.
 - 2. Patch Materials
 - a. Shadow Fill and Patching: Use Sherwin-Williams Poly-Crete MD (up to 1/4 inch).
 - b. Deep Fill and Sloping Materials (over 1/4 inch): Use Sherwin-Williams Cemlack UM.
 - 3. Coved Base: Per manufacturer's recommendation.

- a. Height: 4-inch- (102-mm-).
4. System Thickness: 3/16 inch (4.8 mm), nominal, dry film thickness (DFT).
5. Topcoat Texture: Slip resistant.
6. Color: As indicated in drawings.
7. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated.
 - a. Topping: Poly-Crete
 - 1) Compressive Strength: 9,000 psi per ASTM C 579.
 - 2) Tensile Strength: 2,175 psi per ASTM D 638.
 - 3) Flexural Strength: 5,076 psi per ASTM D 790.
 - 4) Impact Resistance: @ 125 mils, MIL D-3134, PASS. No visible damage or deterioration
 - 5) Percent Reactive: 100%
 - 6) VOC: 0g/L
 - 7) Bond Strength to Concrete: [>400] psi per ASTM D 4541
 - b. Topcoat: Poly-Crete TF PLUS
 - 1) Compressive Strength: 7,250 psi per ASTM C 579.
 - 2) Tensile Strength: 750 psi per ASTM D 638.
 - 3) Flexural Strength: 4,400 psi per ASTM D 790.
 - 4) Abrasion Resistance [40] mg weight loss, per ASTM C 501. PDS-Taber CS17, 1,000 gm load, 1,000 cycles.
 - 5) Percent Solids: 100%
 - 6) VOC: 0g/L
 - 7) Hardness, Shore D [85].
 - 8) Potlife @ 77 F [15] minutes.

2.3 ACCESSORIES

- A. Base Caps: Zinc with projecting base of 1/8 inch (3 mm); color as selected.
- B. Cove Base/Fillet Strips: Molded of flooring resin material.
- C. Metal Edge Strips: Metal strips are to be provided by resinous flooring installer and used at transitions between resinous and adjacent floor finishes.
- D. Subfloor Filler: Type recommended by fluid-applied flooring manufacturer.
- E. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- F. Primer: Type recommended by fluid-applied flooring manufacturer.
- G. Precast, Integral Cove Base: Impact-resistant, polymer-resin, cove base moldings with a grit profile to promote adhesion of resinous flooring and recommended in writing by resinous flooring manufacturer.
 1. Radius Cove Base: 6-inch- (152-mm-) high base molding that provides approximately 1-inch (25-mm) radius cove at floor-to-wall joint; for adhesive installation as substrate for resinous flooring system to form an integral cove base.

- a. Preformed Inside and Outside Corners: Provide manufacturer's standard square inside and square outside corners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive flooring.
- 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 flooring.
- C. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for fluid-applied flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by fluid-applied flooring manufacturer.
 - 2. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- E. Verify that required floor-mounted utilities are in correct location.

3.2 PREPARATION

- A. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with subfloor filler.
- B. Prepare concrete surfaces according to manufacturer's instructions.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Grind irregularities above the surface level. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.

3.3 INSTALLATION - ACCESSORIES

- A. Install fillet strips at base of walls where flooring is to be extended up wall as base.

3.4 INSTALLATION - FLOORING

- A. Apply in accordance with manufacturer's instructions.
- B. Reinforcing Membrane: Apply reinforcing membrane to substrate cracks.
- C. Adhesively install precast accessories before applying flooring coats and in accordance with manufacturer's written instructions.

- D. Field-Formed Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring coats. Apply in accordance with manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - 1. Integral Cove Base Height: As indicated in Drawings..
- E. Apply each coat to minimum thickness required by manufacturer.
- F. Finish to smooth level surface.
- G. Cove at vertical surfaces.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Test installed floor surface in accordance with ANSI/ESD STM7.1 .
 - 1. Temperature
 - a. Air, substrate temperatures and, if applicable, dew point.
 - 2. Coverage Rates
 - a. Rates for all layers shall be monitored by checking quantity of material used against the area covered.

3.6 PROTECTION

- A. Prohibit traffic on floor finish for 48 hours after installation.
- B. Barricade area to protect flooring until fully cured.
- C. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
- D. Remove masking. Perform detail cleaning at floor termination, to leave cleanable surface for subsequent work of other sections.

END OF SECTION 09 6700

SECTION 09 6813 - TILE CARPETING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 7419 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap and removed carpet tile.
- C. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- D. Section 09 0561 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- E. Section 09 6513 - Resilient Base and Accessories: Resilient wall base and accessories installed with tile carpeting.

1.3 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2025.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.4 SUBMITTALS

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

- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- D. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- E. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- 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 Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.6 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Interface, Inc: www.interface.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 MATERIALS

- A. Tile Carpeting, Type CPT-1: Tufted, manufactured in one color dye lot.
 - 1. Product: Desert Veins manufactured by Interface.
 - 2. Tile Size: 50 cm by 1m, nominal.
 - 3. Color: 108149 Cottonwood.
 - 4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
- B. Tile Carpeting, Type CPT-2: Tufted, manufactured in one color dye lot.
 - 1. Product: Navigate it manufactured by Patcraft.
 - 2. Tile Size: 18 inch by 36 inch, nominal.

3. Color: 00500 Hailstorm.
4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
6. Pile Weight: 26 oz/sq yd.
7. Density Factor: 7548 oz/yd.
8. Primary Backing Material: Non-woven synthetic.

2.3 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, color as selected by Architect.
- C. Adhesives:
 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 6116.
- D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
 3. Follow moisture and alkalinity remediation procedures in Section 09 0561.
- D. Painted Subfloors: Perform bond test recommended in writing by adhesive manufacturer. Verify the following:
 1. Underlayment surface is flat, smooth, evenly planed, tightly jointed, and free of irregularities, gaps greater than 1/8 inch (3 mm), protrusions more than 1/32 inch (0.8 mm), and substances that may interfere with adhesive bond or show through surface.
- E. Verify that required floor-mounted utilities are in correct location and set at correct height.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Maintain dye-lot integrity. Do not mix dye lots in same area.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended in writing by carpet tile manufacturer.
- F. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- G. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- H. Install carpet tile as required in access panel and floor box inserts to match flooring pattern.
- I. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- J. Unless otherwise indicated, locate change of color or pattern between rooms under door leaf or at centerline of opening.
- K. Fully adhere carpet tile to substrate.
- L. Trim carpet tile neatly at walls and around interruptions.
- M. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Remove excess adhesive without damage, from floor, base, and wall surfaces.

C. Clean and vacuum carpet surfaces.

END OF SECTION 09 6813

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
- 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. Brick, glass unit masonry, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 7. Glass.
 - 8. Concealed pipes, ducts, and conduits.

1.2 REFERENCE STANDARDS

- A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- B. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- C. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.3 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.

- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating each color and sheen specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- 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.

1.4 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.

1.5 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. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Provide lighting level of 80 ft candles (860 lx) measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Supply each paint material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.
- B. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- C. Colors: As indicated on drawings.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.3 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly 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.

3.2 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. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 2. Prepare surface according to SSPC-SP 2.

- G. Metal Doors to be Painted: Touch up or repair damaged surfaces of factory primed doors and frames. Prime metal door top and bottom edge surfaces as required.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- E. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 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

1.1 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.
- 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.

1.2 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Shop-primed items.

1.3 REFERENCE STANDARDS

- A. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2023.
- B. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application; 2024.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- G. SSPC-SP 2 - Hand Tool Cleaning; 2024.
- H. SSPC-SP 6/NACE No.3 - Commercial Blast Cleaning; 2006.

- I. SSPC-SP 13/NACE No.6 - Surface Preparation of Concrete; 2018.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches (216 by 279 mm) in size, illustrating each color and sheen specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- C. 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.
- 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 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.

1.5 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.

1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply 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 Temperatures for Paints: 50 degrees F (10 degrees C) for interiors 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

2.1 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
- B. Paints:
 - 1. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended 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, 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. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Flammability: Comply with applicable code for surface burning characteristics.
- C. Colors: As indicated on drawings.
 - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
 - 3. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.

2.3 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, wood, plaster, shop primed steel, aluminum, and acoustical ceilings.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): High Performance Architectural Interior Latex; MPI #138, 139, 140, 141, or 142.
 - a. Products:
 - 1) Sherwin-Williams ProMar 200 HP Series, Eg-Shel. (MPI #139)
- B. Paint I-OP-MD-DT - 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, and guardrails.

2. Two top coats and one coat primer.
3. Top Coat(s): Interior Light Industrial Coating, Water Based; MPI #151, 153, or 154.
 - a. Products:
 - 1) Sherwin-Williams Pro Industrial Pre-Catalyzed WB Epoxy, Semi-Gloss. (MPI #153)
- C. Paint I-OP-MD-WC - Medium Duty Vertical and Overhead: Including gypsum board, concrete, shop primed steel, and aluminum.
 1. Two top coats and one coat primer.
 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
 - a. Products:
 - 1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat. (MPI #143)
- D. Concrete Floor & Stairs, non-vehicular:
 1. Latex Systems:.
 2. Satin Finish
 - a. 1st & 2nd coat: S-W Armorseal 8100 WB Epoxy Satin, B70-8100 Series.
 - b. 3rd Coat: Stencil in contrasting color per drawing detail and finish schedule. S-W Armorseal 8100 WB Epoxy Satin, 70-8100 Series (5.0-12.0 mils. wet, 2.0-5.0 mils. dry per coat). On Stairs Only
 - c. Note: for coverage a 2nd stencil coat may be required for color consistency.
 - 1) Substitutions: See Section 01 6000 - Product Requirements

2.4 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 1. Interior Latex Primer Sealer; MPI #50.
 - a. Products:
 - 1) Sherwin Williams ProMar Zero VOC Interior Latex Primer.
 - 2) Substitutions: See Section 01 6000 - Product Requirements
 2. Interior Water Based Primer for Galvanized Metal; MPI #134 or #134 X-Green.
 - a. Products:
 - 1) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #134)
 - 2) Substitutions: See Section 01 6000 - Product Requirements

PART 3 EXECUTION

3.1 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. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. 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.

3.2 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. Prepare surface as recommended by top coat manufacturer and in accordance with SSPC-SP 13/NACE No.6.
- F. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- 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 in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

- K. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.

3.3 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.

3.5 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.6 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION 09 9123

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. High performance coatings.
- B. Surface preparation.

1.2 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Requirements for mechanical and electrical equipment surfaces.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- C. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

1.4 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. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
 - 3. Manufacturer's installation instructions.
 - 4. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.
- 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. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Coating Materials: 1 gallon (4 liters) of each type and color.
 - 3. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.5 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document that applies to application on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience.

1.6 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.

1.7 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.

1.8 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

2.1 MANUFACTURERS

- A. Provide high performance coating products from the same manufacturer to the greatest extent possible.
- B. High-Performance Coatings:
 - 1. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
 - 2. Substitutions: Section 01 6000 - Product Requirements.

2.2 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
 - 1. Colors: As indicated.
- B. High-Build Epoxy Coating:
 - 1. Number of Coats: Two.
 - 2. Product Characteristics:
 - a. Comply with the performance requirements specified above for moderate exposure.
 - 3. Top Coat(s): Epoxy, High-Build.
 - a. Products:
 - 1) Sherwin-Williams; Resuwall Aqua High Build: www.protective.sherwin-williams.com/#sle.
 - 2) Substitutions: Section 01 6000 - Product Requirements.
 - 4. Primer: As recommended by coating manufacturer for specific substrate.

2.3 PRIMERS

- A. Primers: As recommended by coating manufacturer.

2.4 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

3.1 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. 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.

- 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. Proceed with coating application only after unacceptable conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.
- B. Clean surfaces of loose foreign matter.
- C. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- D. Remove finish hardware, fixture covers, and accessories and store.

3.3 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.4 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.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for general requirements for field inspection.

3.6 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.
- D. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.

3.7 PROTECTION

- A. Protect finished work from damage.

END OF SECTION 09 9600

SECTION 10 2113.17 - PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Phenolic toilet compartments.
- B. Urinal and vestibule screens.

1.2 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Concealed steel support members.
- B. Section 05 5000 - Metal Fabrications: Concealed steel support members.
- C. Section 06 1000 - Rough Carpentry: Blocking and supports.
- D. Section 10 2800 - Toilet, Bath, and Laundry Accessories.

1.3 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- D. Manufacturer's Installation Instructions: Indicate special procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Phenolic Toilet Compartments:
 - 1. ASI Global Partitions; _____: www.asi-globalpartitions.com/#sle.
 - 2. Hadrian: www.hadrian-inc.com/#sle.
 - 3. Bradley Corporation; Phenolic Privacy Partitions: www.bradleycorp.com.

4. Substitutions: Section 01 6000 - Product Requirements.

2.2 PHENOLIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted with overhead brace.
 - 1. Color: Single color as selected.
- B. Doors:
 - 1. Thickness: 3/4 inch (19 mm).
 - 2. Width: 26 inch (660.4 mm).
 - 3. Width for Handicapped Use: 36 inch (915 mm), out-swinging.
 - 4. Height: 58 inch (1473 mm).
- C. Panels:
 - 1. Thickness: 1/2 inch (13 mm).
 - 2. Height: 58 inch (1473 mm).
 - 3. Depth: As indicated on drawings.
- D. Pilasters:
 - 1. Thickness: 3/4 inch (19 mm).
 - 2. Width: As required to fit space; minimum 3 inch (76 mm).
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments.

2.3 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch (76 mm) high, concealing floor fastenings.
- B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch (25 mm by 38 mm) size, with anti-grip profile and cast socket wall brackets.
- C. Wall and Pilaster Brackets: Polished stainless steel; manufacturer's standard type for conditions indicated on drawings.
- D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
- E. Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Door Latch: Slide type with exterior emergency access feature.
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch (9 mm to 13 mm) space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.3 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch (6 mm).
- B. Maximum Variation From Plumb: 1/8 inch (3 mm).

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch (5 mm).
- B. Adjust hinges to position doors in full closed position when unlatched. Return out-swinging doors to closed position.

END OF SECTION 10 2113.17

SECTION 10 2123 - CUBICLE CURTAINS AND TRACK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface mounted overhead curtain track and guides.
- B. Cubicle curtains.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Blocking and supports for track.
- B. Section 09 5100 - Acoustical Ceilings: Suspended ceiling system to support track.

1.3 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for curtain fabric characteristics and track information.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples: Submit 12 by 12 inch (300 by 300 mm) sample patch of curtain cloth with representative top, bottom, and edge hem stitch detail, heading with reinforcement and carrier attachment to curtain header.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept curtain materials on site and inspect for damage.
- B. Store curtain materials on site and deliver to Owner for installation when requested.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Cubicle Track and Curtains:
 - 1. Inpro: www.inprocorp.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 TRACKS AND TRACK COMPONENTS

- A. Track: Inpro Whisper Cube, heavy duty rigid vinyl cubicle track.
 - 1. Profile: Channel.
 - 2. Track Size: 1.14" H x 1.20" W.
 - 3. Mounting: Surface.
 - 4. Structural Performance: Capable of supporting vertical test load of 50 lbs (23 kg) without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 - 5. Track End Stop and Tees: To fit track section.
 - 6. Track Bends: Minimum 12 inch (300 mm) radius; fabricated without deformation of track section or impeding movement of carriers.
 - 7. Finish on Exposed Surfaces: White.
 - 8. Products:
 - a. Inpro; Whisper Track: www.inprocorp.com/#sle.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Curtain Carriers: Ball and Chain Cube Carriers, size and type compatible with track; designed to eliminate bind when curtain is pulled; fitted to curtain to prevent accidental curtain removal.
 - 1. Provide three carriers per foot of track length (___ carriers per meter of track length).
- C. Installation Accessories: Types required for specified mounting method and substrate conditions.

2.3 CURTAINS

- A. Cubicle Curtains, (CC-1):
 - 1. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
 - 2. Material: Close weave polyester; anti-bacterial, self deodorizing, sanitized, and preshrunk.
 - 3. Color/Pattern: As indicated on drawings.
 - 4. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
 - 5. Attachment of Curtain Fabric to Open Mesh Cloth: As recommended by manufacturer.
 - 6. Basis for Design Product: As indicated on Drawings.
 - 7. Products:
 - a. Inpro; Simplicity: www.inprocorp.com.
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Curtain Fabrication:
 - 1. Width of curtain to be 10 percent wider than track length, but not less than 12 inches.

2. Length of curtain to end 12 inches (305 mm) above finished floor.
3. Pattern match fabric with vertical seams.
4. Include open mesh cloth at top 20 inches (508 mm) of curtain for room air circulation, attached to curtain as specified above.
5. Curtain Heading: Fabric band matching curtain panel with metal grommet holes for carriers spaced 6 inches (150 mm) on center.
 - a. Grommets to be stainless steel at showers and other wet locations.
6. Seams and Hems: Manufacturer's standard fabrication double-stitching method for securely sewn and finished seams and hems.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work of this Section.
- B. Verify that field measurements are as indicated.

3.2 INSTALLATION

- A. Install curtain track to be secure, rigid, and true to ceiling line.
- B. Secure track to ceiling system.
- C. Install end cap and stop device.
- D. Install curtains on carriers ensuring smooth operation.

END OF SECTION 10 2123

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Crash rails.
- B. Protective corridor handrails.
- C. Corner guards.
- D. Protective wall covering.

1.2 RELATED REQUIREMENTS

- A. Section 05 5000 - Metal Fabrications: Anchors for attachment of work of this section, concealed in wall.
- B. Section 05 5213 - Pipe and Tube Railings: Metal railings not intended to protect walls..
- C. Section 06 1000 - Rough Carpentry: Blocking for wall and corner guard anchors.
- D. Section 09 2116 - Gypsum Board Assemblies: Placement of supports in stud wall construction.
- E. Section 09 7200 - Wall Coverings: Terminating wall covering at wall and door protection.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.4 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. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Stock Materials: One package(s) of minimum 96 inches (2438 mm) long unit of each kind of covers for corner guards, bumper rails, and protective corridor handrails.
- F. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 5-year manufacturer warranty for metal crash rails. Complete forms in Owner's name and register with manufacturer.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures or internal connection failures.
 - b. Deterioration of materials beyond that expected of normal use, as intended by manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Crash Rails, Protective Corridor Handrails, and Corner Guards:
 - 1. Construction Specialties, Inc; Acrovyn Handrails, Acrovyn Corner Guards, Acrovyn Solid Color Crash Rails: www.c-sgroup.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Protective Wall Covering:
 - 1. Construction Specialties, Inc; Acrovyn Wall Panels: www.c-sgroup.com/#sle.
 - 2. Inpro; _____: www.inprocorp.com/#sle.
- C. Protective Wall Panels: Fiber Reinforced Panels (FRP):
 - 1. Marlite: Standard FRP.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PERFORMANCE CRITERIA

2.3 PRODUCT TYPES

- A. Crash Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
 - 1. Performance of Installed Assembly:
 - a. Support vertical live load of 100 lb/lineal ft (1,400 N/m) with deflection not to exceed 1/50 of span between supports.
 - b. Resist lateral force of 250 lbs (1112 N) at any point without damage or permanent set.
 - 2. Material: High impact vinyl, color as indicated.
 - 3. Mounting: Surface.
- B. Protective Corridor Handrails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
 - 1. See Section 05 5213 for metal railings not intended to protect walls.
 - 2. Comply with accessibility requirements of ICC A117.1 and ADA Standards.
 - 3. Material: High impact vinyl, color as selected from manufacturer's standard colors.
 - 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 5. Mounting: Surface.
 - 6. Return rail to wall.
- C. Corner Guards - Surface Mounted:
 - 1. Material: High impact vinyl with full height extruded aluminum retainer.
 - 2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Width of Wings: 3 inches (76 mm).
 - 5. Corner: Square.
 - 6. Color: As indicated.
 - 7. Length: One piece.
 - 8. Preformed end caps.
- D. End Cap Corner Guards - Surface Mounted:
 - 1. Material: High impact vinyl with full height extruded aluminum retainer.
 - 2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Width of Wings: 2 inches (51 mm).
 - 5. Corner: Square.
 - 6. Color: As indicated.
 - 7. Length: One piece.
 - 8. Preformed end caps.
- E. Corner Guards - Surface Mounted:

1. Material: High impact vinyl with full height extruded aluminum retainer.
 2. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 4. Width of Wings: 2 inches (51 mm).
 5. Corner: Square.
 6. Color: As indicated.
 7. Length: One piece.
 8. Preformed end caps.
- F. Corner Guards - Surface Mounted:
1. Material: High impact Stainless Steel.
 2. Material: Type 304 stainless steel, No. 4 finish, 16-gauge.
 3. Performance: Resist lateral impact force of 100 lbs (445 N) at any point without damage or permanent set.
 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 5. Width of Wings: 2 inches (51 mm).
 6. Corner: Radiused.
 7. Color: As indicated.
 8. Length: One piece.
 9. Preformed end caps.
- G. Protective Wall Covering:
1. Material: High-impact acrylic-modified vinyl.
 2. Thickness: 0.040 inch (1.02 mm).
 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 4. Color: As indicated on drawings.
 5. Texture: Suede.
 6. Accessories: Provide manufacturer's standard color-matched sealant.
 7. Mounting: Adhesive.
- H. Protective Wall Panels:
1. Material: Fiber Reinforced Panels (FRP): Homogeneous mixture of fiberglass, calcium carbonate, and resin.
 2. Thickness: 0.075 inch (1.90 mm).
 3. Panel Size: 4 feet by 8 feet (1220 mm by 2440 mm).
 4. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 55 or less, when tested in accordance with ASTM E84.
 5. Color and Pattern: As indicated on drawings.
 6. Texture: Pebbled.
 7. Accessories: Provide manufacturer's standard PVC color-matched trim and moldings.
 - a. Outside Corner Trim: Flat.
 - b. Division Bar: Flat.
 8. Mounting: Adhesive.

- I. Adhesives and Primers: As recommended by manufacturer.
- J. See Section 06 1000 for wood blocking for wall and corner guard anchors.
- K. See Section 05 5000 for anchor devices to be installed as work of this section.
- L. See Section 09 2116 for supports in stud wall construction.

2.4 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as instructed by the manufacturer.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
- D. Start of installation constitutes acceptance of project conditions.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position top of crash rail 12 inches (304.8 mm) from finished floor.
- C. Position top of corridor hand rail 34 inches (609.6 mm) from finished floor.
- D. Position corner guard 4 inches (102 mm) above finished floor to 96 inches high (2438.4 mm high).
- E. Terminate rails 2 inch (50.8 mm) short of door openings and intersecting walls.
- F. Position protective wall covering no less than 1 inch (25.4 mm) above finished floor to allow for floor level variation.
 - 1. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
 - 2. Apply adhesive with 1/8 inch (3.2 mm) V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.
 - 3. At joints indicated to be caulked, allow for a minimum 1/16 inch (1.6 mm) wide gap between edges of sheets. Gaps are required to be of consistent width throughout the project.
 - 4. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch (6 mm).
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch (6 mm).

3.4 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.
- B. 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

1.1 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Institutional ligature-resistant toilet and bath accessories.
- D. Healthcare accessories.
- E. Utility room accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Concealed supports for accessories, including in wall framing and plates.
- B. Section 09 3000 - Tiling: Ceramic washroom accessories.
- C. Section 10 2123 - Cubicle Curtains and Track: Privacy curtain systems.
- D. Section 22 4000 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.3 RELATED PRODUCTS BY OTHERS

- A. Owner-Furnished Owner-Installed (OFOI) Products
 - 1. Sanitary napkin disposal units.
 - 2. Glove dispensers.
 - 3. Sharps disposal containers.
 - 4. Hand sanitizer stations.
- B. Owner-Furnished Contractor-Installed (OFCI) Products
 - 1. Toilet paper dispensers.
 - 2. Paper towel dispensers.
 - 3. Soap dispensers.

1.4 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2024.

- C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2017 (Reapproved 2022).
- E. ASTM C1036 - Standard Specification for Flat Glass; 2025.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2025.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- I. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement to receive anchor attachments.

1.6 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

2.1 MANUFACTURERS

- A. Basis for Design products are listed in product sections. Subject to compliance with requirements, provide products by the following manufacturers, or approved equal:
- B. Commercial Toilet, Shower, Bath and Custodial Accessories:
 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 2. Bradley Corporation: www.bradleycorp.com/#sle.
 3. Bobrick Washroom Equip., Inc.: www.bobrick.com
 4. Georgia-Pacific Professional: www.gppro.com/#sle.
 5. Kimberly-Clark Corporation: www.kcprofessional.com/#sle.

6. Substitutions: Section 01 6000 - Product Requirements.

C. Healthcare Accessories:

1. GOJO Industries, Inc.: www.gojo.com
2. Substitutions: Section 01 6000 - Product Requirements.

D. Provide products of each category type by single manufacturer.

2.2 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Keys: Provide 3 keys for each lockable accessory product to Owner. Coordinate keying with Owners existing stock.
- C. Stainless Steel Sheet: ASTM A666/A666M, Type 304.
- D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- G. Adhesive: Two component epoxy type, waterproof.
- H. Fasteners, Screws, and Bolts: Stainless steel; tamper-proof; security type where exposed.

2.3 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.
- C. Powder-Coated Steel: Clean, degrease, and neutralize. Follow immediately with a phosphatizing treatment, prime coat, and two finish coats of powder coat enamel.

2.4 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Single roll, surface mounted bracket type, stainless steel, spindleless type for tension spring delivery designed to prevent theft of tissue roll.
 1. Products:
 - a. American Specialties, Inc: www.americanspecialties.com/#sle.
 - b. Bradley Corp: www.bradleycorp.com.
 - c. Bobrick: .
 - d. Substitutions: Section 01 6000 - Product Requirements.

- B. Paper Towel Dispenser: Folded paper type, thermoplastic polymer, surface-mounted, with viewing window refill indicator. Dispenser to be compatible with existing folded paper towel product used in facility.
1. Capacity: 500 multifold minimum.
 2. Color: Black
 3. Products:
 - a. American Specialties, Inc: www.americanspecialties.com/#sle.
 - b. Kimberly-Clark, Inc.; K-C Professional Universal Folded Towel Dispenser #09905: www.kcprofessional.com
 - c. Bradley Corp: www.bradleycorp.com.
 - d. Bobrick: www.bobrick.com
 - e. Substitutions: Section 01 6000 - Product Requirements.
- C. Automated Hand Sanitizer Dispenser: Liquid hand sanitizer dispenser, deck-mounted on vanity, with container concealed below deck; chrome-plated brass with bright polished finish; chrome-plated deck escutcheon.
1. Minimum Capacity: 27 ounces (0.80 liters).
 2. Power: Battery operated.
- D. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with plastic body and cover; Refill cartridge soap tank; manual push type soap valve and window refill indicator. Dispenser to be compatible with existing refill cartridges used in facility.
1. Minimum Capacity: 2000 mL, verify.
 2. ADA Compliant operation.
 3. Color: Black.
 4. Products:
 - a. GOJO Industries, Inc.; Purell FMX-20: www.gojo.com
 - b. Bradley Corp: www.bradleycorp.com.
 - c. Bobrick: www.bobrick.com.
 - d. American Specialties, Inc: www.americanspecialties.com/#sle.
 - e. Substitutions: Section 01 6000 - Product Requirements.
- E. Mirrors: Stainless steel framed, 1/4 inch (6 mm) thick annealed float glass; ASTM C1036.
1. Size: As indicated in Drawings.
 2. Frame: 3/4 inch (19 mm) channel shapes, with mitered and welded and ground corners, fixed bracket-and-tab hanging system; satin finish.
 3. Backing: Full-mirror sized, minimum 0.03 inch (0.8 mm) galvanized steel sheet, nonabsorptive filler material with polyethylene padding.
 4. Products:
 - a. Bobrick Washroom Equip., Inc.; B-165 Series: www.bobrick.com
 - b. Substitutions: Section 01 6000 - Product Requirements.
 5. Provide one at each lavatory sink, except at ligature-resistant locations and as indicated in drawings.
- F. Grab Bars: Stainless steel, smooth surface.
1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force (1112 N), minimum.

- b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.05 inch (1.3 mm) wall thickness, concealed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Finish: Peened.
 - d. Length and Configuration: As indicated on drawings.
 - e. Products:
 - 1) American Specialties, Inc; 3700 Series: www.americanspecialties.com/#sle.
 - 2) Bobrick Washroom Equip., Inc.; B-6806 Series: www.bobrick.com
 - 3) Substitutions: Section 01 6000 - Product Requirements.
 - f. Provide at each accessible toilet, bath and shower, except in ligature-resistant units.
 - 2. Heavy Duty Grab Bars: Floor supports are acceptable if necessary to achieve load rating.
 - a. Push/Pull Point Load: Minimum 1000 pound-force (4448.2 N), minimum.
 - b. Dimensions: 1-1/2 inch (38 mm) outside diameter, minimum 0.125 inch (3.17 mm) wall thickness, exposed flange mounting, 1-1/2 inch (38 mm) clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - d. Products:
 - 1) Conway Bariatric; Heavy Duty Grab Bars: www.conwaybariatric.com/#sle.
- G. Sanitary Napkin Disposal Unit: 18-8 Type 304 stainless steel, surface-mounted, self-closing door with magnetic catch, removable stainless steel receptacle.
- 1. Products:
 - a. Bobrick Washroom Equip., Inc.; Model B-2892: www.bobrick.com
 - b. Substitutions: Section 01 6000 - Product Requirements.
 - 2. Finish: Satin.
- H. Coat Hook : Heavy-duty nickel-plated brass, single-prong, circular-shaped bracket and backplate for exposed attachment, satin finish.
- 1. Products:
 - a. American Specialties, Inc; Model 0740-Z: www.americanspecialties.com/#sle.
 - b. Bobrick Washroom Equip., Inc.; Model B-211: www.bobrick.com
 - c. Bradley Corporation; Model: www.bradleycorp.com.
 - d. Substitutions: Section 01 6000 - Product Requirements.
 - 2. Provide one per toilet room, except in ligature-resistant units, and as indicated in Drawings.

2.5 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.
 - 1. Products:
 - a. American Specialties, Inc; 1214 Series: www.americanspecialties.com/#sle.
 - b. Inpro; Shower Accessories : www.inprocorp.com.
 - c. Substitutions: Section 01 6000 - Product Requirements.
 - 2. Locations: Provide one at each shower or bathtub.

- B. Shower Curtain:
1. Material: Opaque vinyl, 0.008 inch (0.2 mm) thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 2. Size: 72" high x width as required, hemmed edges.
 3. Grommets: Stainless steel; pierced through top hem on 6 inch (150 mm) centers.
 4. Color: As selected from manufacturer's standard colors.
 5. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.
 6. Products:
 - a. Inpro; Super Bio Stat: www.inprocorp.com.
 - b. Substitutions: Section 01 6000 - Product Requirements.

2.6 HEALTHCARE ACCESSORIES

- A. PPE Dispensers
1. Glove Box Dispenser: Steel construction.
 - a. Capacity: Three glove boxes.
 - b. Products:
 - 1) Bowman Dispensers LLC; RE301-0012 Triple Glove Box Dispenser: www.bowmandispensers.com/#sle.
 - 2) Poltex, Inc; _____: www.poltex.com/#sle.
 - 3) Substitutions: See Section 01 6000 - Product Requirements.
 2. Automated Hand Sanitizer Dispenser: Foam liquid sanitizer dispenser, wall-mounted, surface, with plastic body and cover; Refill cartridge tank; touch-free automatic type sanitizer valve and refill window refill. Dispenser to be compatible with existing refill cartridges used in facility.
 - a. Provide wall and floor protection tray.
 - b. Capacity: 1200 mL.
 - c. Color: White
 - d. Products:
 - 1) GOJO Industries, Inc.; Purell LTX-12: www.gojo.com
 - 2) Substitutions: See Section 01 6000 - Product Requirements.

2.7 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: Three, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 4. Shelf Depth: 8 inches.
 5. Length: 36 inches (900 mm).
 6. Products:
 - a. American Specialties, Inc; Model 1315-3: www.americanspecialties.com/#sle.
 - b. Bobrick Washroom Equip., Inc.; Model B-224: www.bobrick.com
 - c. Substitutions: 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. See Section 06 1000 - Rough Carpentry for installation of blocking in walls.

3.2 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.

3.3 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.
 - 1. Grab Bars: As indicated on drawings.

3.4 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

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories, including J-hooks.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.

1.3 REFERENCE STANDARDS

- A. FM (AG) - FM Approval Guide; Current Edition.
- B. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- C. UL (DIR) - Online Certifications Directory; Current Edition.
- D. ASTM 2503-23 - Standard Practice for Marking Medical Devices and Other Items for Safety in the Magnetic Resonance Environment

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and signage information.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.5 FIELD CONDITIONS

- A. Do not install or store extinguishers in areas when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers: Provide fire extinguishers, cabinets and accessories by the following:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com
 - 2. Ansul, a Tyco Business: www.ansul.com
 - 3. Babcock-Davis: www.babcockdavis.com
 - 4. Badger Fire Protection: Badgerfire.com
 - 5. Guardian Fire Equipment, Inc.: www.guardianfire.com
 - 6. Larsens Manufacturing Company: www.larsensmfg.com
 - 7. Nystrom, Inc.: www.nystrom.com
 - 8. Substitutions: See Section 01 6000 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
 - 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com
 - 2. Kidde, a unit of United Technologies Corp: www.kidde.com
 - 3. Larsen's Manufacturing Co.: www.larsensmfg.com
 - 4. Nystrom, Inc.: www.nystrom.com
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Multipurpose Dry Chemical Type Fire Extinguishers :(FE).
 - 1. Carbon steel tank, with pressure gauge.
 - 2. Basis Of Design Product: JL Industries; Cosmic Extinguisher - Multipurpose Chemical
 - 3. Class: Type A:B:C.
 - 4. Size and classification as indicated on Drawings.
 - 5. Finish: Baked polyester powder coat, color as selected.
 - 6. Temperature range: Minus 65 degrees F (Minus 54 degrees C)` to 120 degrees F (49 degrees C).
- C. Class K Wet Chemical Type Fire Extinguishers: (FE).
 - 1. Basis Of Design Product: JL Industries; Saturn Extinguisher - Class K Wet Chemical
 - 2. Class: Type K.
 - 3. Size and classification as scheduled.
 - 4. Finish: Polished stainless steel.

2.3 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.

- B. Fire Extinguisher Cabinet (FEC)
 - 1. Basis of Design Product: JL Industries; Ambassador Series
 - 2. Cabinet Tub:
 - a. Tub Material: 18 ga. cold rolled sheet steel base metal.
 - 1) Finish: Powder Coated.
 - 2) Exterior Color: White.
 - 3. Fire Rated Cabinet Construction: Non-fire rated..
 - 4. Cabinet Trim Configuration: Semi-recessed type.
 - a. Trim Material: 18 ga. cold rolled steel base metal.
 - 1) Finish: Powder Coated.
 - 2) Exterior Color: White.
 - b. Projected Trim: Rolled Edge, returned to wall surface, with 3 inch (76 mm) projection, and 1-3/4 inch (45 mm) wide face.
 - 5. Door: Reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinges.
 - a. Door Style: Vertical lite.
 - b. Door Material: Match trim metal and finish.
 - c. Door Glazing: Acrylic plastic, clear, 1/8 inch (3 mm) thick, flat shape and set in resilient channel glazing gasket.
 - d. Door Pull: Manufacturers standard. or Recessed.
 - 1) Material / finish: Manufacturer's standard
 - 6. Cabinet Lettering.
 - a. Lettering Style: Vertical decal.
 - b. Color: Red with clear background.
 - c. Location: Door glazing.
- C. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- D. Fabrication: Weld, fill, and grind components smooth.

2.4 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished. Wall mounted, with quick release keeper strap, manufacturer's standard color.
 - 1. Provide bracket mount at all extinguisher locations where a cabinet is not indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.
- C. Field verify extinguisher bracket and hook mounting locations with Architect or Owner.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets plumb and level in wall openings, at height as indicated in drawings.
- C. Secure rigidly in place.
- D. Place extinguishers on hooks, brackets or in cabinets at locations as indicated.

3.3 FIRE EXTINGUISHER SCHEDULE

- A. Corridor Extinguisher (FEC-_____)
 - 1. Extinguisher Type: Multipurpose dry chemical.
 - 2. UL Rating: 3-A:40-B:C
 - 3. Capacity: 5 lbs.
 - 4. Mount in Cabinet Type: CAB-_____.
- B. Mechanical Room (FEC-_____)
 - 1. Extinguisher Type: Multipurpose dry chemical.
 - 2. UL Rating: 4-A:80-B:C
 - 3. Capacity: 10 lbs.
 - 4. Mount on wall bracket.
- C. Computer Room: (FEC-_____)
 - 1. Extinguisher Type: CO2.
 - 2. UL Rating: 10-B:C
 - 3. Capacity: 10 lbs.
 - 4. Mount on wall bracket.
- D. Commercial Kitchen (FEC-K):
 - 1. Extinguisher Type: Class K wet chemical.
 - 2. UL Rating: 2-A:K
 - 3. Capacity: 2.5 gal.
 - 4. Mount on wall bracket.

END OF SECTION 10 4400

SECTION 10 5129 - PHENOLIC LOCKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Phenolic lockers.

1.2 REFERENCE STANDARDS

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

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate locker plan layout, numbering plan.
- C. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Phenolic Lockers:
 - 1. ASI Storage Solutions: www.asi-storage.com/#sle.
 - 2. Bradleycorp: www.bradleycorp.com
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
 - 1. Doors: Full overlay, covering full width and height of locker body; square edges.
 - 2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
 - 3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
 - 4. Color: As indicated .

- 5. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
- B. Component Thicknesses:
 - 1. Doors: 1/2 inch (13 mm) minimum thickness.
 - 2. Locker Body: One of the following combinations:
 - a. Tops, bottoms, and shelves 3/8 inch (10 mm); sides and backs 5/16 inch (8 mm); minimum.
 - 3. End Panels and Filler Panels: 1/2 inch (13 mm) minimum thickness.
 - 4. Sloped Tops: 1/2 inch (13 mm) minimum thickness.
- C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
 - 1. Surface Burning Characteristics: Flame spread index of 75 or less, and smoke developed index of 450 or less; when tested in accordance with ASTM E84.
- D. Coat Hooks: Stainless steel or reinforced nylon; attached with tamperproof screws.
- E. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.
- F. Locks: Keypad.
- G. Locker Legs: Manufacturer's standard adjustable support and leveling leg, minimum 1 inch (25 mm) adjustment; with hardware for attaching toe kick plates.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.

3.2 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, filler panels, and sloped tops.
- G. Install accessories.
- H. Replace components that do not operate smoothly.

3.3 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION 10 5129

SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior manual roller shades.
- B. Interior motorized roller shades.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.3 REFERENCE STANDARDS

- A. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- B. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.
- C. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.4 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, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
- D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- F. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- G. Maintenance contracts.

1.5 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.

1.6 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 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: 10 years.
 - 2. Fabric: 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Interior Manually Operated Roller Shades:
 - 1. Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
 - 2. MechoShade Systems LLC; Mecho/7 System: www.mechoshade.com/#sle.
 - 3. SWFcontract, a division of Springs Window Fashions, LLC.; Pro Series Manual Solar Shade System: www.swfcontract.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Source Limitations: Furnish products produced by a single manufacturer and obtained from a single supplier.

2.2 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. Interior Roller Shades - Basis of Design: Draper, Inc; Clutch Operated FlexShade: www.draperinc.com/#sle.
 - 1. Description: Double roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.
 - a. Drop Position: Regular roll.
 - b. Mounting: Ceiling mounted.
 - c. Size: As indicated on drawings.
 - d. Fabric: As indicated on drawings.

2. Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Hardware Type: Universal brackets.
 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.
 4. Hembars: Designed to maintain bottom of shade straight and flat, selected from manufacturer's standard options.
 - a. Style: Closed pocket; aluminum elliptical slat inside pocket with heat-sealed ends.
 5. Manual Operation:
 - a. Clutch Operator Location: Right side.
 - b. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
 - c. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 lb (43 kg) minimum breaking strength. Provide upper and lower limit stops.
 - d. Chain Retainer:
 - 1) Chain tensioning device complying with WCMA A100.1.
 - 2) Manufacturer's standard clip.
 6. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to mounting end caps, without exposed fasteners; clear anodized finish.
 - b. Fasteners: Noncorrosive, and as recommended by shade manufacturer.
- C. Interior Roller Shades - Basis of Design: Draper, Inc; Motorized Dual Roller Bottom-Up FlexShade: www.draperinc.com/#sle.
1. Description: Double roller, motor-operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and other components necessary for complete installation.
 - a. Roll Direction: Bottom-up, closed position is at top of window opening.
 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 Mounting: Configured for light-filtering and room-darkening shades in one opening.
 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.
 - c. Take-Up Roller: Manufacturer's standard roller tube pretensioned for winding lift cable in bottom-up type shades.
 4. Hembars: Extruded aluminum, built-in pulley system for lifting shades; manufacturer's standard options.
 5. Shade Motor: Standard 120V AC motor, located as indicated on drawings

2.3 SHADE FABRIC

- A. Fabric: Nonflammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 - 1. Manufacturers:
 - a. Draper Inc.E Screen 0.5% ATF.
 - 2. Material: Vinyl coated fiberglass.
 - 3. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large and small tests.
 - 4. Openness Factor: 0.5%.
 - 5. Color: As indicated on drawings.

2.4 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch (13 mm) space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.2 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.

3.3 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.

3.4 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.5 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 12 2400

SECTION 12 3200 - MANUFACTURED WOOD CASEWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured standard and custom casework, with cabinet hardware.
- B. Countertops.

1.2 RELATED REQUIREMENTS

- A. Section 01 6116 - Volatile Organic Compound (VOC) Content Restrictions: VOC limitations for adhesives and sealants.
- B. Section 06 1000 - Rough Carpentry: Blocking and nailers for anchoring casework.
- C. Section 06 4100 - Architectural Wood Casework: Custom fabricated wood cabinetry.
- D. Section 07 9200 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.
- E. Section 09 2116 - Gypsum Board Assemblies: Reinforcements in metal-framed partitions for anchoring casework.
- F. Section 09 6500 - Resilient Flooring: Resilient wall base.
- G. Section 12 3600 - Countertops: Additional requirements for countertops.
- H. Section 22 4000 - Plumbing Fixtures: Sinks and fittings installed in casework.

1.3 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- B. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.
- E. AWI (QCP) - Quality Certification Program; Current Edition.
- F. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).

- G. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- H. BHMA A156.9 - Cabinet Hardware; 2020.
- I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.
- C. Manufacturer's Installation Instructions.
- D. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 - 1. See Section 01 6000 - Product Requirements for additional provisions.
- F. Finish touch-up kit for each type and color of materials provided.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Quality Certification: Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 1. Provide labels or certificates indicating that the installed 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.
 - 5. Replace, repair, or rework all work for which certification is refused.
- C. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

- B. Acceptance at Site:
 - 1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- C. Storage:
 - 1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification of Conditions" Article of this section.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Plastic Laminate Casework:
 - 1. Case Systems; ____: www.casesystems.com/#sle.
 - 2. Substitutions: See Section 01 6000 - Product Requirements.
- B. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.2 CASEWORK, GENERAL

- A. Quality Standard: AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Types: More than one type is required. See drawings for location of each type of casework.
- C. Plastic Laminate Faced Cabinets: Custom Grade.

2.3 FABRICATION

- A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
- B. Construction: As required for selected grade.
- C. Structural Performance: Safely support the following minimum loads:
 - 1. Base Units: 500 pounds per linear foot (744 kgs/linear m) across the cabinet ends.
 - 2. Suspended Units: 300 pounds (136 kg) static load.
 - 3. Drawers: 125 pounds (57 kg), minimum.
 - 4. Hanging Wall Cases: 300 pounds (135 kg).
 - 5. Shelves: 100 pounds (45 kg), minimum.
- D. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.
- E. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
- F. Removable back panels on all base cabinets. Provide partial height back panels at sink cabinets.

- G. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- H. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- I. Sloped tops for wall and floor cabinets: With closed ends, of matching construction and finish. Concealed anchorages for attachment to cabinet(s) below.
- J. Matching Wood Grain: Comply with requirements of quality standard for specified grade and as follows:
- K. Apron Frames: Construction similar to other cabinets, with modifications.
 - 1. Frames fabricated from panels standard with the manufacturer. Include front and back panels, with drawer suspension framing mechanically fastened to support channels spanning between them.
- L. Countertop Panel-Type Supports: Materials similar to adjacent casework, 1-1/2 inch (38 mm) in width, with front-to-back and toe space dimensions matching base cabinet. Designed to be secured in a concealed fashion to countertop material. Include two leveling devices per support panel.

2.4 PLASTIC-LAMINATE-CLAD CASEWORK

- A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
 - 1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
 - 2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings
 - 3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
 - a. Finish: Matte or suede, gloss rating of 5 to 20.
 - b. Exposed Interior Surfaces: Thermally fused laminate.
 - 1) Color: White.
 - c. Cap exposed plastic laminate finish edges with material of same finish and pattern.

2.5 COUNTERTOPS

- A. Types: More than one type is required. See drawings for location of each type of countertop.
- B. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade, unless otherwise noted.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.

1. 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.
2. Manufacturer's standard configuration for exposed edges, back and end splashes.

2.6 CABINET HARDWARE

- A. Comply with BHMA A156.9 requirements.
- B. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.
- C. Shelves in Cabinets:
 1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.
- D. Swinging Doors: Hinges, pulls, and catches.
 1. Hinges: Concealed, number as required by referenced standards for width, height, and weight of door.
 - a. Concealed Hinges: Installed in cabinet edge, and on door back, bright chromium plated over nickel on base material.
 - 1) European-Style Hinges for Overlay Doors: 120 degree opening angle.
 2. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
 3. Catches: Mechanical catch.
- E. Drawers: Pulls and slides.
 1. Pulls: Chrome wire pulls, 4 inches (102 mm) wide.
 2. Slides: Steel, full extension arms, ball bearings; capacity as recommended by manufacturer for drawer height and width.

2.7 MATERIALS

- A. Adhesives Used for Assembly: Comply with VOC requirements for adhesives and sealants; see Section 01 6116.
- B. Wood-Based Materials:
 1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.
- C. Concealed Solid Wood or Plywood: Any species and without defects affecting strength or utility.
- D. Hardboard: ANSI A135.4, Class 1, tempered.
- E. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications. complying with Grade requirements, and standard with the manufacturer.
- F. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.
- G. Stainless Steel Sheet: ASTM A666/A666M Type 304.

2.8 ACCESSORIES

- A. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As shown on drawings.
- B. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- C. Concealed Joint Fasteners: Corrosion-resistant, standard with manufacturer.
- D. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.
- E. Sealant for Use in Casework Installation:
 - 1. Manufacturer's recommended type.

PART 3 EXECUTION

3.1 PREPARATION

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.2 EXAMINATION

- A. Site Verification of Environmental Conditions:
 - 1. Do not deliver casework until the following conditions have been met:
 - a. Building has been enclosed (windows and doors sealed and weather-tight).
 - b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
 - c. Ceiling, overhead ductwork, piping, and lighting have been installed.
 - d. Installation areas do not require further "wet work" construction.
- B. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch (13 mm) leveling adjustment. When installation conditions are acceptable, for each space, establish the high point of the floor. Set and make level and plumb first cabinet in relation to this high point.
- C. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
 - 1. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet (3 mm in 3 m) in any direction.
- D. Verify adequacy of support framing and anchors.
- E. Verify that service connections are correctly located and of proper characteristics.

3.3 INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch (1.6 mm). In addition, do not exceed the following tolerances:
 - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch (1.6 mm) in 10 feet (3 m).
 - 2. Variation of Faces of Cabinets from a True Plane: 1/8 inch (3 mm) in 10 feet (3 m).
 - 3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch (0.8 mm).
 - 4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch (1.6 mm).
- F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches (407 mm) on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- G. Install hardware uniformly and precisely.
- H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.
- I. Replace units that are damaged, including those that have damaged finishes.

3.4 ADJUSTING

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.5 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean casework and other installed surfaces thoroughly.

3.6 PROTECTION

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.

- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION 12 3200

SECTION 14 2100 - ELECTRIC TRACTION ELEVATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electric traction elevator systems.
- B. Maintenance contract.

1.2 RELATED REQUIREMENTS

- A. Section 09 6500 - Resilient Flooring.
- B. Section 26 0533.13 - Conduit for Electrical Systems: Electrical conduit requirements.
- C. Section 26 0583 - Wiring Connections: Wiring connection requirements.

1.3 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. AISC 360 - Specification for Structural Steel Buildings; 2022, with Errata (2025).
- D. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2022.
- E. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, Dumbwaiters, and Material Lifts; 2023.
- F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2025.
- G. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- H. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.

- L. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- M. NEMA MG 00001 - Motors and Generators; 2024.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
- P. PS 1 - Structural Plywood; 2023.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work with other installers to provide necessary conduits for proper installation of wiring, including but not limited to the following:
 - a. Elevator equipment devices remote from elevator machine room or hoistway.
 - b. Remote group automatic panel in lobby from controller cabinet.
 - c. Telephone service for machine room.
 - d. Elevator pit for lighting, sump pump, and _____.
 - e. Automatic transfer switch from controller cabinet.
 - f. Fire alarm panel from controller cabinet.
- B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
 - 1. Review schedule of installation, proper procedures and conditions, and coordination with related work.
 - 2. Review use of elevator for construction purposes, hours of use, scheduling of use, cleanliness of car, employment of operator, and maintenance of system.
- C. Construction Use of Elevator: Provide designated elevator for transport of construction personnel and materials in compliance with ASME A17.1.
 - 1. Make elevator available for construction use as early as possible.
 - 2. Enclose car with protective plywood on floor, walls, and ceiling.
 - 3. Provide temporary lighting.
 - 4. Provide control panel with manual and emergency operation.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit data on following items:
 - 1. Signal and operating fixtures, operating panels, and indicators.
 - 2. Car design, dimensions, layout, and components.
 - 3. Car and hoistway door and frame details.
 - 4. Electrical characteristics and connection requirements.
- C. Shop Drawings: Include appropriate plans, elevations, sections, diagrams, and details on following items:
 - 1. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.

2. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.
 3. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
 4. Clearances and over-travel of car and counterweight.
 5. Locations in hoistway and machine room of traveling cables and connections for car lighting, telephone, and _____.
 6. Location and sizes of hoistway and car doors and frames.
 7. Electrical characteristics and connection requirements.
 8. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.
- D. Samples: Submit samples illustrating car floor material, car interior finishes, car and hoistway door and frame finishes, handrail material and finish, and _____ in the form of cut sheets, finish color selection brochures, or _____.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Initial maintenance contract.
- H. Specimen warranty.
- I. Executed warranty.
- 1.6 QUALITY ASSURANCE
- A. Designer Qualifications: Design guide rails, brackets, anchors, and machine anchors under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
- 1.7 WARRANTY
- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 1-year manufacturer warranty for elevator operating equipment and devices. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Electric Traction Elevators:
1. Otis Elevator Company; Gen3 Core: www.otis.com/#sle.
- B. Substitutions: See Section 01 6000 - Product Requirements.

- C. Source Limitations: Provide elevator and associated equipment and components produced by the same manufacturer as the other elevator equipment used for this project and obtained from a single supplier.

2.2 ELECTRIC TRACTION ELEVATORS

- A. Electric Traction Passenger Elevator, No. 1 & 2:
 - 1. Electric Traction Elevator Equipment:
 - a. Gearless Traction Machine: Double wrapped traction driving sheave, with dual brake.
 - 2. Drive System:
 - 3. Operation Control Type:
 - 4. Service Control Type:
 - a. Standard service control only.
 - 5. Interior Car Height: 93 inch (2362 mm).
 - 6. Electrical Power: 480 volts; alternating current (AC); three phase; 60 Hz.
 - 7. Rated Net Capacity: 2100 pounds (950 kgs).
 - 8. Rated Speed: 150 feet per minute (0.75 m per second).
 - 9. Hoistway Size: As indicated on drawings.
 - 10. Interior Car Platform Size: As indicated on drawings.
 - 11. Elevator Pit Depth: 48 inch (___ mm).
 - 12. Overhead Clearance at Top Floor: 151 inch (3835 mm).
 - 13. Travel Distance: As indicated on drawings.
 - 14. Number of Stops: As indicated on drawings.
 - 15. Number of Openings: 2 Front.
 - 16. Traction Machine Location: As indicated on drawings.

2.3 COMPONENTS

- A. Elevator Equipment:
 - 1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70 requirements.
 - 2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets, and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
 - 3. Buffers:
 - 4. Lubrication Equipment:
 - a. Provide grease fittings for periodic lubrication of bearings.
 - b. Grease Cups: Automatic feed type.
 - c. Lubrication Points: Visible and easily accessible.
- B. Electrical Equipment:
 - 1. Motors: NEMA MG 1.
 - 2. Boxes, Conduit, Wiring, and Devices: Comply with NFPA 70 requirements.
 - 3. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.

4. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. See Section 26 0583.

2.4 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).
- B. Accessibility Requirements: Comply with ADA Standards.
- C. Perform structural steel design, fabrication, and installation in accordance with AISC 360.
- D. Perform welding of steel in accordance with AWS D1.1/D1.1M.
- E. Fabricate and install door and frame assemblies in accordance with NFPA 80 and complying with requirements of authorities having jurisdiction (AHJ).
- F. Perform electrical work in accordance with NFPA 70.

2.5 OPERATION CONTROLS

- A. Elevator Controls: Provide landing operating panels and landing indicator panels.
 1. Landing Operating Panels: Metallic type, one for originating "Up" and one for originating "Down" calls, one button only at terminating landings; with illuminating indicators.
 2. Landing Indicator Panels: Illuminating.
 3. Comply with ADA Standards for elevator controls.
- B. Interconnect elevator control system with building security, fire alarm, card access, smoke alarm, and building management control systems.
- C. Door Operation Controls:
 1. Program door control to open doors automatically when car arrives at floor landing.
 2. Render "Door Close" button inoperative when car is standing at dispatch landing with doors open.
 3. Door Safety Devices: Moveable, retractable safety edges, quiet in operation; equipped with photo-electric light rays.
- D. Provide "Firefighter's Emergency Operation" in accordance with ASME A17.1, applicable building codes, authorities having jurisdiction (AHJ), and ____.

2.6 OPERATION CONTROL TYPE

- A. Two-Car Selective Collective Automatic (Duplex Collective Automatic) Operation Control: Applies to cars in two elevator shafts.
 1. Park one car at main floor and designate other as free car at landing last served or at a predetermined upper floor landing.
 2. Arrange free car to answer landing calls either above or below landing where car is standing except main floor landing calls.

3. When free car is answering calls, automatically start an alternate car to answer landing calls under any of the following conditions:
 - a. Registration of up calls from landings below the free car while it is traveling up by alternate car below.
 - b. Registration of up or down calls from landings above the free car while it is traveling down by alternate car.
 - c. Free car fails to clear registered landing calls within 40 seconds or to move alternate car in response to registered landing calls within this time frame.
 4. Register and answer calls by momentary pressure on one or more car buttons; cause car to respond.
 5. Once started, either in response to car button calls or to landing button calls, respond to calls registered for the direction of the traveling car in the order that landings are reached, regardless of sequence that calls were registered.
 6. Allow only one car to stop in response to any one landing call.
 7. Return first free car to main floor after answering landing calls.
 8. Should both cars finish their calls at main floor, designate one car as the free car.
 9. If no car buttons are pressed and car starts up in response to several landing down calls, proceed first to the highest landing down call, then reverse to collect other landing down calls. Collect up calls similarly when car starts down in response to such calls.
 10. If a car stops for a landing call, and car button matching direction the car was traveling is pressed within a predetermined time interval after a landing stop, proceed in the same direction regardless of other landing calls that are registered.
 11. If down landing buttons are pressed while car is traveling up, do not stop at those landings, but allow those calls to remain registered for answering by the next down traveling car.
 12. After the highest car has responded to up landing calls, reverse car automatically, and respond to down landing calls.
 13. When traveling down, a car will not respond to up calls. Allow those up calls to remain registered to be answered by next available car on an up trip.
 14. Include a time delay to hold car for an adjustable time interval at landings where stops are made to enable passengers to enter or leave the car. Cancel the time interval upon registration of a car call or pressure on the car door close button.
 15. Permit a registered car call to establish the direction of travel when a car has answered the farthest car call, even if other landing calls are registered.
 16. Answer calls to the basement landing with the car that is normally parked at the main floor unless the free car is at the basement.
 17. If a car is removed from service, the other car shall answer landing calls.
- B. Destination-Based Group Automatic Operation Control: Applies to cars in two or more elevator shafts, with microprocessor and multicar operation with final destination established prior to entering elevator.
1. Reprogrammable group automatic system that assigns elevators to be leaving the main lobby landing in the "UP" direction to preselected floors, and then directs passengers to the specific elevator to bring them to their destination floor.
 2. Cars are dispatched in a regulated sequence to optimize system efficiency; dispatching is based on floor origin and floor destination of calls.
 3. Changes are automatically adjusted, such as changes in demand for different traffic conditions, including heavy incoming, heavy two-way, heavy outgoing, and light off-hours traffic as variations of normal two-way traffic.

2.7 SERVICE CONTROL TYPE

A. Hospital Service Control:

1. Incorporate a spring-return, key-operated switch in the car operating panel labeled "Hospital Service" that performs the following when activated:
 - a. Causes the nearest available elevator to travel directly to that landing and open doors.
 - b. Cancels car calls registered for that car.
 - c. Renders the hold door open switch and door edge protective devices inoperative only while responding to "Hospital Service" switch.
2. Incorporate a key-operated switch in each car labeled "Hospital Service" that performs the following when activated:
 - a. Disconnects that car from group control.
 - b. Programs up traveling cars to stop at main floor landing prior to proceeding to a designated higher landing.
 - c. Do not stop a down traveling car with a registered car button call for landing below the lower dispatch landing, unless the call in that car or a down button call at lower dispatch landing is in registration.
 - d. Incorporate in each car a flashing sign "Emergency Exit" activated immediately when car stops at selected landing. Include buzzer to attract attention to sign.
3. Design "Hospital Service" operation to override and be compatible with emergency power and Independent Service control operation.

B. Independent Service Control:

1. Provide key-operated "Independent Service" on car operating panel. Key activation will remove that car from normal operation and cancel preregistered car calls.
2. Car will respond to selected floor. Car will not respond to any calls from landing call buttons. Car will only respond to calls placed on the car operating panel. Doors will remain open at last landing requested. Doors will close with a constant pressure on "Door Close" button.
3. Key activation to normal operation will return car to normal operation.

2.8 EMERGENCY POWER

- A. Set up elevator operation to run with building emergency power supply when the normal building power supply fails and in compliance with ASME A17.1 requirements.
- B. Building Emergency Power Supply: Supplied by backup generator; provide elevator system components as required for emergency power characteristics with phase rotation the same as for normal power.
 1. Provide transfer switches and auxiliary contacts.
 2. Install connections to power feeders.
- C. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
- D. Provide operational control circuitry for adapting the change from normal to emergency power.
- E. Upon transfer to emergency power, advance one elevator at a time to a preselected landing, stop car, open doors, disable operating circuits, and hold in standby condition.

2.9 MATERIALS

- A. Stainless Steel Sheet: ASTM A666/A666M, Type 304; No. 4 Brushed finish unless otherwise indicated.
- B. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.
- C. Extruded Aluminum: ASTM B221 (ASTM B221M), natural anodized finish unless otherwise indicated.
- D. Aluminum Sheet: ASTM B209/B209M, 3105 alloy, O temper.
- E. Plywood: PS 1, Structural I, Grade C-D or better, sanded.
- F. Plastic Laminate: NEMA LD 3, Type HGS, color as selected by Architect from manufacturer's standard line of colors.

2.10 CAR AND HOISTWAY ENTRANCES

- A. Elevator, No. 1 &2:
 - 1. Car and Hoistway Entrances, Main Elevator Lobby:
 - a. Hoistway Fire Rating: 2 Hours.
 - b. Elevator Door Fire Rating: 1-1/2 Hours.
 - c. Framed Opening Finish and Material: Alkyd enamel on steel.
 - d. Car Door Material: Stainless steel, with rigid sandwich panel construction.
 - e. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.
 - f. Door Type: Double leaf.
 - g. Door Operation: Side opening, two speed.
 - h. Paint Color: As selected by Architect from manufacturer's standard line.
 - i. Door Width: 54 inch (1.372 m).
 - j. Door Height: 84 inch (2.134 m).
 - k. Sills: Extruded aluminum.
 - 2. Car and Hoistway Entrances, Upper Floor Elevator Lobbies:
 - a. Hoistway Fire Rating: 2 Hours.
 - b. Elevator Door Fire Rating: 1-1/2 Hours.
 - c. Framed Opening Finish and Material: Alkyd enamel on steel.
 - d. Car Door Material: Stainless steel, with rigid sandwich panel construction.
 - e. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.
 - f. Door Type: Double leaf.
 - g. Door Operation: Side opening, two speed.
 - h. Paint Color: As selected by Architect from manufacturer's standard line.
 - i. Sills: Extruded aluminum.
- B. Gasketing: Provide acoustic-type gasketing at hoistway doors and frames to eliminate audible noise due to car activities in the hoistway and air pressure differential between hoistway and landing floors.

2.11 CAR EQUIPMENT AND MATERIALS

- A. Elevator Car, No. 1&2:

1. Car Design: Model Gen3 Core by OTIS.
2. Car Operating Panel: Provide main and auxiliary; flush-mounted applied face plate, with illuminated call buttons corresponding to floors served with "Door Open/Door Close" buttons, "Door Open" button, "Door Close" button, and alarm button.
 - a. Panel Material: Integral with front return; one per car.
 - b. Car Floor Position Indicator: Above door with illuminating position indicators.
 - c. Locate alarm button where it is unlikely to be accidentally actuated; not more than 54 inch (1372 mm) above car finished floor.
 - d. Provide following within service cabinet as part of car operating panel:
 - 1) Switch for each auxiliary operational control, keyed.
 - 2) Switches for fan, light, inspection control, and ____.
 - 3) Emergency light.
 - 4) Telephone cabinet and hard-wired connection with telephone.
 - 5) Control for each other special feature specified.
 - 6) Convenience outlet receptacle; 110 VAC, 15 amps.
 - 7) Two-way message display for hearing- and speech-impaired users.
3. Ventilation: Two-speed fan with grille above ceiling.
4. Flooring: LVT.
5. Wall Base: Recessed stainless steel, 6 inch (152 mm) high.
6. Front Return Panel: Match material of car door.
7. Door Wall: Plastic laminate on plywood.
8. Side Walls: Plastic laminate on plywood.
9. Rear Wall: Plastic laminate on plywood.
10. Bumper Rail: Stainless steel, at three side walls. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
 - a. Round, Metal Tube: 1-1/2 inch (38 mm) diameter.
 - b. Stainless Steel Finish: No. 4 Brushed.
11. Ceiling:
 - a. Canopy Ceiling: Stainless steel.
 - b. Frame Finish: Clear anodized aluminum.
 - c. Lay-in Panel: Aluminum sheet.
 - d. Lighting: As selected from manufacturer's standard line.

B. Car Accessories:

1. Protective Pads: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for each elevator.
 - a. Color: Grey.
 - b. Provide at least 4 inch (102 mm) clearance from bottom of pad to finished floor.
 - c. Pad Supports: Stainless steel studs, and mounted from ceiling frame.

2.12 FINISHES

- A. Finish Paint for Metal Surfaces: Alkyd enamel, semi-gloss, color as selected, comply with VOC limitations of authorities having jurisdiction (AHJ).

- B. Clear Anodized Finish: Class I, AAMA 611 AA-M12C22A41 clear anodic coating with electrolytically deposited organic seal; not less than 0.7 mils, 0.0007 inch (0.018 mm) thick.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting this work.
- B. Verify that hoistway, pit, and machine room are ready for work of this section.
- C. Verify hoistway shaft and openings are of correct size and within tolerance.
- D. Verify location and size of machine foundation and position of machine foundation bolts.
- E. Verify that electrical power is available and of correct characteristics.

3.2 PREPARATION

- A. Arrange for temporary electrical power for installation work and testing of elevator components. See Section 01 5000 - Temporary Facilities and Controls for additional requirements.
- B. Maintain elevator pit excavation free of water.

3.3 INSTALLATION

- A. Coordinate this work with installation of hoistway wall construction.
- B. Install system components, and connect equipment to building utilities.
- C. Provide conduit, electrical boxes, wiring, and accessories; see Sections 26 0533.13 and 26 0583.
- D. Mount machines, motors, and _____ on vibration and acoustic isolators.
 - 1. Place on structural supports and bearing plates.
 - 2. Securely fasten to building supports.
 - 3. Prevent lateral displacement.
- E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
- F. Install guide rails to allow for expansion and contraction movement of guide rails.
- G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
- H. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
- I. Structural Metal Surfaces: Clean surfaces of rust, oil, or grease; wipe clean with solvent; prime with two coats.
- J. Wood Surfaces not Exposed to Public View: Finish with one coat primer; one coat enamel.

- K. Adjust equipment for smooth and quiet operation.

3.4 TOLERANCES

- A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
- B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Operational Tests:
 - 1. Perform operational tests in the presence of Owner and Architect.
 - 2. At an agreed time, and the building occupied with normal building traffic, conduct tests to verify performance.
 - a. Furnish event recording of each landing call registrations, time initiated, and response time throughout entire working day.
 - 3. Set period of time elevator takes to travel between typical floor landings at not more than _____ seconds.
 - a. Measure time from moment doors start to close until car has stopped level at next floor landing and doors are opening.

3.6 ADJUSTING

- A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.
- B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch (6.4 mm) maximum from flush with sill.

3.7 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Remove protective coverings from finished surfaces.
- C. Clean surfaces and components in accordance with manufacturers written instructions.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to Owner's designated representative.
- B. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, cleaning, and maintenance of each component.
- C. Training: Train Owner's personnel on cleaning and 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.

3.9 PROTECTION

- A. Do not permit construction traffic within car after cleaning.
- B. Protect installed products until Date of Substantial Completion.
- C. Touch up, repair, or replace damaged products and materials before Date of Substantial Completion.

3.10 MAINTENANCE

- A. Include systematic examination, adjustment, and lubrication of elevator equipment.
- B. Perform work without removing cars from use during peak traffic periods.

END OF SECTION 14 2100

SECTION 20 0513 - COMMON MOTOR REQUIREMENTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.

- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating, unless noted otherwise.
- I. Insulation: Class F, unless noted otherwise.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.

- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 20 0513

SECTION 21 0523 - GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Check valves.
- B. Iron OS&Y gate valves.
- C. Trim and drain valves.

1.2 RELATED REQUIREMENTS

- A. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

1.3 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 B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300; 2021.
- 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 C606 - Grooved and Shouldered Joints; 2022.
- F. FM (AG) - FM Approval Guide; Current Edition.
- G. FM 1120/1130 - Approval Standard for Fire Service Water Control Valves (OS&Y and NRS Gate Valves); 1997.
- H. FM 1140 - Approval Standard for Quick Opening Valves 1/4 Inch through 2 Inch Nominal Size; 1998.
- I. FM 1210 - Approval Standard for Swing Check Valves; 2004.
- J. UL (DIR) - Online Certifications Directory; Current Edition.
- K. UL 258 - Shutoff Valves for Trim and Drain Purposes for Fire Protection Service; Current Edition, Including All Revisions.
- L. UL 262 - Gate Valves for Fire-Protection Service; Current Edition, Including All Revisions.
- M. UL 312 - Check Valves for Fire-Protection Service; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least than ten years of documented experience.
- B. Where listed products are specified, provide products listed, certified, and labeled by FM (AG), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose indicated.
- C. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect valve ends and flange faces.
 - 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. Use sling to handle large valves, rig to avoid damage to exposed parts.
 - 2. Do not use operating handles or stems as lifting or rigging points.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Furnish valves of same kind by same manufacturer.
- B. Valve-End Connections:
 - 1. Flanges on Iron Valves: ASME B16.1 or ASME B16.42.
 - 2. Threaded Ends: ASME B1.20.1.
 - 3. Grooved Ends: AWWA C606.

- C. Valve Pressure Ratings: Not less than minimum pressure rating indicated or higher as required.
- D. Valve Sizes: Same as upstream piping unless otherwise indicated.
- E. 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.

2.2 SWING CHECK VALVES

- A. UL 312 and FM 1210 listed.
- B. Minimum Pressure Rating: 175 psig (1200 kPa).
- C. Body Material: Cast or ductile iron.
- D. Clapper: Bronze, EPDM-coated ductile iron, or stainless steel.
- E. Seat: Bronze or EPDM-coated bronze.
- F. End Connections: Flanged.

2.3 IRON OS&Y GATE VALVES

- A. UL 262 and FM 1120/1130 listed.
- B. Minimum Pressure Rating: 175 psig (1200 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.
- H. End Connections: Flanged.

2.4 TRIM AND DRAIN VALVES

- A. Ball Valves:
 - 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig (1200 kPa).
 - c. Body Design: Two piece.
 - d. Body Material: Forged brass or bronze.
 - e. Port Size: Full or standard.
 - f. Seat: PTFE.

- g. Stem: Bronze or stainless steel.
- h. Ball: Chrome-plated brass.
- i. Actuator: Hand-lever.
- j. End Connections: Threaded or grooved.

B. Angle Valves:

- 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig (1200 kPa).
 - c. Body Material: Brass or bronze.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

- 1. Description:
 - a. UL 258 or FM 1140 listed.
 - b. Pressure Rating: 175 psig (1200 kPa).
 - c. Body Material: Bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc Holder and Nut: Bronze.
 - g. Disc Seat: Nitrile.
 - h. Packing: Asbestos free.
 - i. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.1 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.
- F. Replace defective valves with new valves.

3.2 INSTALLATION

- A. Install valves in accessible locations to allow for operation, inspections, tests, and maintenance.
- B. Install listed valves in accordance with their listing.
- C. Install valves in accordance with manufacturer's instructions.
- D. Support valves independently of adjacent piping.
- E. Install valves in horizontal piping with stem at or above pipe center.
- F. Position valves to allow full actuator movement.
- G. Install OS&Y valves with full clearance for rising stem. Install surrounding components so they do not interfere with nor are they impacted by full extension of rising stem.
- H. Install supervised shutoff valves in supervised-open position.
- I. Install permanent identification signs indicating portion of system controlled by each shutoff valve.
- J. Install threaded-end valves with unions upstream and downstream.
- K. Install valve tags. See Section 21 0553. Label valves in accordance with NFPA standard applying to the piping system in which valves are installed.

END OF SECTION 21 0523

SECTION 21 0553 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Pipe markers.

1.2 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Stencil paint.

1.3 REFERENCE STANDARDS

- A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

- A. Control Panels: Nameplates.
- B. Major Control Components: Nameplates.
- C. Piping: Pipe markers.
- D. Pumps: Nameplates.
- E. Small-sized Equipment: Tags.

2.2 NAMEPLATES

- A. Manufacturers:
 - 1. Brimar Industries, Inc: www.pipemarker.com/#sle.
 - 2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 - 3. Seton Identification Products, a Tricor Direct Company: www.seton.com/#sle.
- 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.

2.3 TAGS

- A. Manufacturers:
 1. Advanced Graphic Engraving, LLC: www.advancedgraphicengraving.com/#sle.
 2. Brady Corporation: www.bradycorp.com/#sle.
 3. Brimar Industries, Inc: www.pipemarker.com/#sle.
 4. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 5. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.

2.4 PIPE MARKERS

- A. Manufacturers:
 1. Brady Corporation: www.bradycorp.com/#sle.
 2. Brimar Industries, Inc: www.pipemarker.com/#sle.
 3. Craftmark Pipe Markers: www.craftmarkid.com/#sle.
 4. Kolbi Pipe Marker Co: www.kolbipipemarkers.com/#sle.
 5. Seton Identification Products, a Tricor Company: www.seton.com/#sle.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- C. Color code as follows:
 1. Fire Quenching Fluids: Red with white letters.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 9123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Identify service, flow direction, and pressure.
 1. Install in clear view and align with axis of piping.

2. 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.

END OF SECTION 21 0553

SECTION 21 1300 - FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Fire department connections.

1.2 RELATED REQUIREMENTS

- A. Section 21 0500 - Common Work Results for Fire Suppression: Pipe and fittings.
- B. Section 21 0523 - General-Duty Valves for Water-Based Fire-Suppression Piping.
- C. Section 21 0553 - Identification for Fire Suppression Piping and Equipment.

1.3 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 AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry; 2018, with Editorial Revision (2020).
- D. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 1963 - Standard for Fire Hose Connections; 2019.
- I. UL (DIR) - Online Certifications Directory; Current Edition.
- J. UL 405 - Standard for Safety Fire Department Connection Devices; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

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

1.5 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. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components, and accessories. Indicate system controls.
 - 2. Submit shop drawings to Authorities Having Jurisdiction for approval. 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. 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.
- F. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.6 QUALITY ASSURANCE

- A. Comply with UL (DIR) requirements.
- B. Designer Qualifications: Design system under direct supervision of a NICET Certified or 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 the Products specified in this section with minimum three years documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience and approved by manufacturer.
- E. Equipment and Components: Provide products that bear UL (DIR) label or marking.
- F. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.7 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

2.1 MANUFACTURERS

- A. Sprinklers, Valves, and Equipment:
 - 1. Anvil International: www.anvilintl.com/#sle.
 - 2. Tyco Fire Protection Products: www.tyco-fire.com/#sle.
 - 3. Viking Corporation: www.vikinggroupinc.com/#sle.

2.2 SPRINKLER SYSTEM

- A. Sprinkler System: Provide coverage for building areas as noted on plans..
- B. Occupancy: Light hazard; comply with NFPA 13.
- C. Water Supply: Determine volume and pressure from water flow test data.
- D. Provide fire department connections as indicated on plans.
- 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.

2.3 SPRINKLERS

- A. Suspended Ceiling Type: Concealed pendant type with matching push on escutcheon plate.
 - 1. Response Type: Quick.
 - 2. Coverage Type: Standard.
 - 3. Finish: Enamel, color white .
 - 4. Escutcheon Plate Finish: Chrome plated.
 - 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- B. Exposed Area Type: Upright type with guard in areas subject to damage (Gyms, etc.).
 - 1. Response Type: Quick.
 - 2. Coverage Type: Standard.
 - 3. Fusible Link: Glass bulb 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: Enamel, color white .
 - 4. Escutcheon Plate Finish: Enamel, color white .
 - 5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

- D. Storage Sprinklers: Pendant type with guard.
 - 1. Response Type: Standard.
 - 2. Coverage Type: Standard.
 - 3. Finish: Chrome plated.
 - 4. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- E. Guards: Finish to match sprinkler finish. Provide in areas subject to damage (Gyms, etc.)
- F. Flexible Drop System: Stainless steel, multiple use, open gate type.
 - 1. Application: Use to properly locate sprinkler heads in the center of ceiling grids.
 - 2. Include all supports and bracing.
 - 3. Provide braided type tube as required for the application.
 - 4. Manufacturers:

2.4 PIPING SPECIALTIES

- A. Backflow Preventer: Double check valve assembly backflow preventer with drain and OS & Y gate valve on each end with tamper switches.
- B. 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.
- C. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- D. 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.
- E. Fire Department Connections:
 - 1. Type: Flush, wall mount made of corrosion resistant metal complying with UL 405.
 - a. Inlets: Two way, 2-1/2 inch (65 DN) swivel fittings, internal threaded. Thread size and inlets according to NFPA 1963 and local fire department threads. Brass caps with gaskets, chains, and lugs.
 - b. Configuration: Horizontal.
 - c. Finish: Brass or bronze.
 - d. Signage: Raised or engraved lettering 1 inch (25.4 mm) minimum indicating system type "Fire Department Connection".
- F. Supervisory Switches: Provide tamper switches on each valve in system.

2.5 STEEL PIPE AND FITTINGS

- A. All steel piping in this article is suitable for 175-psig (1200-kPa) minimum working pressure.

- B. Thinwall Steel Pipe (Wet Pipe): ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- C. Schedule 10, Black-Steel Pipe (Wet Pipe): ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end.
- D. Schedule 10, Hot dipped galvanized Pipe (Dry Pipe): ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250), plain end. All dry system fittings to be listed galvanized with tri-seal gaskets on grooved piping.
- E. Steel Pipe Hot dipped galvanized pipe (Dry Pipe): ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, Schedule 40. Pipe ends may be factory or field formed to match joining method. All dry system fittings to be listed galvanized.
- F. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- G. Malleable- or Ductile-Iron Unions: UL 860.
- H. Cast-Iron Flanges: ASME 16.1, Class 125.
 - 1. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 - 2. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Pressure Rating: 175-psig (1200-kPa) minimum.
 - 2. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
 - 3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- J. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
- K. Description: System of support brackets and covers made to protect sprinkler piping.
- L. Brackets: Glass-reinforced nylon.

PART 3 EXECUTION

3.1 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 double check valve 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.
- G. Place pipe runs to minimize obstruction to other work.
- 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 required.
- M. Hydrostatically test entire system.
- N. Require test be witnessed by Fire Marshal.

3.2 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
 - 1. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. The margin-of-safety requirement may not be required by authorities having jurisdiction. Retain "Margin of Safety for Available Water Flow and Pressure" Subparagraph below to require the application of a margin of safety in the Contractor's design.
 - b. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 1) Sprinkler Occupancy Hazard Classifications:
 - 2) Building Service Areas: [Ordinary Hazard, Group 1]
 - 3) Electrical Equipment Rooms: [Ordinary Hazard, Group 1]
 - 4) General Storage Areas: [Ordinary Hazard, Group 1]
 - 5) Mechanical Equipment Rooms: [Ordinary Hazard, Group 1]
 - 6) Office and Public Areas: [Light Hazard]
 - 7) Classrooms: [Light Hazard]
 - 8) Attic: [Light Hazard]
 - 2. Minimum Density for Automatic-Sprinkler Piping Design:

- a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. (4.1 mm/min. over 139-sq. m) area.
- b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. (6.1 mm/min. over 139-sq. m) area.
- c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. (8.1 mm/min. over 139-sq. m) area.
- 3. Maximum Protection Area per Sprinkler: According to UL listing.
- 4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft. (20.9 sq. m).
 - b. Storage Areas: 130 sq. ft. (12.1 sq. m).
 - c. Mechanical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
 - d. Electrical Equipment Rooms: 130 sq. ft. (12.1 sq. m).
 - e. Other Areas: According to NFPA 13 recommendations.

END OF SECTION 21 1300

SECTION 22 0516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Expansion joints and compensators.
- C. Pipe loops, offsets, and swing joints.

1.2 RELATED REQUIREMENTS

- A. Section 21 0500 - Common Work Results for Fire Suppression.
- B. Section 22 1005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

- A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2024.
- B. EJMA (STDS) - EJMA Standards; Tenth Edition.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.2 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Flex-Hose Co. Inc: www.flexhose.com/#sle.
 - 2. Flex-Weld, Inc: www.kelcoind.com/#sle.
 - 3. The Metraflex Company; Metraloop: www.metraflex.com/#sle.
 - 4. Minnesota Flexible Corporation.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain or air release port.
- C. Maximum Allowable Motion: 2 inch (50.8 mm) in the x, y, and z planes with no thrust loads to the building structure.
- D. Maximum Working Pressure: 150 psi (1030 kPa) at 800 degrees F (426.7 degrees C).
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with copper fittings, including elbows and female copper sweat or flanged end connections sized to match pipe segment.
 - 1. Selected Product to Accommodate:
 - a. Angular Rotation: 15 degrees.
 - b. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 2. Provide necessary accessories including, but not limited to, swivel joints.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

- E. Provide support and equipment required to control expansion and contraction of piping.
Provide loops, pipe offsets, and swing joints, or expansion joints where required.

END OF SECTION 22 0516

SECTION 22 0517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe sleeves.
- B. Pipe sleeve-seals.

1.2 RELATED REQUIREMENTS

- A. Section 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.
- D. Section 22 0523 - General-Duty Valves for Plumbing Piping.
- E. Section 22 0553 - Identification for Plumbing Piping and Equipment: Piping identification.
- F. Section 22 0716 - Plumbing Equipment Insulation.
- G. Section 22 0719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

- A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 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.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.
- B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 1 inch (25 mm) 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.
- B. Plastic or Sheet Metal: Pipe passing through interior walls, partitions, and floors, unless steel or brass sleeves are specified below.
- C. 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.
- D. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:
 - 1. Galvanized steel pipe or black iron pipe with asphalt coating.
 - 2. Connect sleeve with floor plate except in mechanical rooms.
- E. 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 complying with ASTM E814 in accordance with Section 07 8400 to prevent the spread of fire, smoke, and gases.

2.2 PIPE-SLEEVE SEALS

- A. Modular Mechanical Sleeve-Seal:

1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 3. Size and select seal component materials in accordance with service requirements.
 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Oil, fuel, gas, and solvent resistant.
 - c. Underground, buried, and wet conditions.
 - d. Fire Resistant: 1 hour, UL (DIR) approved.
 - e. High Temperature, up to 400 degrees F (204 degrees C).
 - f. Low temperature, down to minus 67 degrees F (minus 55 degrees C).
 5. Glass-reinforced plastic pressure end plates.
- B. Sealing Compounds:
1. Provide packing and sealing compound to fill pipe to sleeve thickness.
 2. Combined packing and sealing compounding to match partition fire-resistance hourly rating.
- C. Pipe Sleeve Material:
1. Bearing Walls: Steel, cast iron, or terra-cotta pipe.
 2. Masonry Structures: Sheet metal or fiber.
- D. Wall Sleeve: PVC material with waterstop collar, and nailer end-caps.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Inserts:
 1. Provide inserts for placement in concrete formwork.
 2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (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.
- E. Structural Considerations: Do not penetrate building structural members unless indicated.
- F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.
 2. Aboveground Piping:
 - a. Pack solid using mineral fiber complying with ASTM C592.
 - b. Fill space with an elastomer caulk to a depth of 0.50 inch (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.
 4. Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.
- G. Manufactured Sleeve-Seal Systems:
1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.
 2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.
 3. Locate piping in center of sleeve or penetration.
 4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.
 5. Tighten bolting for a water-tight seal.
 6. Install in accordance with manufacturer's recommendations.
- H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 22 0517

SECTION 22 0519 - METERS AND GAUGES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water meters.
- B. Pressure gauges.
- C. Thermometers.
- D. Pressure-temperature test plugs.

1.2 REFERENCE STANDARDS

- A. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- B. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- C. AWWA C701 - Cold-Water Meters -- Turbine Type, for Customer Service; 2019.
- D. AWWA C707 - Encoder-Type Remote-Registration Systems for Cold-Water Meters; 2022.
- E. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- F. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Utility Service Metering: Coordinate and apply Utility Service Provider requirements in terms of meter type, size, physical location, pipe size, upstream/downstream pipe lengths required, and other installation details.

1.4 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.
- C. Project Record Documents: Record actual locations of components and instrumentation.

- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements. for additional provisions.
 2. Extra Pressure Gauges: One of each type and size.

PART 2 PRODUCTS

2.1 WATER METERS

- A. Turbine Water Meters:
1. Inline Type: Class 150 flanged.
 2. Flow Capacity Range: As indicated on drawings, provide a water meter with a pressure drop less than 5 psi at required flow. Contractor to verify piping and valving arrangement required by city prior to installation.
 3. Remote Monitoring: AWWA C707 digital-register with wireless (RF) AMI interface.
 4. Lead-free bronze alloy case, polymer-based cap, test port, and hermetically sealed register with low flow indicator.
 5. Pressure and Temperature: Up to 175 psi (12 bar) and 120 degrees F (49 degrees C).
 6. AWWA C701 Class II, with lead content below 0.25 percent when using non-lead-free materials on wetted surfaces according to NSF 61 and NSF 372.

2.2 PRESSURE GAUGES

- A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
 3. Winters Instruments: www.winters.com/#sle.
 4. Weiss Instruments, Inc.
 5. Watts.
 6. Trerice.
 7. Tel-Tru Manufacturing Company.
 8. Flo Fab Inc.
 9. Ametek, Inc.
 10. Wika Instrument Corporation - USA.

2.3 THERMOMETERS

- A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
 2. Moeller Instrument Company, Inc: www.moellerinstrument.com/#sle.
 3. Watts Water Technologies, Inc: www.watts.com/#sle.
 4. Winters Instruments: www.winters.com/#sle.
 5. Wika Instrument Corporation - USA.
 6. Weiss Instruments, Inc.
 7. Wika Instrument Corporation - USA.
 8. Tel-Tru Manufacturing Company.
 9. Flo Fab Inc.

10. Ametek, Inc.

B. General:

1. Product Compliance: ASTM E1.
2. Lens: Clear glass, except where stated.
3. Accuracy: One percent, when tested in accordance with ASTM E77, except where stated.
4. Scale: Black markings depicting single scale in degrees F where expected process value falls half-span of standard temperature range.

C. Thermometers - Straight: 5 inch (127 mm) v-shape lead-free brass case with clear glass window scale, 2 inch (50.8 mm) NPT stem, 3-1/4 inch (82.5 mm) NPT thermowell, and red or blue non-toxic organic liquid filled glass tube.

D. Thermometers - Dial Type:

1. Fixed: 5 inch (125 mm) diameter dial with black pointer, stainless steel case, silicone damping bimetal element, hermetically sealed lens, recalibrating screw, and 2-1/2 inch (63.5 mm) NPT stem.

2.4 PRESSURE-TEMPERATURE TEST PLUGS:

A. Manufacturers:

1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Watts Water Technologies, Inc: www.watts.com/#sle.
3. Weiss Instruments, LLC: www.weissinstruments.com/#sle.
4. Weksler Glass Thermometer Corp: www.wekslerglass.com/#sle.
5. Winters Instruments: www.winters.com/#sle.
6. Wika Instrument Co

B. 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.

C. Wetted Materials per Temperature Range:

1. Up to 200 degrees F (93 degrees C): Brass or stainless steel body with neoprene core and gasketed caps. Include extended stem on units to be installed in insulated piping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Verify Utility Service Provider piping readiness to receive meter.
- B. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports, and test plugs.

3.2 INSTALLATION

- A. Install metering products in accordance with manufacturer's instructions for intended fluid type and service.

- B. Install water meters with inlet and outlet isolation valves in compliance with AWWA M6.
- C. Install rotameters (flowmeters) between 4 to 6 ft (1.2 to 1.8 m) above finished floor unless instructed otherwise to allow easy readability.
- D. Install pressure gauges as follows:
 - 1. At Pumps: Place single gauge before strainer, suction side and discharge side.
 - 2. Include gauge cock to isolate each gauge and extend nipples for insulation clearance.
 - 3. Include siphons on high temperature systems and select type according to service rating.
 - 4. Adjust gauges to selected viewing angle, clean thoroughly, and calibrate to zero.
- E. Install thermometers as follows:
 - 1. Hot Water Heaters: Place upstream and downstream of heater. Add one on the inlet end when using steam as the water heating medium.
- F. Locate PT (pressure-temperature) test plugs adjacent to control device sockets.

END OF SECTION 22 0519

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ball valves.
- B. Check valves.
- C. Gate valves.
- D. Globe valves.
- E. Chainwheels.

1.2 RELATED REQUIREMENTS

- A. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- B. Section 22 0719 - Plumbing Piping Insulation.
- C. Section 22 1005 - Plumbing Piping.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Non-rising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.4 REFERENCE STANDARDS

- A. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

- C. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 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. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- F. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- G. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- H. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- I. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- J. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- K. NSF 372 - Drinking Water System Components - Lead Content; 2024.

1.5 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. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.6 QUALITY ASSURANCE

- A. Manufacturer:
 - 1. Obtain valves for each valve type from single manufacturer.
 - 2. Company must specialize in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Welding Materials and Procedures: Comply with ASME BPVC-IX.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
 - 2. Protect valve parts exposed to piped medium against rust and corrosion.
 - 3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.
 - 4. Adjust globe, gate, and angle valves to the closed position to avoid clattering.
 - 5. Secure check valves in either the closed position or open position.

- 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 off the ground in watertight enclosures when indoor storage is not an option.

1.8 EXERCISE THE FOLLOWING PRECAUTIONS FOR HANDLING:

- A. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. See drawings for specific valve locations.
- B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- C. Provide the following valves for the applications if not indicated on drawings:
 - 1. Shutoff: Ball, gate or plug.
 - 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.
 - c. 2-1/2 inch (65 mm, DN) and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- 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.
 - c. 5 inch (125 mm, DN) and Larger: Grooved or flanged ends.

2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.

- C. Valve Actuator Types:
 - 1. Gear Actuator: Quarter-turn valves 8 inch (200 mm, DN) and larger.
 - 2. Hand Lever: Quarter-turn valves 6 inch (150 mm, DN) and smaller except plug valves.
 - 3. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator, of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- 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:
- 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.
- G. Potable Water Use:
 - 1. Certified: Approved for use in compliance with NSF 61 and NSF 372.
 - 2. Lead-Free Certified: Wetted surface material includes less than 0.25 percent lead content.
- H. Source Limitations: Obtain each valve type from a single manufacturer.

2.3 BRASS, BALL VALVES

- A. Two Piece, Full Port with Brass Trim and Female Thread, Male thread, Solder, or Press Connections:
 - 1. Comply with MSS SP-110.
 - 2. WSP Rating: 150 psi (1035 kPa).
 - 3. WOG Rating: 600 psi (4140 kPa).
 - 4. Body: Forged brass.
 - 5. Seats: PTFE.
 - 6. Ball: Stainless steel, vented.
 - 7. Operator: Oval handle and memory stop.
 - 8. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Conbraco Industries, Inc.; Apollo Valves
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Valves.
 - f. Hammond Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO Inc.
 - i. Watts; a Water Technologies company.

2.4 STAINLESS STEEL, BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim:
 - 1. Comply with MSS SP-110.
 - 2. WSP Rating: 150 psi (1035 kPa).
 - 3. CWP Rating: 2,000 psi (13790 kPa).
 - 4. Seats: PTFE.
 - 5. Stem: Stainless steel, blowout proof.
 - 6. Ball: Stainless steel, vented.
 - 7. End Connections: Threaded.
 - 8. Operator: Oval handle.
 - 9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2.5 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. CWP Rating: 200 psi (1380 kPa).
 - 4. Body: Bronze, ASTM B62.
 - 5. End Connections: Threaded or soldered.
 - 6. Disc: Bronze.
 - 7. Manufacturers:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2.6 IRON, HORIZONTAL SWING CHECK VALVES

A. Class 125:

1. Pressure and Temperature Rating: MSS SP-71, Type I.
2. Design: T-body style for clear or full waterways.
3. WOG Rating: 200 psi (1380 kPa).
4. Body: ASTM A126, gray cast iron with bolted bonnet.
5. End Connections: Flanged or threaded.
6. Trim: Composition.
7. Seat Ring and Disc Holder: Bronze.
8. Disc: PTFE.
9. Gasket: Asbestos free.
10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Crane Co. Crane Valves.
 - c. Crane Co. Jenkins Valves.
 - d. Crane Co, Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve.
 - h. Watts Regulator.

2.7 BRONZE, GATE VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Rising Stem or OS&Y:

1. Pressure-Temperature Range: MSS SP-80, Type I.
2. Class 125:
 - a. WSP Rating: 125 psi (861.8 kPa), saturated.
 - b. CWP Rating: 200 psi (1380 kPa).
3. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
4. End Connections: Threaded or solder.
5. Stem: Bronze.
6. Disc: Solid wedge; bronze.
7. Packing: Asbestos free.
8. Handwheel Operator: Malleable iron.
9. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Crane Co. Crane Valves.
 - c. Crane Co. Jenkins Valves.
 - d. Crane Co, Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.

- g. Milwaukee Valve.
- h. Watts Regulator.

2.8 BRONZE, GLOBE VALVES

A. General:

- 1. Fabricate from dezincification resistant material.
- 2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125 and Class 250:

- 1. Class 125:
 - a. CWP Rating: 200 psi (1380 kPa).
- 2. Class 250: CWP Rating: 300 psi (2070 kPa).
- 3. Comply with MSS SP-80, Type 1.
- 4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
- 5. End Connections: Threaded or solder.
- 6. Bonnet: NRS; Non-rising Stem.
- 7. Non-Rising Stem: Bronze.
- 8. Disc: Bronze or PTFE.
- 9. Packing: Asbestos free.
- 10. Manufacturers:
 - a. Apollo Valves: www.apollovalves.com/#sle.
 - b. Crane Co. Crane Valves.
 - c. Crane Co, Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve.
 - g. Watts Regulator.

2.9 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

- 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
- 2. Attachment: For connection to ball valve stems.
- 3. Sprocket Rim with Chain Guides: Ductile iron. Include zinc coating.
- 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.

B. Manufacturers:

- 1. Roto Hammer Industries..
- 2. Trumbull Industries,.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- 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 into horizontal or vertical position, between flanges.
- E. Provide chainwheels on operators for valves 4 inch (100 mm, DN) and larger where located 96 inches (2.4 m) or more above finished floor, terminating 60 inches (1.5 m) above finished floor.

END OF SECTION 22 0523

SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Strut systems for pipe or equipment support.
- B. Beam clamps.
- C. Pipe hangers.
- D. Pipe supports, guides, shields, and saddles.
- E. Anchors and fasteners.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 05 5000 - Metal Fabrications.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- 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; 2024.
- 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; 2024.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- M. FM (AG) - FM Approval Guide; Current Edition.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- O. UL (DIR) - Online Certifications Directory; Current Edition.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.5 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. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.
- B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.
- C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
- D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
- E. Fire Resistance: Provide hardware rated for 60 minutes resistance unless specifically indicated by the authority having jurisdiction.
- F. Materials for Metal Fabricated Supports: Comply with Section 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.
- G. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.2 STRUT SYSTEMS FOR PIPE OR EQUIPMENT SUPPORT

- A. Strut Channels:
 - 1. ASTM A653/A653M galvanized steel bracket with clamps for surface mounting of piping or plumbing equipment support.
 - 2. Channel or Bracket Kits: Include rods, brackets, end-fixed fittings, covers, clips, and other related hardware required to complete sectional trapeze section for piping or other support.

- B. Hanger Rods:
 - 1. Threaded zinc-plated steel unless otherwise indicated.
 - 2. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch (13 mm, DN) diameter.
- C. Channel Nuts:
 - 1. Provide carbon steel channel nut with epoxy copper or zinc finish and long, regular, or short spring as indicated on drawings.

2.3 BEAM CLAMPS

- A. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
- B. C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
- C. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
- D. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
- E. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
- F. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
- G. 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.

2.4 PIPE HANGERS

- A. Band Hangers, Adjustable:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 7 or 9, zinc-plated ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
- B. Swivel Ring Hangers, Adjustable:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. MSS SP-58 type 10, epoxy-painted, zinc-colored.
 - 3. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
 - 4. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.
 - 5. Felt-Lined: Provide for uninsulated pipe to reduce noise and prevent static issues.

- C. Clevis Hangers, Adjustable:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
 - 3. Felt-Lined: MSS SP-58 type 1, zinc-plated, silicone-free carbon steel.
 - 4. Light-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
 - 5. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.

2.5 PIPE CLAMPS

- A. Riser Clamps:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 - 3. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 4. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 - 5. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 - 6. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).
- B. Extension Split Pipe Clamp:
 - 1. MSS SP-58 type 12, hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 - 2. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 - 3. Provide hanger rod and nuts of the same type and material for a given pipe run.
 - 4. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
- C. Strut Clamps:
 - 1. Manufacturers:
 - a. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
 - 2. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.

2.6 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 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.
- C. 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. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as required.
 - c. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
 - d. Provide pipe supports for 1/2 to 30 inch (15 to 750 mm, DN) iron pipes.
 - e. 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.
 - 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).

2.7 ANCHORS AND FASTENERS

- A. Manufacturers - Mechanical Anchors:
1. Hilti, Inc: www.us.hilti.com/#sle.
 2. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
 3. Powers Fasteners, Inc: www.powers.com/#sle.
 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- B. Manufacturers - Powder-Actuated Fastening Systems:
1. Hilti, Inc: www.us.hilti.com/#sle.
 2. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 3. Powers Fasteners, Inc: www.powers.com/#sle.
 4. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- C. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
- D. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- E. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- F. Hollow Masonry: Use toggle bolts.
- G. Hollow Stud Walls: Use toggle bolts.

- H. Steel: Use beam ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
- I. Beam Ceiling Flanges: ASTM A47/A47M Grade 32510, malleable iron or stainless steel with copper, plain, stainless steel, or zinc finish.
- J. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - 1. Channel Material: Use galvanized steel.
 - 2. Manufacturer: Same as manufacturer of metal strut channel framing system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- H. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

- I. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- J. Secure fasteners according to manufacturer's recommended torque settings.
- K. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

- A. See Section 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 CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Vibration isolation requirements.
- B. Vibration-isolated equipment support bases.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 05 5000 - Metal Fabrications: Materials and requirements for fabricated metal supports.
- C. Section 22 0529 - Hangers and Supports for Plumbing Piping and Equipment.

1.3 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.

1.4 REFERENCE STANDARDS

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate selection and arrangement of vibration isolation and/or seismic control components with the actual equipment to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. 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.

1.6 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.
- C. Shop Drawings - Vibration Isolation Systems:
 - 1. Include dimensioned plan views and sections indicating proposed arrangement of vibration isolators; indicate equipment weights and static deflections.
 - 2. Vibration-Isolated Equipment Support Bases: Include base weights, including concrete fill where applicable; indicate equipment mounting provisions.

1.7 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATION REQUIREMENTS

- A. Design and provide vibration isolation systems to reduce vibration transmission to supporting structure from vibration-producing plumbing equipment and/or plumbing connections to vibration-isolated equipment.
- B. Comply with applicable general recommendations of ASHRAE (HVACA), where not in conflict with other specified requirements:
- C. General Requirements:
 - 1. Select vibration isolators to provide required static deflection.
 - 2. Select vibration isolators for uniform deflection based on distributed operating weight of actual installed equipment.
- D. Equipment Isolation: As indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive vibration isolation and/or seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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. 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.
 - 2. Clean debris from beneath vibration-isolated equipment that could cause short-circuiting of isolation.
 - 3. Use elastomeric grommets for attachments where required to prevent short-circuiting of isolation.
 - 4. Adjust isolators to be free of isolation short circuits during normal operation.
 - 5. Do not overtighten fasteners such that resilient material isolator pads are compressed beyond manufacturer's maximum recommended deflection.

3.3 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. 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.

- D. Correct deficiencies and replace damaged or defective vibration isolation and/or seismic control components.

END OF SECTION 22 0548

SECTION 22 0553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Stencils.
- D. Pipe markers.
- E. Underground warning tape.
- F. Warning Tags

1.2 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers catalog literature for each product required.
- C. Project Record Documents: Record actual locations of tagged valves.

PART 2 PRODUCTS

2.1 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

- A. Nameplates:
 - 1. Heat exchangers, water heaters, and other heat transfer products.
 - 2. Control panels, transducers, and other related control equipment products.
 - 3. Pumps, tanks, filters, water treatment devices, and other plumbing equipment products.
- B. Tags:
 - 1. Piping: 3/4 inch (20 mm) diameter and smaller.
 - 2. Manual operated and automated control valves.

3. Instrumentation, relays, gauges, and other related control equipment products.
4. Ceiling tacks placed on lay-in ceiling surface to reference plumbing components.

C. Stencil:

1. Piping: 3/4 inch (20 mm) diameter and higher.
2. Heat exchangers, water heaters, and other heat transfer products.
3. Pumps, tanks, filters, water treatment devices, and other fluid managing products.

D. Pipe Markers: 3/4 inch (20 mm) diameter and higher.

2.2 NAMEPLATES

A. 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.

2.3 TAGS

- A. Metal: Brass, 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.
- B. Valve Tag Chart: Typewritten 12-point letter size list in anodized aluminum frame.
- C. Piping: 3/4 inch (20 mm) diameter and smaller. Include corrosion resistant chain. Identify service, flow direction, and pressure.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-tag schedule shall be included in operation and maintenance data.

2.4 PIPE MARKERS

- A. Comply with ASME A13.1.
- B. 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.
- C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- D. Underground Flexible Marker: Bright-colored continuously printed ribbon tape, minimum 6 inches (150 mm) wide by 4 mil, 0.004 inch (0.10 mm) thick, manufactured for direct burial service.
- E. Identification Scheme, ASME A13.1:
1. Primary: External Pipe Diameter, Uninsulated or Insulated.

- 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. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.
 - b. Sanitary Waste and Storm Drainage Piping: White text on black background.

2.5 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial or non detectible taped and 14 gauge tracer wire, unless otherwise indicated.
 - 1. Exception: Use foil-backed detectable type tape where required by serving utility or where directed by Owner.
- B. Foil-backed Detectable Type Tape: 3 inches (76 mm) wide, with minimum thickness of 5 mil, 0.005 inch (0.12 mm), unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:

2.6 WARNING TAGS

- A. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 1. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 - 2. Size: 3 by 5-1/4 inches minimum.
 - 3. Fasteners: Reinforced grommet and wire.
 - 4. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 5. Color: Safety-yellow background with black lettering.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive identification products.
- B. Prepare surfaces for stencil painting, see Section 09 9123.

3.2 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. Apply stencil painted identification in compliance with Section 09 9123 requirements. Identify unit with assigned id-number and area being served using pipe marking rules.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.
- F. Apply ASME A13.1 Pipe Marking Rules:
 - 1. Place pipe marker adjacent to changes in direction.
 - 2. Place pipe marker adjacent each valve port and flange end.
 - 3. Place pipe marker at both sides of floor and wall penetrations.
 - 4. Place pipe marker every 25 to 50 feet (7.6 to 15.2 m) interval of straight run.

END OF SECTION 22 0553

SECTION 22 0716 - PLUMBING EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cellular glass insulation.
- B. Cellular melamine insulation.
- C. Flexible elastomeric cellular insulation.
- D. Flexible glass fiber insulation.
- E. Rigid glass fiber insulation.
- F. Weather barrier coatings.
- G. Jacketing and accessories.

1.2 REFERENCE STANDARDS

- A. Equipment, piping, fittings, & accessories covered in this specification shall conform to the Domestic Content Bonus requirements of Section 48 of the Investment Tax Credit. Provide proper documentation to the accountant/owner as required. Documentation requirements are similar to Build America Buy America Act requirements, but differ. It is the responsibility of the contractor and supplier to understand the domestic bonus content filing requirements when bidding and work with the project accountant during the project to provide the necessary documentation. Examples of documentation that may be requested include but are not limited to:
 - 1. Build America Buy America Act Compliance Statement Certificate
 - 2. Manufacturer letter/statement confirming at least 40% of the total cost of manufactured products are produced, mined, or manufactured in the U.S.
 - 3. Bill of Materials or Parts List that includes a breakdown of material costs and manufacturing origins.
 - 4. Other related materials related to the project such as:
 - a. Most recent pay application
 - b. Electrical and HVAC invoices or detailed breakout of costs
- 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 C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

- E. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- F. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- G. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- H. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- I. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- J. ASTM C1410 - Standard Specification for Cellular Melamine Thermal and Sound-Absorbing Insulation; 2017 (Reapproved 2023).
- K. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- L. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2017 (Reapproved 2021).
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- N. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- O. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 FLEXIBLE GLASS FIBER INSULATION

- A. Manufacturers:
 1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Johns Manville Corporation: www.jm.com/#sle.
 3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C553; flexible, noncombustible.

1. K (Ksi) Value: 0.36 at 75 degrees F (0.052 at 24 degrees C), when tested in accordance with ASTM C177 or 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: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
1. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
- D. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.3 RIGID GLASS FIBER INSULATION

- A. Manufacturers:
1. CertainTeed Corporation: www.certainteed.com/#sle.
 2. Johns Manville Corporation: www.jm.com/#sle.
 3. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- B. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
1. K (Ksi) Value: 0.25 at 75 degrees F (0.036 at 24 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 2. Maximum Service Temperature: 850 degrees F (454 degrees C).
 3. Maximum Water Vapor Absorption: 5.0 percent by weight.
 4. Maximum Density: 8.0 pcf (128 kg/cu m).

2.4 CELLULAR GLASS INSULATION

- A. Manufacturers:
1. Owens Corning Corporation; FOAMGLAS: www.ocbuildingspec.com/#sle.
- B. Pipe and Tube Insulation: ASTM C552, Type II, Grade 6.
1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C), when tested in accordance with ASTM C177 or ASTM C518.
 2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
 3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/(Pa s m)) maximum per inch.
 4. Water Absorption: 0.5 percent by volume, maximum.
 5. Density: 6.12 pcf (98 kg/cu m), minimum.

2.5 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
1. Aeroflex USA: www.aeroflexusa.com/#sle.
 2. Armacell LLC: www.armacell.us/#sle.
 3. K-Flex USA LLC: www.kflexusa.com/#sle.
- B. 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: 220 degrees F (104 degrees C).
3. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.6 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.
 3. Resistance to Fungal Growth: No growth when tested in accordance with ASTM D5590.
 4. Color: White.

2.7 JACKETING AND ACCESSORIES

- A. PVC Plastic:
1. Manufacturers:
 - a. Johns Manville Corporation: www.jm.com/#sle.
 2. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).
 - e. Connections: Brush on welding adhesive.
 3. Covering Adhesive Mastic: Compatible with insulation.
- B. Reinforced Tape:
1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 2. Comply with UL 723 or ASTM E84.
 3. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 4. Finish: Match insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. Install cellular melamine with factory-applied jackets with a manufacturer-approved adhesive along seams, both straight lap joints and circumferential lap joints.
- H. For fiberglass insulated equipment containing fluids below ambient temperature, provide vapor barrier jackets, factory-applied or field-applied, and finish with glass cloth and vapor barrier adhesive.
- I. For hot equipment containing fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions, but bevel and seal ends of insulation.
- J. For hot equipment containing fluids over 140 degrees F (60 degrees C), insulate flanges and unions with removable sections and jackets.
- K. Fiberglass insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- L. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert location: Between support shield and equipment 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.
- M. Finish insulation at supports, protrusions, and interruptions.
- N. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with canvas jacket sized for finish painting.
- O. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- P. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- Q. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.3 SCHEDULES

A. Plumbing Systems:

1. Domestic Hot Water Storage Tanks:
 - a. Glass Fiber, Rigid Insulation: 1" inches (25.4 mm) thick.
2. Water Softeners and Tanks:
 - a. 1" thick flexible elastomeric insulation.

END OF SECTION 22 0716

SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass fiber insulation.
- B. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 22 1005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.3 REFERENCE STANDARDS

- A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- B. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- C. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- E. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- F. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 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.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than 10 years of documented experience.

- B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum 3 years of experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 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.

2.2 GLASS FIBER INSULATION

- A. Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Johns Manville Corporation: www.jm.com/#sle.
 - 3. Knauf Insulation: www.knaufinsulation.com/#sle.
 - 4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
- 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 (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.

2.3 JACKETING AND ACCESSORIES

- A. PVC Plastic Jacket:
 - 1. 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.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. 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.
- F. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- H. 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.
- I. 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.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.

3.3 SCHEDULES

A. Plumbing Systems:

1. Service: Domestic hot, recirculated hot and cold water:
 - a. Operating Temperature: 35 to 140 deg F (2 to 60 deg C).
 - b. Insulation Material: Mineral-fiber preformed pipe.
 - c. Insulation Thickness: Apply the following insulation thicknesses:
 - d. Copper Pipe, all sizes 1" thick.
 - e. Vapor Retarder Required: Yes.
2. Plumbing Vents Within 10 Feet (3 Meters) of the Exterior:
 - a. Insulation Thickness: 1" thick all pipe sizes.
 - b. Operating Temperature: 35 to 140 deg F (2 to 60 deg C).
 - c. Insulation Material: Mineral-fiber preformed pipe.
 - d. Vapor Retarder Required: Yes.

END OF SECTION 22 0719

SECTION 22 1005 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sanitary waste piping, buried within 5 feet (1500 mm) of building.
- B. Sanitary waste piping, above grade.
- C. Domestic water piping, buried within 5 feet (1500 mm) of building.
- D. Domestic water piping, above grade.
- E. Storm drainage piping, buried within 5 feet (1500 mm) of building.
- F. Storm drainage piping, above grade.
- G. Pipe flanges, unions, and couplings.
- H. Pipe hangers and supports.
- I. Pipe sleeve-seal systems.

1.2 RELATED REQUIREMENTS

- A. Section 22 0516 - Expansion Fittings and Loops for Plumbing Piping.
- B. Section 22 0553 - Identification for Plumbing Piping and Equipment.
- C. Section 22 0719 - Plumbing Piping Insulation.

1.3 REFERENCE STANDARDS

- A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- C. ASME B31.9 - Building Services Piping; 2020.
- D. ASTM B32 - Standard Specification for Solder Metal; 2020.
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- F. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- G. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- H. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

- I. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- J. ASTM C1540 - Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings; 2020.
- K. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- L. ASTM D2239 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Inside Diameter; 2025.
- M. ASTM D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2020.
- N. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2024.
- O. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020 (Reapproved 2024).
- P. ASTM D2609 - Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe; 2024.
- Q. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2025.
- R. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2024.
- S. 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.
- T. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2024, with Editorial Revision (2025).
- U. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- V. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.
- W. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2023.
- X. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2024.
- Y. ASTM F441/F441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2023.
- Z. ASTM F442/F442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2023.

- AA. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2022.
- BB. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- CC. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2017, with Errata (2018).
- DD. AWWA C651 - Disinfecting Water Mains; 2023.
- EE. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2021.
- FF. 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.
- GG. FM 1680 - Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/ Commercial and Residential; 1989.
- HH. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).
- II. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- JJ. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- KK. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 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.
- C. Project Record Documents: Record actual locations of valves.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements for additional provisions.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- C. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.
- B. Plenum-Installed Acid Waste Piping: Flame-spread index equal or below 25 and smoke-spread index equal or below 50 according to ASTM E84 or UL 723 tests.
- C. PVC Storm, Drain, Waste & Vent Piping installed in Return Air Plenum:
 - 1. PVC shall not be allowed for installation above ceilings within Return Air Plenums, unless steps are taken by the installing contractor for PVC to meet or exceed the flame/smoke spread rating as indicated in Section 703.5 of the International Building Code or such materials shall have a flame spread index of not more than 25 and smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723.

2.2 SANITARY WASTE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Epoxy Coated Cast Iron Pipe (In Kitchen area where higher temperatures are expected: CISPI 301, hubless.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gasket and stainless steel clamp and shield assemblies.
- B. CPVC Pipe (In Kitchen area where higher temperatures are expected: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.
 - 1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 - 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
- C. Schedule 40 PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.3 SANITARY WASTE PIPING, ABOVE GRADE

- A. Epoxy Coated Cast Iron Pipe (In Kitchen area where higher temperatures are expected: CISPI 301, hubless, service weight.
 - 1. Fittings: Cast iron.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
- B. CPVC Pipe (In Kitchen area where higher temperatures are expected: ASTM D2846/D2846M, ASTM F441/F441M, or ASTM F442/F442M.

1. Fittings: CPVC; ASTM D2846/D2846M, ASTM F437, ASTM F438, or ASTM F439.
 2. Joints: ASTM D2846/D2846M, solvent weld with ASTM F493 solvent cement.
- C. PVC Pipe: ASTM D1785 Schedule 40, with not less than 150 psi (1 034 kPa) pressure rating.
1. Fittings: ASTM D2466, PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.4 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Copper Pipe: ASTM B88 (ASTM B88M), Type K (A), Drawn (H) for 2" and smaller.
1. No joint allowed under building.
- 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.
- C. PE Pipe: ASTM D2239.
1. Fittings: ASTM D2609, PE.
 2. Joints: Mechanical with stainless steel clamp.
- D. PVC Pipe (Where allowed by Plumbing Inspector): AWWA C900-07 Polyvinyl Chloride (Pressure Pipe & Fabricated Fittings)
1. Fittings: AWWA C900-07 Polyvinyl Chloride (Pressure Pipe & Fabricated Fittings)
 2. Joints: Bell & Spigot with factory installed elastomeric sealing gasket.
 3. Apply a thin layer of lubricant to the outer circumference of the pipe from bevel to approximately half-way back toward the insertion line. In addition, lube the surface area of the elastomeric sealing gasket with a brush or roller. Only use lubricant certified by NSF when installing in potable water application.
 4. Field cutting & beveling shall be AWWA guidelines.
 5. Provide thrust restraint meeting to ASTM F1674 Standard Test Method for Joint Restraint Products for Use with PVC.

2.5 DOMESTIC WATER PIPING, ABOVE GRADE

- A. Copper Pipe: 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: 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.

2.6 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

- A. Schedule 40 PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.7 STORM DRAINAGE PIPING, ABOVE GRADE

- A. Schedule 40 PVC Pipe: ASTM D2665.
 - 1. Fittings: PVC.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.8 PIPE FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 inch (80 mm, DN) and Under:
 - 1. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Sizes Over 3 inch (25 mm, DN):
 - 1. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Shielded, Heavy Duty No-Hub Couplings:
 - 1. Testing: In accordance with ASTM C1540 and FM 1680.
 - 2. Gasket Material: Neoprene complying with ASTM C564.
 - 3. Band Material: Stainless steel.
 - 4. Eyelet Material: Stainless steel.
 - 5. Manufacturers:
 - a. Ideal Clamp Products, Inc; Green Shield Super Heavy Duty:
www.idealtridon.com/#sle.
 - b. MIFAB, Inc: www.mifab.com/#sle.
 - c. ANACO-Husky.
 - d. Fernco Inc.
 - e. Tyler Pipe.
 - f. Ideal
- D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.9 PIPE HANGERS AND SUPPORTS

- A. Provide hangers and supports that comply with MSS SP-58.
 - 1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
 - 2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
 - 3. Trapeze Hangers: Welded steel channel frames attached to structure.
 - 4. Vertical Pipe Support: Steel riser clamp.
 - 5. Floor Supports: Concrete pier or steel pedestal with floor flange; fixture attachment.
- B. Plumbing Piping - Drain, Waste, and Vent:
 - 1. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Malleable iron, adjustable swivel, split ring.
 - 2. Hangers for Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
 - 3. Wall Support for Pipe Sizes to 3 inch (80 mm, DN): Cast iron hook.
 - 4. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Over: Welded steel bracket and wrought steel clamp.

5. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

C. Plumbing Piping - Water:

1. Provide oversize hangers on insulated pipe to allow insulation at full thickness to be provided on the piping.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm, DN): Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inch (50 mm, DN) and Over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inch (50 to 100 mm, DN): Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Adjustable steel yoke, cast iron pipe roll, double hanger.
6. Wall Support for Pipe Sizes Up to 3 inch (80 mm, DN): Cast iron hook.
7. Wall Support for Pipe Sizes 4 inch (100 mm, DN) and Larger: Welded steel bracket and wrought steel clamp.
8. Wall Support for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.
9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
10. Floor Support for Hot Pipe Sizes to 4 inch (100 mm, DN): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.
11. Floor Support for Hot Pipe Sizes 6 inch (150 mm, DN) and Larger: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.
12. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.10 PIPE SLEEVE-SEAL SYSTEMS

A. Modular Mechanical Seals:

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 to service requirements.
4. Glass reinforced plastic pressure end plates.

B. Wall Sleeve: PVC material with water-stop collar, and nailer end-caps.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.

- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 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. See Section 22 0516.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- 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. Provide support for utility meters in accordance with requirements of utility companies.
- K. Install bell and spigot pipe with bell end upstream.
- L. Install valves with stems upright or horizontal, not inverted. See Section 22 0523.
- M. Install water piping to ASME B31.9.
- N. 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.
- O. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.
- P. 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, DN).
 - 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.
- Q. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.
2. Provide oversize hangers on insulated pipe to allow insulation at full thickness to be provided on the piping.
3. Support horizontal piping as required.
4. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.
5. Place hangers within 12 inches (300 mm) of each horizontal elbow.
6. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
7. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
8. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
9. Provide copper plated hangers and supports for copper piping.
10. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
11. Support cast iron drainage piping at every joint.

R. Pipe 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.

- S. 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.

3.4 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, or vertical risers.
- C. Provide flow controls in water recirculating systems where indicated.

3.5 TOLERANCES

- A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/4 inch per foot (1:50) slope for pipe 3" and smaller. Slope to drain at minimum of 1/8" per foot (1:100) slope for pipe 4" and larger.
- B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.6 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).
- C. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.7 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

- A. Prior to starting work, verify system is complete, flushed, and clean.
- B. Disinfect water distribution system in accordance with Plumbing Code.
- C. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.8 SERVICE CONNECTIONS

- A. Provide new sanitary and storm sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.
- B. Provide new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves, pressure reducing valve, and sand strainer (refer to details on plans for items required specific to project).

END OF SECTION 22 1005

SECTION 22 1006 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Drains.
- B. Cleanouts.
- C. Hose bibbs.
- D. Hydrants.
- E. Washing machine outlet boxes.
- F. Ice maker outlet boxes.
- G. Condensate Drain Boxes.
- H. Backflow preventers.
- I. Water hammer arrestors.
- J. Sanitary waste interceptors.
- K. Mixing valves.
- L. Relief valves.
- M. Air vents.
- N. Floor drain trap seals.

1.2 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.
- D. Section 22 4000 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASME A112.6.3 - Floor Drains; 2022.
- C. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.

- D. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.
- E. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- F. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- G. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- H. PDI-WH 201 - Water Hammer Arresters; 2017.

1.4 SUBMITTALS

- A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
- B. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, and water hammer arrestors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

- A. Manufacturers:
 - 1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - 2. Josam Company: www.josam.com/#sle.
 - 3. MIFAB, Inc: www.mifab.com/#sle.
 - 4. Zurn Industries, LLC: www.zurn.com/#sle.
 - 5. Tyler Pipe.
- B. Roof Drains:
 - 1. Assembly: ASME A112.6.4.
 - 2. Body: Lacquered cast iron with sump.
 - 3. Strainer: Removable polyethylene dome.
 - 4. Accessories: Coordinate with roofing type:
 - a. Membrane flange and membrane clamp with integral gravel stop.
 - b. Waterproofing flange.
- C. Downspout Nozzles:
 - 1. Bronze round with straight bottom section, with flange with attachment holes.
- D. Floor Drains Refer to schedule on plans:

1. ASME A112.6.3; lacquered cast iron or stainless steel, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable heel-proof nickel-bronze strainer suitable for a finished floor area. Provide with trap seal. Drain must be suitable for floor type.

E. Floor Sink (FS-1) Refer to schedule on plans:

1. Lacquered cast iron body with dome strainer and seepage flange.

2.3 CLEANOUTS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Josam Company: www.josam.com/#sle.
3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Cleanouts at Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas. Adjustable with ABS tapered plug.

C. Cleanouts at Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

2.4 HOSE BIBBS

A. Manufacturers:

1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Watts Regulator Company: www.wattsregulator.com/#sle.

B. Interior Hose Bibbs:

1. Bronze or brass with integral mounting flange, replaceable hexagonal disc, hose thread spout, 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.

2.5 HYDRANTS

A. Manufacturers:

1. Arrowhead Brass & Plumbing, LLC.
2. Jay R. Smith Manufacturing Company.
3. Murdock Manufacturing, Inc.
4. Zurn Industries, LLC.
5. Woodford.

B. Wall Hydrants:

1. ASSE 1019; freeze resistant, self-draining type with chrome-plated wall plate hose thread spout, lockshield and removable key, and integral vacuum breaker.

2.6 WASHING MACHINE OUTLET BOXES

- A. Manufacturers:
 1. HoldRite, a brand of Reliance Worldwide Corporation.
 2. IPS Corporation/Water-Tite.
 3. Oatey Supply Chain Services, Inc.
 4. Zurn Industries, LLC.
- B. Description: Plastic preformed rough-in box with brass quarter-turn ball valves or single lever-handle valves, socket for 2 inch (50 mm) waste, and slip-in finishing cover.
- C. Provide fire-rated outlet-box assembly for installation in 1- and 2-hour rated walls.
- D. Accessories:
 1. Water-hammer arrestors.
 2. Support brackets for installation between framing studs.

2.7 ICE MAKER OUTLET BOXES

- A. Manufacturers:
 1. IPS Corporation/Water-Tite: www.ipscorp.com/#sle.
 2. Oatey Supply Chain Services, Inc: www.oatey.com/#sle.
 3. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Description: Plastic preformed square rough-in box with brass quarter-turn ball valve, and slip-in finishing cover.
- C. Provide fire-rated outlet-box assembly for installation in 1- and 2-hour rated walls.
- D. Accessories:
 1. Water-hammer arrestors.
 2. Support brackets for installation between framing studs.

2.8 CONDENSATE DRAIN BOXES

- A. Manufacturers:
 1. IPS Corporation/Water-Tite
 2. Oatey Supply Chain Services, Inc
 3. Zurn Industries, LLC
- B. Description: Plastic preformed square or round rough-in box with 1" air gap fitting.
- C. Provide fire-rated outlet-box assembly for installation in 1- and 2-hour rated walls.
- D. Accessories:
 1. Support brackets for installation between framing studs.

2.9 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Apollo Valves: www.apollovalves.com/#sle.
 - 2. MIFAB, Inc: www.mifab.com/#sle.
 - 3. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
 - 4. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Reduced Pressure Backflow Preventer Assembly:
 - 1. ASSE 1013 and NSF 61 compliant reinforced-nylon 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, integral male test fittings, and non-threaded vent outlet.
 - 2. Size: 3/4 to 2 inch (20 to 50 mm, DN) assembly with threaded full port ball valves.
 - 3. Maximum Working Parameters: 175 psi (1,207 kPa) at 180 degrees F (82.2 degrees C).
 - 4. Accessories: Provide air gap fitting, lead-free Y-strainer, and test cocks.
- C. Reduced Pressure Backflow Preventer Assembly:
 - 1. ASSE 1013 and NSF 61 compliant stainless steel body assembly with corrosion resistant internal parts, stainless steel springs, 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. Configured to protect against backsiphonage and backpressure into potable water supply.
 - 3. Size: 2-1/2 to 10 inch (65 to 250 mm, DN) assembly with flanged OS&Y gate valves.
 - 4. Maximum Working Parameters: 175 psi (1,207 kPa) at 140 degrees F (60 degrees C).
 - 5. Accessories: Provide flanged Y-strainer and test cock.

2.10 DOUBLE CHECK-VALVE ASSEMBLIES

- A. Manufacturers:
 - 1. Apollo Valves: www.apollovalves.com/#sle.
 - 2. MIFAB, Inc: www.mifab.com/#sle.
 - 3. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
 - 4. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Double Check Valve Assembly:
 - 1. ASSE 1015 and NSF 61 compliant 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.
 - 3. Maximum Working Parameters: 175 psi (1,207 kPa) at 180 degrees F (82.2 degrees C).
 - 4. Accessories: Provide lead-free Y-strainer and test cock.

2.11 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.

2. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
3. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com/#sle.
4. Zurn Industries, LLC: www.zurn.com/#sle.

B. Water Hammer Arrestors:

1. Copper construction, piston 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 SANITARY WASTE INTERCEPTORS

A. Sand/Oil Interceptor (refer to schedule on plans)

B. Grease Interceptor (Refer to schedule on plans):

1. Schier Great Basin® grease interceptor shall be lifetime guaranteed and made in USA of seamless, molded polyethylene with minimum 3/8" uniform wall thickness. Interceptor shall be furnished for above or below grade installation with adjustable cover adapter, Safety Star® access restrictor built into each cover adapter, temporary jobsite cover, built in flow control (for 200 GPM only) and three outlet options. Interceptor shall be certified for hydromechanical performance to ASME A112.14.3 (Type D) and CSA B481.1. Interceptor flow rate shall be 100 or 200 GPM, or up to 250 GPM in high-flow applications. Interceptor grease capacity shall be as indicated on schedule on plans. Covers are chosen by the contractor. Injection-molded pedestrian cover shall provide water/ gas-tight seal and have minimum 2,000 lbs. load capacity and center bolt. Cast iron, traffic cover shall provide water/ gas-tight seal and have minimum 16,000 lbs. load capacity. Interceptor shall be furnished with Fast Pitch® riser model # FP24 as needed to extend cover and adapter to finish grade. Interceptor shall be furnished with pumpout port kit model #PP3 to enable remote pumpout.

2.13 MIXING VALVES

A. Digitally Controlled Thermostatic Master Mixing Valves (refer to schedule on plans):

1. Manufacturers:
 - a. Leonard Valve Company: www.leonardvalve.com/#sle.
 - b. Watts Water Technologies; POWERS: www.watts.com/#sle.
 - c. Lawler.
 - d. PVI Digatemp.
2. Valve: ASSE 1017, bronze or brass body; corrosion- and lime-resistant internal components; microprocessor-control unit for temperature control and monitoring.
3. Finish: Rough bronze.
4. Microprocessor Controller:
 - a. Manufacturer-provided, packaged application-specific controller with keypad or touch-screen operator interface.
 - b. Integral display of temperature and pressure.
 - c. Field Programmable: Settings configurable locally at controller or remotely through building automation system.
 - d. Programmable high- and low-temperature alarms.
 - e. Failsafe: Upon loss of water pressure, valve ceases hot water flow.

5. Electrical Characteristics:
 - a. 120 V, single phase, 60 Hz.
 6. Accessories:
 - a. Strainer stop checks on inlets.
 - b. Shut-off valve on outlet.
- B. Water Temperature Limiting Valves:
1. Manufacturers:
 - a. Leonard Valve Company: www.leonardvalve.com/#sle.
 - b. Watts Water Technologies; POWERS: www.watts.com/#sle.
 - c. Lawler.
 2. Valve: ASSE 1070, bronze or brass body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment with high-temperature limit stop; integral check valves with strainer screens on inlets.

2.14 RELIEF VALVES

- A. Manufacturers:
1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
- B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.15 AIR VENTS

- A. Manufacturers:
1. Cash Acme, a brand of Reliance Worldwide Corporation: www.cashacme.com/#sle.
 2. ITT Bell & Gossett: www.bellgossett.com/#sle.
 3. Taco, Inc: www.taco-hvac.com/#sle.
- B. Manual Type: Short vertical sections of 2 inch (50 mm) diameter pipe to form air chamber, with 1/8 inch (3 mm) brass needle valve at top of chamber.

2.16 FLOOR DRAIN TRAP SEALS (PROVIDE ON ALL FLOOR DRAINS & FLOOR SINKS)

- A. Manufacturers:
1. Green Drains; GD4: www.greendrains.com/#sle.
 2. MIFAB, Inc; MI-GARD: www.mifab.com/#sle.
 3. Jay R. Smith Company.
- B. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.
- C. Install floor cleanouts at elevation to accommodate finished floor.
- D. 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.
- E. Pipe relief from backflow preventer to nearest drain.
- F. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatory sinks, washing machine outlets, or as detailed by PDI-WH 201.

END OF SECTION 22 1006

SECTION 22 1123 - DOMESTIC WATER PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Inline pumps.

1.2 RELATED REQUIREMENTS

- A. Section 22 0513 - Common Motor Requirements for Plumbing Equipment.
- B. Section 23 0923 - Direct-Digital Control System for HVAC.
- C. Section 25 3500 - Integrated Automation Instrumentation and Terminal Devices for HVAC.
- D. Section 20 0513 - Common Motor Requirements
- E. Section 26 0583 - Wiring Connections.

1.3 REFERENCE STANDARDS

- A. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- D. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.
 - 2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.
- C. Shop Drawings: Include dimensions and performance data.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Project Record Documents: Record actual locations of components.

- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements for additional provisions.

1.5 QUALITY ASSURANCE

- A. Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.
- B. Identification: Provide pumps with manufacturer's name, model number, and rated capacity identified by permanently attached label.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 1-year manufacturer warranty for pumps . Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 INLINE PUMPS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a Brand of Xylem, Inc: www.xylem.com/#sle.
 - 3. Grundfos Pumps Corporation; TPE Series: www.grundfos.com/#sle.
 - 4. Taco, Inc: www.tacomfort.com/#sle.
- B. Description: Pump shall be of the horizontal system lubricated type specifically designed and guaranteed for quiet operation.
 - 1. Pump to be suitable for 225 F operation at 150 psig working pressure.
 - 2. Pump shall have a ceramic shaft supported by carbon bearings. Bearings are to be lubricated by the circulating fluid.
 - 3. Pump body shall be lead-free bronze or stainless steel for circulators.
 - 4. Motor shall be non-overloading at any point on the pump curve.
 - 5. Motor stator to be isolated from circulating fluid through use of stainless steel can. rotor to be sheathed in stainless steel.
- C. Type: Horizontal, single-stage inline with Class 125 flanged pipe-end connections.
- D. Impeller: statically and dynamically balanced, closed, and keyed to shaft

- E. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gasket
- F. Electrical:
 - 1. Refer to schedule on plans for voltage/phase.
 - 2. Motor: Constant speed, with prelubricated ball bearings and resiliently or rigidly mounted to pump casing, comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in section 20 0513 "Common Motor Requirements."
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor above 1.0
 - 4. Motor Protection: Include overvoltage, overcurrent, and motor overload.
 - 5. Wiring Connections: See Section 26 0583.
 - 6. 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.
- G. Controls:
 - 1. Thermostats: Electric; adjustable for control of hot-water circulation pump, water-immersion temperature sensor for installation in piping, 65 to 200 deg F range, NEMA 250 enclosure, on or off pump operation
 - 2. Timers: Electric, for control of hot-water circulation pump, programmable, seven-day clock with manual override on-off switch, NEMA 250, type 1 suitable for wall mounting enclosure, on or off pump operation, up to 2 on-off cycles each day for seven days
- H. Accessories: Include drain ports and inlet-outlet pressure gauges with 2-way isolation valves.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install horizontally mounted, in-line, close-coupled centrifugal pumps with shaft horizontal, install continuous-thread hanger rods and spring hangers of size required to support pump weight. Install thermostats in hot-water return piping, Install timers near pump as required.
- B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).
- C. Ensure that small pressure gauges are installed on both upstream and downstream ends.
- D. Sump Pumps: Ensure shaft length of sump pump located minimum of 24 inches (600 mm) below lowest invert into sump pit with minimum of 6 inches (150 mm) clearance from bottom of sump pit.
- E. Coordinate BAS, BMS, or Integrated Automation linking between unit controller and remote front-end interface; see Section 23 0923.

3.2 FIELD QUALITY CONTROL

- A. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.3 CLEANING

- A. Thoroughly clean plumbing fixtures and equipment.

3.4 PROTECTION

- A. Protect installed products from damage due from subsequent construction operations.
- B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION 22 1123

SECTION 22 1429 - SUMP PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submersible sump pumps.
- B. Sump basins and pits.

1.2 REFERENCE STANDARDS

- A. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide certified pump chart or curve with duty point marked over.
- C. Shop Drawings: Include dimensions and performance data.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
 - 1. Grundfos Pumps Corporation: www.grundfos.com/#sle.
 - 2. PROFLO: www.ferguson.com/#sle.
 - 3. Superior Pump: www.superiorpump.com/#sle.
 - 4. Zoeller Company: www.zoeller.com/#sle.
- B. General: Cast iron housing and base with oil-filled motor chamber, ball bearings, and mechanical seal.
- C. Impeller: Thermoplastic; open nonclog, stainless steel shaft.
- D. Motor: Base mount, enclosed, lubricated oil-free, thermal-overload protected, continuous duty, permanent split capacitor with oil-resistant, three-prong connector, 10 foot (3 m) power cord.

- E. Controls: Integral, chemically-resistant, vertical plated-steel rod float switch. Cycle pump Off/On between 2.5 and 9 inch (5.1 and 22.9 cm), or within recommended range by manufacturer, from bottom of pump.
- F. Solids Handling Capacity: Pass lint and other small solids up to 1/2 inch (15 mm) in size.
- G. Discharge Pipe Size: 1-1/2 inch (40 mm, DN), NPT, female.
- H. Maximum Water-Based Effluent Temperature: 120 degrees F (48,9 degrees C).
- I. Accessories: Provide full flow swing-type discharge check valve and high level alarm system tied into BAS.

2.2 SUMP BASINS AND PITS

- A. Sump Basin:
 - 1. Basin Dimensions: 18 inch (45.7 cm) diameter, 22 inch (55.8 cm) deep.
 - 2. Basin Material: Fiberglass, heavy duty injection molded.
 - 3. Molded-Finish Requirements: Hard bottom, watertight, gas-tight and radon-tight molding.
 - 4. Maximum Effluent Temperature: Match or exceed maximum pump service temperature.
 - 5. Basin Cover:
 - a. Material: One-piece flat lid made of polyethylene with seal gasket.
 - b. Openings: 1-1/2 inch (40 mm, DN) discharge and cord grommet with hubs.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install products with related fittings and accessories according to manufacturer instructions.
- B. Observe and provide incidentals required to complete installation in compliance with ICC (IPC).

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Operational Tests: Conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.3 PROTECTION

- A. Protect installed products from damage from subsequent construction operations.

END OF SECTION 22 1429

SECTION 22 3000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Commercial Hot Water Storage Tank.
- B. Diaphragm-type compression tanks.
- C. Water softeners.

1.2 RELATED REQUIREMENTS

- A. Section 22 1123 - Domestic Water Pumps.
- B. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

1.4 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. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
 - 1. Indicate heat exchanger dimensions, size of tappings, and performance data.
 - 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 HOT WATER STORAGE TANK

A. Commercial Hot Water Storage Tank (Refer to schedule on plans).

1. Manufacturers:
 - a. PVI Conquest (the basis for the design).
2. Construction:
 - a. Water heaters will be of the BTU input(s) and storage capacity indicated on the equipment schedule.
 - b. Water heater tank will be National Board Registered for a working pressure of 150 psi, and will be pressure tested at 1-1/2 times working pressure.
 - c. Tank will be unlined. Lined or plated water heaters will not be acceptable.
3. Tank will be constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923, Method A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected must be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2 and ASTM G123 – 00 (2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”
 - a. Tanks will be welded utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) must be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized must result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
4. All internal and external tank surfaces must undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not permitted. Immersion passivation and pickling certification documents are required and must be provided with each product.
 - a. Materials must meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials must contain more than 80% post- consumer recycled materials and be 100% recyclable.
 - b. All water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
 - c. All tank connections/fittings will be non-ferrous or stainless steel.
 - d. To preserve thermal efficiency, the water heater will not use or require a circulator piped from the hot water outlet to the cold water inlet of the heater for the purpose of temperature control during normal operation. Connection for a building return circulation line will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping. Connection to a sidearm tank, if used, will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping.

- e. The finished vessel will not require sacrificial or impressed current anodes and none will be used. Water heaters or sidearm storage tanks that employ anode rods of any type will not be acceptable.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 - 1. Amtrol Inc: www.amtrol.com/#sle.
 - 2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
 - 3. Taco, Inc: www.taco-hvac.com/#sle.
- 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).

2.3 WATER SOFTENERS

- A. Salt-Based Ion-Exchange Water Softener:
 - 1. Manufacturers:
 - a. Culligan International Company: www.culligan.com/#sle.
 - b. EcoWater Systems LLC: www.ecowater.com/#sle.
 - c. Water Control Corporation.
 - 2. Capacity: Refer to schedule on plans.
 - 3. Type: Separate ion exchange and feed tanks.
 - 4. Tank Materials: Glassfiber reinforced plastic ion exchange with one-piece resin for feed.
 - 5. Solenoid Valves: Brass or other process-resistant suitable material.
 - 6. Connections: 2-inch (50 mm) inlet, outlet, and backwash or regeneration with drain pipe.
 - 7. Multifunctional Controller:
 - a. Allows metered, timed cycle, or continuous duty usage.
 - b. Full control of both softening and backwashing processes.
 - c. Includes setting to enable automated system water bypass.
 - d. Stores maximum and minimum usage when in continuous duty.
 - e. Displays setting, usage, and flow, date, time, and other related specifics.
 - f. Provides status and historical usage data including ability to filter specifics.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.
- B. Electrical Work: Provide automatic control and protective devices with associated wiring to interconnect related interfaced devices required for specified operation.

- C. Coordinate system, equipment, and piping work with applicable electrical, fuel, gas, vent, drain, and waste support interconnections as included or provided by other trades.
- D. 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.

END OF SECTION 22 3000

SECTION 22 4000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush valve water closets.
- B. Wall hung urinals.
- C. Lavatories.
- D. Sinks.
- E. Under-lavatory pipe supply covers.
- F. Shower receptors.
- G. Showers.
- H. Electric water coolers.
- I. Mop sinks.
- J. Service sinks.
- K. Emergency eye and face wash.
- L. Emergency showers.
- M. Clinic Service Sink.

1.2 RELATED REQUIREMENTS

- A. Section 22 1005 - Plumbing Piping.
- B. Section 22 1006 - Plumbing Piping Specialties.
- C. Section 22 3000 - Plumbing Equipment.

1.3 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).
- C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).
- D. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

- E. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011 (Reaffirmed 2022).
- F. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2024.
- G. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2022.
- H. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2022.
- I. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2020.
- J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- K. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- M. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- N. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- O. NSF 61 - Drinking Water System Components - Health Effects; 2024.
- P. NSF 372 - Drinking Water System Components - Lead Content; 2024.
- Q. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 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. Manufacturer's Instructions: Indicate installation methods and procedures.
- D. Maintenance Data: Include fixture trim exploded view and replacement parts lists.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- 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 Faucet Washers: One set of each type and size.
 - 3. Flush Valve Service Kits: One for each type and size.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum 10 years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept fixtures on-site in factory packaging. Inspect for damage.
- B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.7 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide five year manufacturer warranty for electric water cooler.

PART 2 PRODUCTS

2.1 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.

2.2 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.

2.3 FLUSH VALVE WATER CLOSETS

- A. Water Closets: (Refer to schedule on plans for specific information)
 - 1. Vitreous china, ASME A112.19.2, floor mounted, siphon jet flush action, china bolt caps.
 - 2. Flush Valve: Exposed (top spud).
 - 3. Flush Operation: See schedule on plans for type.
 - 4. Handle Height: 44 inches (1117 mm) or less.
 - 5. Inlet Size: 1-1/2 inches (38 mm).
 - 6. Trapway Outlet: 4 inch (100 mm, DN).
 - 7. Color: White.
 - 8. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Kohler Company: www.kohler.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
- B. Flush Valves: (Refer to schedule on plans for specific information)
 - 1. Valve Supply Size: 1 inch (25 mm, DN).
 - 2. Valve Outlet Size: 1-1/2 inches (40 mm, DN).
 - 3. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Sloan Valve Company: www.sloanvalve.com/#sle.

- c. Zurn Industries, LLC: www.zurn.com/#sle.
- d. Substitutions: See Section 01 6000 - Product Requirements.

C. Toilet Seats:

- 1. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Bemis Manufacturing Company: www.bemismfg.com/#sle.
 - c. Church Seat Company: www.churchseats.com/#sle.
 - d. Olsonite: www.olsonite.com/#sle.
 - e. Zurn Industries, LLC: www.zurn.com/#sle.
- 2. Plastic: Solid, white finish, elongated shape, open front, slow-closing hinged seat cover, extended back complete with self-sustaining hinges, and brass bolts with covers.
- 3. Plastic: Black finish, open front, extended back, self-sustaining hinge, brass bolts, with cover.

2.4 WALL HUNG URINALS (REFER TO SCHEDULE ON PLANS)

A. Manufacturers:

- 1. American Standard, Inc: www.americanstandard-us.com/#sle.
- 2. Kohler Company: www.kohler.com/#sle.
- 3. Zurn Industries, LLC: www.zurn.com/#sle.

B. Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier (Refer to schedule on plans for specific information).

- 1. Consumption Volume: 0.125 gal (0.47 L) per flush, maximum.
- 2. Flush Valve: Exposed (top spud).
- 3. Flush Operation: Sensor operated.
- 4. Trapway Outlet: Integral.

C. Flush Valves:

- 1. Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Sloan Valve Company: www.sloanvalve.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
- 2. Sensor-Operated:
 - a. Type: ASME A112.19.5; chloramine-resistant, clog-resistant dual-seat diaphragm valve with vacuum breaker, stops and accessories.
 - b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
 - c. Supplied Volume Capacity: .125 gal (____ L) per flush.

D. Urinal Carriers:

- 1. Manufacturers:
 - a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
 - b. JOSAM Company: www.josam.com/#sle.
 - c. Zurn Industries, LLC: www.zurn.com/#sle.
- 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.5 LAVATORIES (REFER TO SCHEDULE ON PLANS FOR SPECIFIC INFORMATION)

- A. Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com/#sle.
 - 2. Kohler Company: www.kohler.com/#sle.
 - 3. Zurn Industries, LLC: www.zurn.com/#sle.
 - 4. Crane.
- B. Wall-Hung Basin:
 - 1. Vitreous China: ASME A112.19.2; white, rectangular basin with splash lip, front overflow, soap depression, and hanger. Size as indicated on drawings, refer to schedule.
 - 2. Carrier:
 - a. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, concealed arm supports, bearing plate and studs.
 - b. Manufacturers:
 - 1) Jay R. Smith MFG. Co: www.jrsmith.com/#sle.
 - 2) JOSAM Company: www.josam.com/#sle.
 - 3) Zurn Industries, LLC: www.zurn.com/#sle.
- C. Supply Faucet:
 - 1. Deck Mounted Faucet Manufacturers:
 - a. American Standard, Inc: www.americanstandard-us.com/#sle.
 - b. Zurn Industries, LLC: www.zurn.com/#sle.
 - c. Chicago Faucets.
 - 2. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gpm (8.3 L/min), indexed handles.
- D. Thermostatic Mixing Valve:
 - 1. ASSE 1070 listed with combination stop, strainer, and check valves, and flexible stainless steel connectors.
 - 2. Manufacturers:
 - a. Lawler.
 - b. Watts.
- E. Lavatory Carrier:
 - 1. Manufacturers:
 - a. JOSAM Company: www.josam.com/#sle.
 - b. Zurn Industries, LLC: www.zurn.com/#sle.
 - 2. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded studs for fixture hanger, bearing plate and studs.

2.6 STAINLESS STEEL SINKS (REFER TO SCHEDULE ON PLANS FOR SPECIFIC INFORMATION)

- A. Manufacturers:
 - 1. American Standard, Inc: www.americanstandard-us.com/#sle.
 - 2. Kohler Company: www.kohler.com/#sle.
 - 3. Elkay.
 - 4. Just.

- B. Single or Double Compartment Bowl
 - 1. ASME A112.19.3; 18 gauge, 0.050 inch (1.27 mm) thick, type 304 stainless steel, self-rimming and undercoated, with ledge back drilled for trim.
 - 2. Provide with chrome plated cast p-trap(s), basket or grid strainer as applicable - see schedule.

2.7 UNDER-LAVATORY PIPE SUPPLY COVERS

- A. Manufacturers:
 - 1. Plumberex Specialty Products, Inc: www.plumberex.com/#sle.
 - 2. Truebro
- B. General:
 - 1. Insulate exposed drainage piping including hot, cold and tempered water supplies under lavatories or sinks per ADA Standards.
 - 2. Construction: 1/8 inch (3.2 mm) PVC with antimicrobial, antifungal and UV resistant properties.
 - a. Comply with ASME A112.18.9 for covers on accessible lavatory piping.
 - b. Comply with ICC A117.1.
 - 3. Color: High gloss white.

2.8 SHOWERS

- A. Acrylic surface, 12"x24" subway tile, (refer to schedule on plans): Solid plastic resin casting, self-supporting, for installation in recessed concrete.
 - 1. Material: Complying with ISFA 2-01 and NEMA LD 3; acrylic resin, material filler, and pigments; homogenous, nonporous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - 2. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 450 or less, Class A, when tested in accordance with ASTM E84.
 - 3. Finish on Exposed Surfaces: Provide semi-gloss, gloss rating of 25 to 50.
 - 4. Color and Pattern: White, 12"x 24" subway tile acrylic surface.
 - 5. Drain Trim: Removable linear stainless steel trench drain with center drain connection in trench.
 - 6. Provide factory installed pressure balanced mixing valve, vertical stainless steel grab bar with handheld shower 60" flexible hose, horizontal grab bars, no shower curtain bar.
 - 7. Manufacturers:
 - a. Aquatic: www.aquaticbath.com
 - b. Best Bath Systems: www.bestbath.com/#sle.
 - c. Freedom Showers.
- B. Drain Trim: Removable linear stainless steel trench drain with center drain connection.

2.9 SHOWER TRIM AND VALVE SH-2 (REFER TO SCHEDULE ON PLANS, FIELD BUILT SHOWERS)

- A. Manufacturers:

1. American Standard, Inc: www.americanstandard-us.com/#sle.
2. Symmons.
3. Delta.
4. Chicago Faucet.

B. Shower Trim:

1. Single Handle pressure balanced mixing valve, vertical 30" stainless steel grab bar with handheld shower 60" flexible hose,.

2.10 ELECTRIC WATER COOLERS

A. Manufacturers:

1. Elkay Manufacturing Company: www.elkay.com/#sle.
2. Haws Corporation: www.hawesco.com/#sle.
3. Oasis International: www.oasiscoolers.com/#sle.

B. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.

1. Capacity: 8 gph (30.3 Lph) of 50 degrees F (10 degrees C) water with inlet at 80 degrees F (27 degrees C) and room temperature of 90 degrees F (32 degrees C), when tested in accordance with ASHRAE Std 18.
2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot (2 m) cord and plug for connection to electric wiring system including grounding connector.

C. Bottle Filler: Materials to match fountain.

2.11 MOP SINKS

A. Manufacturers:

1. Just Manufacturing Company: www.justmfg.com/#sle.
2. Zurn Industries, LLC.
3. Mustee.

B. Material: High Impact resistant Structural Fiberglass, marbleized white finish.

C. Type: Square 24"x24"x10"H

D. Accessories:

1. 5 feet (1.5 m) of 1/2 inch (13 mm) diameter plain end reinforced plastic hose.
2. Mop hanger.
3. Grid strainer: Stainless steel; integral; removable.

2.12 SERVICE SINKS (REFER TO SCHEDULE ON PLANS)

A. Service Sink Manufacturers:

1. Commercial Enameling Company: www.cecosinks.com/#sle.
2. Elkay Manufacturing Company: www.elkay.com/#sle.
3. Just Manufacturing Company: www.justmfg.com/#sle.

4. Zurn Industries, LLC: www.zurn.com/#sle.
5. Mustee.
6. Fiat.

B. Faucet Manufacturers:

1. Chicago Faucet.
2. T&S Brass.

2.13 EMERGENCY EYE WASH (REFER TO SCHEDULE ON PLANS)

A. Manufacturers:

1. Haws Corporation: www.hawsco.com/#sle.
2. Guardian.
3. Stingray.

B. Emergency Wash: ANSI Z358.1; wall-mounted, self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor, twin eye wash heads and face spray ring, stainless steel dust cover, copper alloy control valve and fittings.

C. Integral Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.

2.14 EMERGENCY SHOWERS

A. Manufacturers:

1. Haws Corporation: www.hawsco.com/#sle.
2. Guardian
3. Stingray

B. Emergency Shower: ANSI Z358.1; free standing, self-cleaning, nonclogging 8 inch (200 mm) diameter stainless steel deluge shower head with elbow, one inch (25 mm) full flow valve with pull chain and 8 inch (200 mm) diameter ring, one inch (25 mm) interconnecting fittings. All piping shall be stainless steel, galvanized piping for water way is not allowed.

C. Integral Thermostatic Mixing Valve: Thermostatic mixing valve, ASSE 1070 listed, with combination stop, strainer, and check valves, and flexible stainless steel connectors.

2.15 CLINIC SERVICE SINK (REFER TO SCHEDULE ON PLANS)

A. Manufacturers:

1. American Standard, Inc: www.americanstandard-us.com/#sle.
2. Kohler Company: www.kohler.com/#sle.

B. Sink, Service, Disposal, Flushing Rim:

1. Vitreous china pedestal type with flushing rim and siphon jet flushing action.
2. Provide 1-1/2 inch (40 mm) top inlet spud and riser accessory with stainless steel rim guards on front and both sides, and elongated open-front seat.
3. Provide ANSI large diaphragm (not less than 2.625 inches (66.70 mm) upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower

chambers), nonhold open flush valve of chrome plated copper alloy, including vacuum breaker and angle (control-stop) valve with back check.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.
- B. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Solidly attach water closets to floor with lag screws.
- F. Seal fixtures to wall and floor surfaces with sealant color to match fixture.
- G. Seal under the rim of self rimming counter top mounted sinks and lavatories with either caulk or plumbers putty.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

- A. Protect installed products from damage due to subsequent construction operations.
- B. Do not permit use of fixtures by construction personnel.
- C. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION 22 4000

SECTION 22 6000 - GAS AND VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, tube, and fittings.
- B. Valves.
- C. Outlets.
- D. Alarm systems.

1.2 ABBREVIATIONS AND ACRONYMS

- A. CGA: Compressed Gas Association.

1.3 REFERENCE STANDARDS

- A. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- B. ASME B16.50 - Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings; 2021.
- C. 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.
- D. ASSE/IAPMO/ANSI 6010 - Medical Gas System Installers; 2021.
- E. ASSE/IAPMO/ANSI 6020 - Medical Gas Systems Inspectors; 2021.
- F. ASSE/IAPMO/ANSI 6030 - Medical Gas Systems Verifiers; 2021.
- G. ASTM B819 - Standard Specification for Seamless Copper Tube for Medical Gas Systems; 2019.
- H. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- I. AWS B2.2/B2.2M - Specification for Brazing Procedure and Performance Qualification; 2016.
- J. CGA G-4.1 - Cleaning of Equipment for Oxygen Service; 2018.
- K. CGA V-5 - Standard for Diameter Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications); 2019.

- L. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .
- M. NFPA 99 - Health Care Facilities Code; 2024, with Errata.
- N. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's literature and data sheets for each product. Include capacities, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
 - 1. Compressors and Vacuum Pumps: Include sound level data.
- C. Shop Drawings: Provide for products listed below. Indicate general assembly of components, mounting and installation details, unit dimensions, required clearances, construction details, field piping connection details, and electrical characteristics and connection requirements.
 - 1. Manifolds: Include dimensioned plans and elevations showing manifold, header assemblies, and cylinder arrangements.
 - 2. Outlets: Include elevation drawings showing arrangements of medical outlet wall assemblies.
 - 3. Alarm Panels.
- D. Independent Inspection, Testing, and Verification Agency Reports: Documentation of inspection, testing, and verification results showing system compliance with NFPA 99.
 - 1. Submit copies to Owner.
- E. Manufacturer's Instructions: Provide for products listed below. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
 - 1. Manifolds.
 - 2. Outlets.
 - 3. Alarm systems.
- F. Manufacturer's qualifications statement.
- G. Installer's qualifications statement.
- H. Inspector's qualification statement.
- I. Testing and verification company's qualification statement.
- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- K. Project Record Documents: Complete set of floor plans showing actual installed locations of components, equipment, tanks, cylinders, piping, and valving. See Section 01 7800 for additional requirements.

1.5 QUALITY ASSURANCE

- A. Medical Gas Systems: Select products and execute work in compliance with NFPA 99.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
 - 1. Brazing: Qualified in accordance with ASME BPVC-IX or AWS B2.2/B2.2M.
 - 2. Medical Gas and Medical Vacuum Systems: Certified in accordance with ASSE/IAPMO/ANSI 6010.
- D. Inspector Qualifications: Company specializing in performing testing of type specified in this section, with minimum five years of documented experience.
 - 1. Medical Gas and Medical Vacuum System Inspectors: Certified in accordance with ASSE/IAPMO/ANSI 6020 or ASSE/IAPMO/ANSI 6030.
- E. Independent Testing and Verification Qualifications: Company specializing in performing testing of type specified in this section, with minimum five years of documented experience.
 - 1. Medical Gas and Medical Vacuum System Verifiers: Certified in accordance with ASSE/IAPMO/ANSI 6030.
- F. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.

1.6 MOCK-UPS

- A. Provide mock-up of outlets in typical patient head wall unit.
 - 1. Locate where directed.
 - 2. Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept material on-site in factory containers and packing. Inspect for damage.
- B. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.

1.8 WARRANTY

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

PART 2 PRODUCTS

2.1 PERFORMANCE CRITERIA

- A. Medical:
 - 1. Medical Oxygen: 50 to 55 psig (345 to 380 kPa) operating pressure.
 - 2. Medical Vacuum: 15 in-Hg (380 mm-Hg).

2.2 PIPE, TUBE, AND FITTINGS

- A. Medical Gases:
 - 1. General Requirements:
 - a. Comply with NFPA 99.
 - b. Pipe, tube, and fittings cleaned by manufacturer in accordance with CGA G-4.1.
 - c. Pipe ends and tube ends factory capped or plugged by manufacturer prior to shipping and kept sealed until time of installation.
 - d. Fittings sealed and labeled prior to shipping and kept sealed until time of installation.
 - 2. Copper Medical Gas Pipe:
 - a. ASTM B819, seamless, drawn, Type L, factory labeled with nomenclature and colors complying with NFPA 99.
 - b. Fittings: Wrought copper, ASME B16.22 or ASME B16.50.
 - c. Joints: Brazed, AWS A5.8M/A5.8, copper-phosphorus or copper-phosphorus-silver brazing filler.
- B. Medical Vacuum Systems:
 - 1. Copper Pipe:
 - a. ASTM B819, seamless, drawn, Type L. ASTM B819, factory labeled with nomenclature and colors complying with NFPA 99.
 - b. Joints: Brazed, AWS A5.8M/A5.8, copper-phosphorus or copper-phosphorus-silver brazing filler.

2.3 VALVES

- A. Manufacturers:
 - 1. Amico Corporation: www.amico.com/#sle.
 - 2. BeaconMedaes: www.beaconmedaes.com/#sle.
- B. General Requirements for Valves for Medical and Laboratory Gas Systems:
 - 1. Manufacturer cleaned in accordance with CGA G-4.1.
 - 2. Sealed, bagged, and labeled prior to shipping in accordance with CGA G-4.1 and kept bagged and sealed until the time of installation.
- C. Ball Valves:

1. Three-piece, bronze body, MSS SP-110, double-seal, with quarter-turn handle and replaceable neoprene or teflon seat and stem seals, 600 psi (4140 kPa) cold working pressure.
 2. Ball Valves for Medical Gas Systems: Provide manufacturer-installed ASTM B819 Type K copper extensions with threaded purge ports on upstream and downstream sides of valve.
- D. Check Valves:
1. Brass or bronze body, three piece, spring loaded, in-line removable and serviceable, 300 psi (2070 kPa) cold working pressure.
 2. Check Valves for Medical Gas Systems: Provide manufacturer-installed ASTM B819 Type K copper extensions with threaded purge ports on upstream and downstream sides of valve.
- E. Zone Valve Boxes:
1. Manufacturers:
 - a. Allied Healthcare Products, Inc: www.alliedmedicalllc.com/#sle.
 - b. Amico Corporation: www.amico.com/#sle.
 2. 18 gauge steel box with baked enamel finish cabinet, flush-mounted and rigidly assembled to accommodate isolation valves and accompanying pressure gauges, punched or drilled sides to receive tubing, anchors to secure to wall construction.
 3. Cover Plate: Extruded aluminum, with replaceable plastic window with pull ring to remove window.
 4. Valve Labels: Label and color code valves; indicate intended gas service and area served.
 5. Pressure Gauges: Locate in valve box downstream of each isolation valve.
 6. Provide factory installed shutoff valves and alarms in Zone Valve Box.

2.4 OUTLETS

- A. Outlet Units:
1. Manufacturers:
 - a. Amico Corporation: www.amico.com/#sle.
 - b. BeaconMedaes: www.beaconmedaes.com/#sle.
 2. CGA V-5 Diameter-Index Safety System (DISS) non-interchangeable connectors, automatic valves, secondary check valves (except vacuum and evacuation outlets), and capped 3/8 inch (8 mm) tubing stubs for supply connections, color coded and labeled for intended service.
 3. Quick-Coupler Pressure Service Connections: Outlets for oxygen with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
 - a. All outlets shall be MEDAES/Ohmeda Compatible (Quick Connect) - verify all connection styles with owner prior to ordering.
- B. Faceplates:
1. Flush Outlets: Mount in galvanized steel boxes with stainless steel faceplate with polycarbonate cover, color coded with embossed labeling.

2. Surface Outlets: Surface mount with color coded plastic cover and stainless steel faceplate with polycarbonate cover, color coded with embossed labeling.

2.5 ALARM SYSTEMS

A. Manufacturers:

1. Amico Corporation: www.amico.com/#sle.
2. BeaconMedaes: www.beaconmedaes.com/#sle.

B. GENERAL REQUIREMENTS FOR ALARM PANELS

1. Provide Medical Gas Notification System to include the following:
 - a. Medical Signaling Device.
 - 1) The medical gas notification alarms provide master and area alarm signals as required by the latest edition of NFPA 99. The alarm is ETL listed to UL 1069 and CSA C22.2 No.205 Signal Equipment.
 - 2) All field wiring and signals are self-monitoring and on a closed circuit. Fault signals activate on an open circuit.
 - 3) Provide mounting for recessed installation with fabricated enclosure of steel or aluminum with knockouts for electrical and piping connections.
 - 4) Master, Area, and Combination Alarms shall have a 10.2" touch screen LCD display.
 - a) A Green NORMAL condition on the home screen shows that there are no alarms active.
 - b) The home page includes a location/area served badge for the alarm panel, customizable with the keyboard feature of the touch screen during the set up process.
 - c) LCD display contains an adjustable background with many color/brightness options.
 - d) LCD display backlight includes a "sleep mode" option via motion sensor to preserve screen life, adjustable from 5 minutes to 60 minutes. By default, the alarm sleep mode option is not active and the backlight remains on all of the time. If option is active and an alarm occurs during "sleep mode", the backlight turns on and remains on during the alarm condition.
 - e) A full diagnostic self-test of the alarm tests the alarm signals (green and red), the LED indicators on the front panel, the audible horn, and displays all of the alarm set points. Initiate test with the touchscreen controls
 - 5) Power:
 - a) Input power to the alarm panel is 100 to 250 VAC 50/60 Hz, fused on the input side rated at 250mA, time-delayed.
 - b) The internal power supply converts the input voltage to low voltage 24 VDC.
 - c) All user accessible electronics and wiring utilize low voltage.
 - d) Plastic guard protects user from high voltage wiring.
 - 6) Area Alarm Digital Sensors:

- a) Gas specific digital gas sensor contains a transducer capable of providing factory calibrated signals to the alarm panel.
 - b) Gas sensors may be located inside the alarm rough-in (local) or outside the alarm rough-in (remote).
 - c) When installed remotely, sensors may be located up to 5,000 feet from the alarm panel per manufacturers guidelines.
 - d) Pipeline connections are 3/8" nominal (1/2" OD) type K copper tube and include a DISS check fitting. •
- 7) Area Alarm Panel Configuration:
- a) Area alarm panel monitors 1 to 8 digital gas sensor modules, installed locally or remotely.
 - b) Display screen continuously displays the monitored gas pressures or vacuum in the piping system.
 - c) Customize gas badges on the display for gas types, color, and language. Type in areas served per gas during set up process through the touchscreen interface.
 - d) Program the units of measure for each gas badge to read PSI, BAR, and kPa in increments of 1 PSI, .1 BAR, and to 10 kPa respectively.
 - e) Visual indicators for system pressure or vacuum are NORMAL (green) and individual indicators (red) for alarm fault condition such as LOW or HIGH pressure.
 - f) Low and high alarm points are factory set per NFPA 99 standards, but remain field programmable through touch screen interface.
 - g) The Area alarm panel contains a general fault relay for the entire panel or add an optional relay board to provide the pressure fault status for each gas.
- 8) Master Alarm
- a) Master alarm panel monitors up to 40 normally closed dry contact switch signals wired locally.
 - b) Status for each signal, shown on the touchscreen, is Green under normal conditions (closed) and flashing Red under fault conditions (open).
 - c) During a fault condition, the visual green NORMAL display turns off, the location icon flashes red, the active alarm icon flashes red, and the audible alarm sounds.
 - d) Optional relay boards provide up to 48 dry contacts normally closed relays for connection to a building automation system. Relay ratings are 30 VAC/VDC 3A max.
 - e) Master alarms allow for optional relay outputs tied to single or multiple alarm conditions.
- 9) Combination Alarm
- a) Alarm panels monitor a combination of normally closed dry contact switch signals, digital gas sensor modules, and 4-20mA transducers.
 - b) Alarm panel is capable of monitoring up to 30 normally closed dry contact switch signals wired locally or up to 6 digital gas sensors.
 - c) xxx

b.

C. High-Low Pressure Alarm Panel:

1. Closed circuit, self-monitoring type to monitor single gas such as oxygen, vacuum, compressed air, nitrous oxide, or nitrogen.
2. Green light for system normal.
3. High or low pressure warning:
 - a. Green light extinguishes.
 - b. Audible warning device sounds.
 - c. Red light energizes.
4. Gauge indicates pressure or vacuum.
5. Switch silences warning device.
6. Provide system with internal switches, gauge, control unit, and transformer.

END OF SECTION 22 6000

SECTION 23 0516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible pipe connectors.
- B. Pipe loops, offsets, and swing joints.

1.2 RELATED REQUIREMENTS

- A. Section 23 2113 - Hydronic Piping.

1.3 REFERENCE STANDARDS

- A. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- B. EJMA (STDS) - EJMA Standards; Tenth Edition.
- C. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness, hose convolutions per foot (meter) and per assembly, fundamental frequency of assembly, braid structure, and total number of wires in braid.
 - 2. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions, special procedures, and external controls.
- D. Maintenance Data: Include adjustment instructions.
- E. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements for additional provisions.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Comply with UL (DIR) requirements.

2.2 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. Manufacturers:
 - 1. Metraflex
 - 2. Mason
 - 3. Minnesota Flexible Corporation
- B. Inner Hose: Stainless Steel.
- C. Exterior Sleeve: Braided, stainless steel.
- D. Pressure Rating: 125 psi up to 12 inch (862 kPa up to 300 mm, DN).
- E. Maximum Service Temperature: 250 degrees F (121 degrees C).
- F. End Connections: As specified for pipe joints.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.

2.3 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Manufacturers:
 - 1. Metraflex
 - 2. Mason
 - 3. Minnesota Flexible Corporation
- B. Inner Hose: Bronze.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 psi up to 2 inch (862 kPa up to 50 mm, DN).
- E. Maximum Service Temperature: 250 degrees F (121 degrees C).
- F. End Connections: Welded or sweat.
- G. Size: Use pipe sized units.
- H. Maximum offset: 3/4 inch (20 mm) on each side of installed center line.
- I. Application: Copper piping.

2.4 EXPANSION JOINTS AND LOOPS - HOSE AND BRAID

- A. Manufacturers:
 - 1. Metraflex
 - 2. Mason
 - 3. Minnesota Flexible Corporation
- B. Provide flexible loops with two flexible sections of hose and braid, two 90 degree elbows, and 180 degree return with support brackets and plugged drain port for steam service.
- C. Maximum Allowable Motion: 2 inch (50.8 mm) in the x, y, and z planes with no thrust loads to the building structure
- D. Maximum Working Pressure: 150 psi (1030 kPa) at 800 degrees F (426.7 degrees C).
- E. Construction: Class 150, schedule 40, stainless steel hose and braid assembly with carbon steel fittings, including elbows and flanged end connections sized to match pipe segment
 - 1. Selected Product to Accommodate:
 - a. Compression and Expansion Axial Deflection
 - b. Angular Rotation: 15 degrees.
 - c. Force developed by 1.5 times specified maximum allowable operating pressure.
 - 2. Provide necessary accessories including, but not limited to, swivel joints.

2.5 ACCESSORIES

- A. Pipe Alignment Guides:
 - 1. Manufacturers:
 - a. Metraflex
 - b. Mason
 - c. Minnesota Flexible Corporation
 - 2. Two piece welded steel with enamel paint, bolted, with spider to fit standard pipe, frame with four mounting holes, clearance for minimum 1 inch (25 mm) thick insulation, minimum 3 inches (75 mm) travel.
- B. Engineered Riser Anchor Clamps:
 - 1. Applications:
 - a. Provide one clamp to serve as a riser clip.
 - 1) Verify the total load of filled pipe to be supported will be a safety factor of one less than the maximum loading of the clamp per the manufacturer's instructions.
 - b. Provide one clamp above and one clamp below the slab to anchor pipe.
 - 1) Coordinate with the structural engineer to determine the maximum thrust loading calculated for the slab or floor structure. Use the maximum thrust loading calculations to verify the clamps will be a safety factor of one less than the maximum loading of clamp per the manufacturer's instructions.
 - 2. Provide two piece, ductile iron in compliance with ASTM A536. Use with metal pipes with an outer diameter of 2.5 inches (64 mm) to 8 inches (203 mm).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with EJMA (Expansion Joint Manufacturers Association) Standards.
- C. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.
- D. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- E. Anchor pipe to building structure where indicated. Provide pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.
- F. Provide support and equipment required to control expansion and contraction of piping. Provide loops, pipe offsets, and swing joints, or expansion joints where required.

3.2 PIPING APPLICATIONS

- A. Hydronic heating systems:
 - 1. Steel Mains, NPS 1" and smaller, runs exceeding 100' of straight pipe
 - a. Threaded flexible hose expansion loops at every 100' interval
 - 2. Steel Mains, NPS 1-1/4" to NPS 2", runs exceeding 100' of straight pipe
 - a. Threaded flexible hose expansion loops at every 100' interval
 - 3. Steel Mains, NPS 2-1/2" and larger, runs exceeding 100' of straight pipe
 - a. Flanged or grooved flexible hose expansion loops at every 100' interval
 - 4. Polypropylene PP-R, runs exceeding 75' of straight pipe
 - a. Flanged flexible hose expansion loops at every 75' interval
 - 5. Copper branch runs, runs exceeding 75' of straight pipe
 - a. Copper sweat flexible hose expansion loops at every 75' interval
- B. Domestic hot & recirc water systems:
 - 1. Copper runs exceeding 75' of straight pipe
 - a. Copper sweat flexible hose expansion loops at every 75' interval
 - b. Domestic water rated expansion loops

3.3 INSTALLATION OF EXPANSION JOINTS

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install and guide per manufacturer's installation instructions and Mechanical Contractors Association of America "Guidelines for Quality Piping Installations"
- C. Flexible hose expansion loop return fitting shall be supported to allow movement

- D. Install grooved-joint expansion joints to grooved-end steel piping.
- E. Install flanged-joint expansion joints to flanged-end steel piping

3.4 INSTALLATION OF ALIGNMENT GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- B. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 23 0516

SECTION 23 0517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 23 0719 - HVAC Piping Insulation.

1.2 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2024.

1.3 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.

1.4 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.

1.5 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

2.1 PIPE SLEEVES

- A. Vertical Piping:
 - 1. Sleeve Length: 2 inch (50 mm) above finished floor.
 - 2. Provide sealant for watertight joint.
- B. Pipe Passing Through Below Grade Exterior Walls:
 - 1. Galvanized pipe.
 - 2. Provide watertight space with link rubber or modular seal between sleeve and pipe on both pipe ends.

- 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.

2.2 PIPE-SLEEVE SEALS

- A. Manufacturers:
 - 1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.
 - 2. Link-Seal
 - 3. Metraflex Company (The)
 - 4. Pipeline Seal and Insulator, Inc
- B. Modular Mechanical Sleeve-Seal:
 - 1. Elastomer-based interlocking links continuously fill annular space between pipe and wall-sleeve, wall or casing opening.
 - 2. Watertight seal between pipe and wall-sleeve, wall or casing opening.
 - 3. Size and select seal component materials in accordance with service requirements.
 - 4. Service Requirements:
 - a. Corrosion resistant.
 - b. Underground, buried, and wet conditions.
 - 5. Stainless Steel pressure end plates.
- C. Pipe Sleeve Material:
 - 1. Bearing Walls: Galvanized Steel
 - 2. Masonry Structures: Galvanized Steel

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- B. Install piping to conserve building space, to not interfere with use of space and other work.
- C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- D. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.
 - 1. 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.
- 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.
- G. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system

3.3 CLEANING

- A. Upon completion of work, clean all parts of the installation.
- B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

3.4 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves with sleeve-seal system.

- 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves
 - b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 23 0517

SECTION 23 0519 - METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flow meters.
- B. Pressure gauges and pressure gauge taps.
- C. Thermometers and thermometer wells.
- D. Static pressure gauges.

1.2 REFERENCE STANDARDS

- A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2022.
- B. ASME MFC-3M - Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi; 2004 (Reaffirmed 2017).
- C. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014 (Reapproved 2020).
- D. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).
- E. AWWA M6 - Water Meters -- Selection, Installation, Testing, and Maintenance; 2012, with Addendum (2018).
- F. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.4 FIELD CONDITIONS

- A. Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

PART 2 PRODUCTS

2.1 LIQUID FLOW METERS

- A. Manufacturers:
 - 1. Flow Design
 - 2. Gerand Engineering Co.
 - 3. Griswold
 - 4. Tour Anderson
 - 5. Pro Hydronics
 - 6. Nexus
- B. Description: Flowmeter with calibrated flow-measuring element, hoses or tubing, fittings, valves, indicator, and conversion chart.
- C. Flow Range: Sensor and indicator shall cover operating range of equipment or system served.
- D. Sensor: Venturi-type, calibrated, flow-measuring element; for installation in piping.
 - 1. Design: Differential-pressure-type measurement for water or water glycol mixture.
 - 2. Construction: Bronze, brass, or factory-primed steel, with brass fittings and attached tag with flow conversion data.
 - 3. Minimum Pressure Rating: 250 psig.
 - 4. Minimum Temperature Rating: 250 deg F
 - 5. End Connections for NPS 2 and Smaller: Threaded.
 - 6. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
 - 7. Flow Range: Flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- E. Operating Instructions: Include complete instructions with each flowmeter.
- F. Calibrated ASME MFC-3M Venturi orifice plate and flanges with valved taps, chart for conversion of differential pressure readings to flow rate, with pressure gauge in case.

2.2 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Ametek, Inc
 - 2. Flo Fab Inc
 - 3. Tel-Tru Manufacturing Company
 - 4. Trerice
 - 5. Watts
 - 6. Weiss Instruments, Inc
 - 7. Wika Instrument Corporation - USA
 - 8. Winters Instruments - US
- B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
 - 1. Case: Cast Aluminum or drawn steel.

2. Size: 4-1/2 inch (115 mm) diameter.
3. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
4. Provide liquid filled gauges for inlet and outlet of hydronic circulating pumps.
5. Movement: Mechanical, with link to pressure element and connection to pointer.
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
7. Pointer: Dark-colored metal.
8. Window: Glass or plastic.
9. Ring: Metal.
10. Mid-Scale Accuracy: One percent.
11. Scale: Psi and KPa.

2.3 PRESSURE GAUGE TAPPINGS

- A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).
- B. Needle Valve: Brass, 1/4 inch (6 mm) NPT for minimum 150 psi (1034 kPa).
- C. Pulsation Damper: Pressure snubber, brass with 1/4 inch (6 mm) connections.
- D. Syphon: Steel, Schedule 40, 1/4 inch (6 mm) angle or straight pattern.

2.4 STEM TYPE THERMOMETERS

- A. Manufacturers:
 1. Flo Fab Inc.
 2. Tel-Tru Manufacturing Company.
 3. [Trerice](#)
 4. Watts
 5. Weiss Instruments, Inc.
 6. Wika Instrument Corporation - USA.
 7. Winters Instruments - U.S.
- B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 1. Size: 9 inch (225 mm) scale.
 2. Window: Clear Lexan.
 3. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Air-Duct Installation: With ventilated shroud.
 - b. Design for Thermowell Installation: Bare stem.
 4. Accuracy: 2 percent, per ASTM E77.
 5. Calibration: Degrees F.

2.5 THERMOMETER SUPPORTS

- A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

- B. Flange: 3 inch (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.6 TEST PLUGS

- A. Test Plug: 1/4 inch (6 mm) or 1/2 inch (13 mm) brass fitting and cap for receiving 1/8 inch (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F (93 degrees C).

2.7 STATIC PRESSURE GAUGES

- A. 3-1/2 inch (90 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- B. Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- C. Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4 inch (6 mm) diameter tubing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install positive displacement meters with isolating valves on inlet and outlet to AWWA M6. Provide full line size valved bypass with globe valve for liquid service meters.
- C. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.
- D. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Provide siphon on gauges in steam systems. Extend nipples and siphons to allow clearance from insulation.
- E. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch (60 mm) for installation of thermometer sockets. Ensure sockets allow clearance from insulation.
- F. Install thermometers in air duct systems on flanges.
- G. Install thermometer sockets adjacent to controls system thermostat, transmitter, or sensor sockets. Refer to Section 23 0943. Where thermometers are provided on local panels, duct or pipe mounted thermometers are not required.
- H. Locate duct mounted thermometers minimum 10 feet (3 m) downstream of mixing dampers, coils, or other devices causing air turbulence.
- I. Coil and conceal excess capillary on remote element instruments.

- J. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- K. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.
- L. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.
- M. Locate test plugs adjacent thermometers and thermometer sockets.
- N. Install thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic boiler.
 - 3. Two inlets and two outlets of each chiller.
 - 4. Inlet and outlet of each hydronic coil in air-handling units.
 - 5. Two inlets and two outlets of each hydronic heat exchanger.
 - 6. Inlet and outlet of each thermal-storage tank.
 - 7. Outside-, return-, supply-, and mixed-air ducts.
- O. Install pressure gages in the following locations:
 - 1. Discharge of each pressure-reducing valve.
 - 2. Inlet and outlet of each chiller chilled-water and condenser-water connection.
 - 3. Suction and discharge of each pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Connect flowmeter transmitters to meters.
- D. Connect thermal-energy meter transmitters to meters.

3.3 ADJUSTING

- A. After installation, calibrate meters according to manufacturer's written instructions.
- B. Adjust faces of meters and gages to proper angle for best visibility.
- C. THERMOMETER SCHEDULE
- D. Thermometers at inlet and outlet of each hydronic zone shall be one of the following:
- E. Sealed, bimetallic-actuated type.
- F. Industrial-style, liquid-in-glass type.
- G. Thermometers at inlet and outlet of each hydronic boiler shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.

- H. Thermometers at inlets and outlets of each chiller shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- I. Thermometers at inlet and outlet of each hydronic coil in air-handling units and built-up central systems shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- J. Thermometers at inlets and outlets of each hydronic heat exchanger shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- K. Thermometers at inlet and outlet of each hydronic heat-recovery unit shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- L. Thermometers at inlet and outlet of each thermal-storage tank shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- M. Thermometers at outside-, return-, supply-, and mixed-air ducts shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- N. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Sealed, bimetallic-actuated type.
 - 2. Industrial-style, liquid-in-glass type.
- O. Thermometer stems shall be of length to match thermowell insertion length.

3.4 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Chilled-Water Piping: 0 to 100 deg F.
- B. Scale Range for Heating, Hot-Water Piping: 30 to 240 deg F.
- C. Scale Range for Steam and Steam-Condensate Piping: 0 to 250 deg F.
- D. Scale Range for Air Ducts: Minus 40 to plus 110 deg F.
- E. Scale Range for Heat Pump Piping: 0 to plus 160 deg F. (Minus 20 to plus 100 deg C).
- F. Scale Range for Domestic Cold Water Piping: 0 to 100 deg F. (Minus 20 to plus 50 deg C).
- G. Scale Range for Domestic Hot Water Piping: 0 to 250 deg F. (Minus 20 to plus 150 deg C).

3.5 PRESSURE-GAGE SCHEDULE

- A. Pressure gages at discharge of each pressure-reducing valve shall be one of the following:

1. Sealed, direct mounted, metal case.
- B. Pressure gages at inlet and outlet of each chiller chilled-water and condenser-water connection shall be one of the following:
 1. Sealed, remote-mounted, metal case.
- C. Pressure gages at suction and discharge of each pump shall be one of the following:
 1. Sealed, liquid filled, direct-mounted, metal case.
- D. Pressure gages at discharge of each water service into the building at water meter shall be one of the following:
 1. Sealed, direct-mounted, metal case.

3.6 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Piping: 1.5 times standard working pressure.
- B. Scale Range for Steam Piping: 1.5 times standard working pressure.

3.7 FLOWMETER SCHEDULE

- A. Flowmeters for Water Piping: Venturi type.

END OF SECTION 23 0519

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Globe valves.
- B. Ball valves.
- C. Butterfly valves.
- D. Check valves.
- E. Gate valves.
- F. Chainwheels.

1.2 RELATED REQUIREMENTS

- A. Section 23 2113 - Hydronic Piping.

1.3 ABBREVIATIONS AND ACRONYMS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. PTFE: Polytetrafluoroethylene.
- G. RS: Rising stem.
- H. TFE: Tetrafluoroethylene.
- I. WOG: Water, oil, and gas.

1.4 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 B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.10 - Face-to-Face and End-to-End Dimensions of Valves; 2022.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- F. ASME B16.34 - Valves — Flanged, Threaded, and Welding End; 2020.
- G. ASME B31.9 - Building Services Piping; 2020.
- H. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2023).
- I. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- J. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.
- K. AWWA C606 - Grooved and Shouldered Joints; 2022.
- L. MSS SP-67 - Butterfly Valves; 2022.
- M. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends; 2011.
- N. MSS SP-71 - Gray Iron Swing Check Valves, Flanged and Threaded Ends; 2018.
- O. MSS SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Service; 2010a.
- P. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves; 2019.
- Q. MSS SP-85 - Gray Iron Globe and Angle Valves, Flanged and Threaded Ends; 2011.
- R. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.5 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. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Use the following precautions during storage:
 - 1. Maintain valve end protection and protect flanges and specialties from dirt.
 - 2. Store valves in shipping containers and maintain in place until installation.
 - a. Store valves indoors in dry environment.

- B. Exercise the following precautions for handling:
 - 1. Handle large valves with sling, modified to avoid damage to exposed parts.
 - 2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).
- B. Provide the following valves for the applications if not indicated on drawings:
 - 1. Throttling (Hydronic): Butterfly, Ball, and Globe.
 - 2. Isolation (Shutoff): Butterfly, Gate, and Ball.
 - 3. Swing Check (Pump Outlet):
 - a. Size 2 inch (50 mm, DN) and Smaller: Bronze with bronze disc.
 - b. Size 2-1/2 inch (65 mm, DN) and Larger: Iron with lever and weight, lever and spring, center-guided metal, or center-guided with resilient seat.
- C. 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.

2.2 GENERAL REQUIREMENTS

- A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.
- B. Valve Sizes: Match upstream piping unless otherwise indicated.
- C. Valve Actuator Types:
- D. Valves in Insulated Piping: Provide 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.
 - 3. Butterfly Valves: Extended neck.
 - 4. Memory Stops: Fully adjustable after insulation is installed.
- E. Memory Stops: Fully adjustable after insulation is installed.
- F. Valve-End Connections:
 - 1. Threaded End Valves: ASME B1.20.1.
 - 2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
 - 3. Pipe Flanges and Flanged Fittings 1/2 inch (15 mm, DN) through 24 inch (600 mm, DN): ASME B16.5.
 - 4. Solder Joint Connections: ASME B16.18.
 - 5. Grooved End Connections: AWWA C606.

- G. General ASME Compliance:
 - 1. Ferrous Valve Dimensions and Design Criteria: ASME B16.10 and ASME B16.34.
 - 2. Building Services Piping Valves: ASME B31.9.
- H. Bronze Valves:
 - 1. Fabricate from dezincification resistant material.
 - 2. Copper alloys containing more than 15 percent zinc are not permitted.

2.3 BRONZE, GLOBE VALVES

- A. CWP Rating: Class 125: 200 psi (1,380 kPa):
 - 1. Comply with MSS SP-80, Type 1.
 - 2. Body: Bronze; ASTM B62, with integral seat and screw in bonnet.
 - 3. Ends: Threaded or solder joint.
 - 4. Stem and Disc: Bronze.
 - 5. Packing: Asbestos free.
 - 6. Handwheel: Malleable iron, bronze, or aluminum..
 - 7. Manufacturers:
 - a. Crane Co
 - b. Hammond Valve
 - c. Kitz Corporation
 - d. Milwaukee Valve Company
 - e. Nibco Inc
 - f. Watts Regualtor Co

2.4 IRON, GLOBE VALVES

- A. CWP Ratings: Class 125: 200 psi (1,380 kPa) and Class 250: 500 psi (3,450 kPa):
 - 1. Comply with MSS SP-85, Type I.
 - 2. Body: Gray iron; ASTM A126, with bolted bonnet.
 - 3. Ends: Flanged.
 - 4. Trim: Bronze.
 - 5. Packing and Gasket: Asbestos free.
 - 6. Operator: Handwheel or chainwheel.
 - 7. Manufacturers:
 - a. [Crane Co.](#)
 - b. [Hammond Valve.](#)
 - c. [Kitz Corporation.](#)
 - d. [Milwaukee Valve Company.](#)
 - e. [NIBCO INC.](#)
 - f. Watts Regulator Co

2.5 BRASS, BALL VALVES

- A. Two Piece, Full Port with Stainless Steel Trim and Female Thread, Male thread, or Solder Connections:

1. Comply with MSS SP-110.
2. SWP Rating: 150 psi (1,035 kPa).
3. CWP Rating: 600 psi (4,140 kPa).
4. Vacuum Rating: 28.9 in-Hg (97.9 kPa).
5. Body: Forged brass.
6. Seats: PTFE.
7. Stem: Stainless Steel.
8. Ball: Stainless Steel, vented..
9. Manufacturers:
 - a. [Crane Co.](#)
 - b. [Hammond Valve.](#)
 - c. [Kitz Corporation.](#)
 - d. [Milwaukee Valve Company.](#)
 - e. [NIBCO INC.](#)
 - f. Watts Regulator Co

2.6 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 Brass Trim:
 1. Comply with MSS SP-110.
 2. WSP Rating: 150 psi (1,035 kPa).
 3. CWP Rating: 400 psi (2,758 kPa).
 4. Body: Forged bronze or dezincified-brass alloy.
 5. End Connections: Pipe thread or solder.
 6. Seats: PTFE.
 7. Stem: Bronze or brass.
 8. Ball: Stainless steel, vented.
 9. Manufacturers:
 - a. [Crane Co.](#)
 - b. [Hammond Valve.](#)
 - c. [Kitz Corporation.](#)
 - d. [Milwaukee Valve Company.](#)
 - e. [NIBCO INC.](#)
 - f. Watts Regulator Co

2.7 IRON, BALL VALVES

- A. Split Body, Full Port:
 1. Comply with MSS SP-72.
 2. CWP Rating: 200 psi (1380 kPa).
 3. Body: ASTM A126, gray iron.
 4. Ends: Flanged.

5. Seats: PTFE.
6. Stem: Stainless steel.
7. Ball: Stainless steel.
8. Manufacturers:
 - a. Conbraco Industries, Inc
 - b. Crane Co.
 - c. Milwaukee Valve Company
 - d. Nibco Inc

2.8 IRON, SINGLE FLANGE BUTTERFLY VALVES

- A. Lug Style; Bidirectional Dead-End Service without Use of Downstream Flange:
 1. Size: As indicated on drawings, Class 125.
 2. Comply with MSS SP-67, Type I.
 3. Lug Style, CWP Ratings:
 - a. Sizes 2 to 12 inch (50 to 300 mm, DN): 150 psi (1034 kPa).
 - b. 250 psi (1725 kPa) Sizes 14 to 24 inch (350 to 600 mm, DN): 250 psi (1725 kPa).
 - c. Vacuum Service: Down to 29.9 in-Hg (101.2 kPa).
 4. Body Material: ASTM A126 cast iron or ASTM A536 ductile iron.
 5. Stem: One or two-piece stainless steel.
 6. Seat: EPDM.
 7. Disc: Aluminum-bronze.
 8. Manufacturers:
 - a. Conbraco Industries
 - b. Crane Co
 - c. Hammond Valve
 - d. Kitz Corporation
 - e. Milwaukee Valve Company
 - f. Nibco Ince
 - g. Spence Engineering Company, Inc
 - h. Watts Regulator Co

2.9 BRONZE, LIFT CHECK VALVES

- A. Class 125:
 1. Comply with MSS SP-80, Type 1, Metal Disc to Metal Seat and Type 2, Nonmetallic Disc to Metal Seat.
 2. CWP Rating: 200 psi (1,380 kPa).
 3. Design: Vertical flow.
 4. Body: Bronze.
 5. Ends: Threaded.
 6. Disc (Type 1): Bronze.
 7. Disc (Type 2): NBR or PTFE.
 8. Manufacturers:
 - a. [Crane Co](#)
 - b. [Hammond Valve](#).

- c. [Kitz Corporation.](#)
- d. [Milwaukee Valve Company.](#)
- e. [NIBCO INC.](#)
- f. Watts Regulator Co

2.10 BRONZE, SWING CHECK VALVES

- A. Class 125:
 - 1. Pressure and Temperature Rating: MSS SP-80, Type 3.
 - 2. Design: Y-pattern, horizontal or vertical flow.
 - 3. CWP Rating: 200 psi (1,380 kPa).
 - 4. Body: Bronze, ASTM B62.
 - 5. End Connections: Threaded or soldered.
 - 6. Disc: Bronze.
 - 7. Manufacturers:
 - a. [Crane Co](#)
 - b. [Hammond Valve.](#)
 - c. [Kitz Corporation.](#)
 - d. [Milwaukee Valve Company.](#)
 - e. [NIBCO INC.](#)
 - f. Watts Regulator Co

2.11 IRON, SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125:
 - 1. Comply with MSS SP-71, Type I.
 - 2. Sizes 2-1/2 to 12 inch (65 to 300 mm, DN): CWP Rating; 200 psi (1,380 kPa).
 - 3. Sizes 14 to 24 inch (350 to 600 mm, DN): CWP Rating; 150 psi (1,035 kPa).
 - 4. Body Design: Clear or full waterway.
 - 5. Body Material: ASTM A126, gray iron with bolted bonnet.
 - 6. Ends: Flanged or threaded, See valve schedule
 - 7. Trim: Bronze.
 - 8. Gasket: Asbestos free.
 - 9. Closer Control: Factory installed, exterior lever, and spring or weight.
 - 10. Manufacturers:
 - a. [Crane Co](#)
 - b. [Hammond Valve.](#)
 - c. [Kitz Corporation.](#)
 - d. [Milwaukee Valve Company.](#)
 - e. [NIBCO INC.](#)
 - f. Watts Regulator Co

2.12 BRONZE, GATE VALVES

- A. Nonrising Stem or NRS:
 - 1. Pressure-Temperature Range: MSS SP-80, Type I.

2. Class 125:
 - a. CWP Rating: 200 psi (1,380 kPa).
3. Class 150: CWP Rating: 300 psi (2,070 kPa).
4. Body: ASTM B62, bronze with integral seat and screw-in bonnet.
5. Ends Connections: Threaded or solder.
6. Stem: Bronze.
7. Disc: Solid wedge; bronze.
8. Packing: Asbestos free.
9. Handwheel Operator: Malleable iron, bronze, or aluminum.
10. Manufacturers:
 - a. [Crane Co](#)
 - b. [Hammond Valve](#).
 - c. [Kitz Corporation](#).
 - d. [Milwaukee Valve Company](#).
 - e. [NIBCO INC](#).
 - f. Watts Regulator Co

2.13 IRON, GATE VALVES

- A. NRS or OS&Y:
 1. Comply with MSS SP-70, Type I.
 2. Class 125:
 - a. Sizes 2-1/2 to 12 inch (65 to 300 mm, DN), CWP Rating; 200 psi (1,380 kPa).
 - b. Sizes 14 to 24 inch (350 to 60 mm, DN), CWP Rating; 500 psi (3,450 kPa).
 3. Body Material: Gray iron with bolted bonnet.
 4. Ends: Flanged.
 5. Trim: Bronze.
 6. Disc: Solid wedge.
 7. Packing and Gasket: Asbestos free.
 8. Manufacturers:
 - a. [Crane Co](#)
 - b. [Hammond Valve](#).
 - c. [Kitz Corporation](#).
 - d. [Milwaukee Valve Company](#).
 - e. [NIBCO INC](#).
 - f. Watts Regulator Co

2.14 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 2. Attachment: For connection to ball and butterfly valve stems.
 3. Sprocket Rim with Chain Guides: Ductile iron include zinc coating.
 4. Chain: Hot-dip galvanized steel. Sized to fit sprocket rim.
- B. Manufacturers:

1. [Babbitt Steam Specialty Co.](#)
2. [Roto Hammer Industries.](#)
3. [Trumbull Industries.](#)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.
- B. Verify valve parts to be fully operational in all positions from closed to fully open.
- C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.
- D. Should valve is determined to be defective, replace with new valve.

3.2 INSTALLATION

- A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.
- B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.
- 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.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

1. If valve applications are not indicated, use the following:
 2. Shutoff Service: Ball or butterfly valves.
 3. Throttling Service: Globe, angle, ball or butterfly valves.
- B. Pump-Discharge Check Valves:
 1. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - a. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.

- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- D. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
- E. Chilled-Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
 - 2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
 - 3. Butterfly Valves, NPS 2-1/2 and Larger: Single-flange, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 - 4. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
 - 5. Spring-Loaded Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, cast iron.
- F. Heating Water Piping: Use the following types of valves:
 - 1. Ball Valves, NPS 2 and Smaller: Two-piece, 400-psig CWP rating, copper alloy.
 - 2. Ball Valves, NPS 2-1/2 and Larger: Class 150, ferrous alloy.
 - 3. Butterfly Valves, NPS 2-1/2 and Larger: Single Flange, 150-psig CWP rating, ferrous alloy, with EPDM liner.
 - 4. Check Valves, NPS 2 and Smaller: Type 2, Class 125, horizontal or vertical, bronze.
 - 5. Swing Check Valves, NPS 2 and Smaller: Type 4, Class 125, bronze.
 - 6. Swing Check Valves, NPS 2-1/2 and Larger: Type II, Class 125, gray iron.
 - 7. Spring-Loaded, Check Valves, NPS 2 and Smaller: Type IV, Class 125 minimum.
 - 8. Spring-Loaded, Check Valves, NPS 2-1/2 and Larger: Type I or II, Class 125, cast iron.
 - 9. Globe Valves, NPS 2 and Smaller: Type 2, Class 125, bronze.
 - 10. Globe Valves, NPS 2-1/2 and Larger: Type I, Class 125, bronze-mounted cast iron.
- G. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water service.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded ends.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.

END OF SECTION 23 0523

SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.

1.2 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- 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; 2024.
- 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; 2024.
- L. FM (AG) - FM Approval Guide; Current Edition.
- M. MFMA-4 - Metal Framing Standards Publication; 2004.
- N. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

- O. UL (DIR) - Online Certifications Directory; Current Edition.
- P. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.3 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.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel (strut) framing systems, nonpenetrating rooftop supports, post-installed concrete and masonry anchors, and thermal insulated pipe supports.
- C. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.5 QUALITY ASSURANCE

- A. Comply with applicable building code.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:

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. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Steel Components: Use corrosion resistant materials suitable for the 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. Prefabricated Trapeze-Framed Metal Strut Systems:
1. MFMA-4 compliant, pre-fabricated, MSS SP-58 type 59 continuous-slot metal strut channel with associated tracks, fittings, and related accessories.
 2. Strut Channel or Bracket 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.
 3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch (2.66 mm).
 4. Minimum Channel Dimensions: 1-5/8 inch (41 mm) width by 13/16 inch (21 mm) height.
 5. Accessories: Provide bracket covers, cable basket clips, cable tray clips, clamps, conduit clamps, fire-retarding brackets, j-hooks, protectors, and vibration dampeners.
- C. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
- D. 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.
 - b. Support From Below: MSS SP-58 Types 35 through 38.
 3. Operating Temperatures from 122 to 446 degrees F (50 to 230 degrees C):
 - a. Overhead Support: MSS SP-58 Type 1 or 3 through 12, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
- E. Beam Clamps:
1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
 2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
 3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
 4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
 5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.

6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
 7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
 8. 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.
- F. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
 2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 3. Medium Split Horizontal Pipe Clamp: MSS SP-58 type 4, carbon steel or stainless steel with epoxy plated, plain, stainless steel, or zinc plated finish.
 4. Copper Tube Pipe Clamp: MSS SP-58 type 8, epoxy plated copper.
 5. UL (DIR) listed: Pipe sizes 1/2 to 8 inch (15 to 200 mm, DN).
- G. U-Bolts:
1. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.
- H. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.
- I. Insulation Clamps:
1. Two bolt-type clamps designed for installation under insulation.
 2. Material: Carbon steel with epoxy copper or zinc finish.
- J. Pipe Hangers:
1. Split Ring Hangers:
 - a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
 - b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
 - c. Provide hanger rod and nuts of the same type and material for a given pipe run.
 - d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.
 2. Clevis Hangers, Adjustable:
 - a. Copper Tube: MSS SP-58 Type 1, epoxy-plated copper.
 - b. Light-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
 - c. Standard-Duty: MSS SP-58 Type 1, zinc-colored, epoxy plated.
- K. Intermediate Pipe Guides:
1. Pipe Diameter 6 inch (150 mm, DN) and Smaller: Provide minimum clearance of 0.16 inch (4 mm).
 2. Pipe Sizes 8 inch (200 mm, DN): 0.625 inch (16 mm) U-bolt with double nuts providing minimum clearance of 0.28 inch (7 mm).
 3. Pipe Size 10 inch (250 mm, DN): 0.75 inch (19 mm) U-bolt.
 4. Pipe Sizes 12 to 16 inch (300 to 400 mm, DN): 0.875 inch (24 mm) U-bolt.
 5. Pipe Sizes 18 to 30 inch (450 to 750 mm, DN): 1 inch (25 mm) U-bolt.

6. Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.
- L. Pipe Alignment Guides:
1. Pipe Sizes 8 inch (200 mm, DN) and Smaller: Spider or sleeve type.
 2. Pipe Sizes 10 inch (250 mm, DN) and Larger: Roller type.
- M. 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.
- N. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
1. Provide steel pedestals with thermoplastic or rubber base that rest on top of roofing membrane, not requiring any attachment to the roof structure and not penetrating the roofing assembly, with support fixtures as specified.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 4. Mounting Height: Provide minimum clearance of 6 inches (150 mm) under supported component to top of roofing.
- O. Pipe Shields for Insulated Piping:
1. MSS SP-58 Type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel
 2. 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. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - e. Maximum Service Temperature: 178 degrees F (81 degrees C).
 - f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
- P. 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. Hollow Masonry: Use toggle bolts.
 4. Steel: Use beam-ceiling clamps, beam clamps, machine bolts, or welded threaded studs.
 5. Sheet Metal: Use sheet metal screws.
 6. Plastic and lead anchors are not permitted.
 7. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Manufacturer: Same as manufacturer of metal channel (strut) framing system.
- Q. Pipe Installation Accessories:
1. Thermal Insulated, Surface-Mounted Pipe Supports:

- a. Material: Carbon steel with epoxy copper or zinc finish.
- b. Weather and UV light resistant foam, plastic, or rubber material with built-in strut.
Maximum Load: 50 lb (22.7 kg) for single pipe or multiple landed on top strut.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.
- D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.
- E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.
- 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.
- H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners according to manufacturer's recommended torque settings.
- J. Remove temporary supports.

3.3 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.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
- C. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
- F. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
- G. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- J. 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.
- K. Install Cast Iron pipe and pipe restraints in compliance with all U S soil pipe and fitting manufacturers' installation instructions and per CISPI Designation 310-11, CISPI Designation 301-09 and the CISPI Cast Iron Soil Pipe Handbook, regarding auxiliary support for ho-hub cast iron pipe and fitting joints over 4 inches (102 mm) in size and for joints subjected to

excessive thrust forces, use manufactured assemblies with appropriate thrust pressure ratings, rather than field assembled miscellaneous materials.

- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.5 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.6 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.8 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 09 9123 "Interior Painting".
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.9 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal-hanger shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
 - 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 - 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 0529

SECTION 23 0548 - VIBRATION CONTROLS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Elastomeric isolation pads.
 - 2. Elastomeric isolation mounts.
 - 3. Open-spring isolators.
 - 4. Housed-spring isolators.
 - 5. Restrained-spring isolators.
 - 6. Housed-restrained-spring isolators.
 - 7. Pipe-riser resilient supports.
 - 8. Resilient pipe guides.
 - 9. Elastomeric hangers.
 - 10. Spring hangers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
- B. Delegated-Design Submittal: For each vibration isolation device.
 - 1. Include design calculations for selecting vibration isolators and for designing vibration isolation bases.

PART 2 PRODUCTS

2.1 ELASTOMERIC ISOLATION PADS

- A. Elastomeric Isolation Pads:
 - 1. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
 - 2. Size: Factory or field cut to match requirements of supported equipment.
 - 3. Pad Material: Oil and water resistant with elastomeric properties.
 - 4. Surface Pattern: Ribbed or Waffle pattern.

5. Infused nonwoven cotton or synthetic fibers.
6. Load-bearing metal plates adhered to pads.

2.2 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Mounting Plates:
 - a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
 - b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.
2. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.3 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - a. Housing: Cast-ductile iron or welded steel.
 - b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 OPEN-SPRING ISOLATORS

A. reestanding, Laterally Stable, Open-Spring Isolators:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig (3447.38 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.5 HOUSED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators in Two-Part Telescoping Housing:

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators.

- a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447.38 kPa).
- b. Top housing with threaded mounting holes and internal leveling device.

2.6 RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:
 - 1. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.
 - a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447.38 kPa).
 - b. Top plate with elastomeric pad.
 - c. Internal leveling bolt that acts as blocking during installation.
 - 2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 HOUSED-RESTRAINED-SPRING ISOLATORS

- A. Freestanding, Steel, Open-Spring Isolators with Vertical-Limit Stop Restraint in Two-Part Telescoping Housing:
 - 1. Two-Part Telescoping Housing: A steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings are equipped with adjustable snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig (3447.38 kPa).
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.8 PIPE-RISER RESILIENT SUPPORT

- A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2-inch-thick neoprene.
 - 1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
 - 2. Maximum Load Per Support: 500 psig (3447.38 kPa) on isolation material providing equal isolation in all directions.

2.9 RESILIENT PIPE GUIDES

- A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2-inch-thick neoprene.
 - 1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.10 ELASTOMERIC HANGERS

- A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:
 - 1. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.11 SPRING HANGERS

- A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION CONTROL DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 03 3000 "Cast-in-Place Concrete."
- B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

END OF SECTION 23 0548

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Stencils.
- E. Pipe markers.
- F. Ceiling tacks.

1.2 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Identification painting.

1.3 REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2023.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Chart and Schedule: Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 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: Stencilled painting.
- G. Heat Transfer Equipment: Nameplates.
- H. Instrumentation: Tags.
- I. Major Control Components: Nameplates.
- J. Piping: Stencilled painting.
- K. Pumps: Nameplates.
- L. Small-sized Equipment: Tags.
- M. Tanks: Nameplates.
- N. Valves: Tags and ceiling tacks where located above lay-in ceiling.
- O. Water Treatment Devices: Nameplates.

2.2 NAMEPLATES

- A. Letter Color: White.
- B. Letter Height: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
- C. Background Color: Black.
- D. Plastic: Comply with ASTM D709.
- E. Minimum size: Length and width vary for required label content, but not less than 2-1/2" by 3/4"
- F. Warning Nameplates:
 - 1. Letter Color: Black or White
 - 2. Background Color: Red
 - 3. Label Content: Include caution and warning information plus emergency notification instructions

2.3 TAGS

- A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.
- B. Valve Tag Chart: Typewritten letter size list in anodized aluminum frame.
- C. Warning Tags

1. Size: 3 by 5-1/4 inches minimum
2. Nomenclature: Large-size primary caption such as "DANGER", "CAUTION", or "DO NOT OPERATE"
3. Color: Safety-yellow background with black lettering

2.4 ADHESIVE-BACKED DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.
- B. Style: Individual Label.
- C. Color: Yellow/Black.

2.5 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 1. 3/4 to 1-1/4 inch (20-30 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 1/2 inch (15 mm) high letters.
 2. 1-1/2 to 2 inch (40-50 mm) Outside Diameter of Insulation or Pipe: 8 inch (200 mm) long color field, 3/4 inch (20 mm) high letters.
 3. 2-1/2 to 6 inch (65-150 mm) Outside Diameter of Insulation or Pipe: 12 inch (300 mm) long color field, 1-1/4 inch (30 mm) high letters.
 4. 8 to 10 inch (200-250 mm) Outside Diameter of Insulation or Pipe: 24 inch (600 mm) long color field, 2-1/2 inch (65 mm) high letters.
 5. Over 10 inch (250 mm) Outside Diameter of Insulation or Pipe: 32 inch (800 mm) long color field, 3-1/2 inch (90 mm) high letters.
 6. Ductwork and Equipment: 2-1/2 inch (65 mm) high letters.
- B. Stencil Paint: As specified in Section 09 9123, semi-gloss enamel, colors complying with ASME A13.1.

2.6 PIPE MARKERS

- A. Color: Comply with ASME A13.1.
- B. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.
- C. Color code as follows:
 1. Heating, Cooling, and Boiler Feedwater: Green with white letters.
 2. Toxic and Corrosive Fluids: Orange with black letters.
 3. Compressed Air: Blue with white letters.

2.7 CEILING TACKS

- A. Description: Steel with 3/4 inch (20 mm) diameter color coded head.

- B. Color code as follows:
 - 1. HVAC Equipment: Yellow.
 - 2. Fire Dampers and Smoke Dampers: Red.
 - 3. Heating/Cooling Valves: Blue.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 9123 for stencil painting.

3.2 INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion resistant chain.
- C. Apply stencil painting in accordance with Section 09 9123.
- D. Install plastic pipe markers in accordance with manufacturer's instructions.
- E. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- F. Locate ceiling tacks to locate valves or dampers above lay-in panel ceilings. Locate in corner of panel closest to equipment.

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- C. Pipe Label Color Schedule:
1. Label all piping systems in accordance with ANSI/ASME A13.1.
 2. Domestic Water Piping
 - a. Background: Safety green.
 - b. Letter Colors: White.
 3. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Safety black.
 - b. Letter Color: White.
 4. Chilled-Water Piping: White letters on a safety-green background.
 5. Heating Water Piping: White letters on a safety-green background.
 6. Refrigerant Piping: White letters on a safety-black background.
 7. Low-Pressure Steam Piping: White letters on a safety-black background.
 8. High-Pressure Steam Piping: White letters on a safety-black background.
 9. Steam-Condensate Piping: White letters on a safety-black background.

3.5 DUCT LABEL INSTALLATION

- A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Colors:
1. Toxic and Corrosive Fluids: Black letters on a safety-orange background.
 2. Flammable Fluids: Black letters on a safety-yellow background.
 3. Combustible Fluids: White letters on a safety-brown background.

4. Potable and Other Water: White letters on a safety-green background.
5. Compressed Air: White letters on a safety-blue background.
6. Defined by User: White letters on a safety-purple background, black letters on a safety-white background, white letters on a safety-gray background, and white letters on a safety-black background

3.7 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 0553

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of hydronic, steam, and refrigerating systems.
- C. Measurement of final operating condition of HVAC systems.

1.2 RELATED REQUIREMENTS

- A. Section 01 4000 - Quality Requirements: Employment of testing agency and payment for services.

1.3 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; 2023.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Include at least the following in the plan:
 - a. List of all air flow, water flow, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Identification and types of measurement instruments to be used and their most recent calibration date.
 - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - e. Final test report forms to be used.

- f. Procedures for formal deficiency reports, including scope, frequency and distribution.
- C. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - 2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
 - 3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - 4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
 - 5. Units of Measure: Report data in I-P (inch-pound) units only.
 - 6. Include the following on the title page of each report:
 - a. Name of Testing, Adjusting, and Balancing Agency.
 - b. Address of Testing, Adjusting, and Balancing Agency.
 - c. Telephone number of Testing, Adjusting, and Balancing Agency.
 - d. Project name.
 - e. Project location.
 - f. Project Architect.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project altitude.
 - j. Report date.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 - 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 - 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 - 3. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications:
 - 1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.
 - 2. Having minimum of three years documented experience.
 - 3. Certified by one of the following:
 - a. AABC, Associated Air Balance Council: www.aabc.com/#sle; upon completion submit AABC National Performance Guaranty.

- b. NEBB, National Environmental Balancing Bureau: www.nebb.org/#sle.
 - c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute: www.tabbcertified.org/#sle.
- D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
 - 12. Hydronic systems are flushed, filled, and vented.
 - 13. Pumps are rotating correctly.
 - 14. Proper strainer baskets are clean and in place.
 - 15. Service and balance valves are open.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

3.3 ADJUSTMENT TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 10 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 - 1. Running log of events and issues.
 - 2. Discrepancies, deficient or uncompleted work by others.
 - 3. Contract interpretation requests.
 - 4. Lists of completed tests.

- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.

- M. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- N. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.
- O. On fan powered VAV boxes, adjust air flow switches for proper operation.

3.6 WATER SYSTEM PROCEDURE

- A. Adjust water systems to provide required or design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- D. Effect system balance with automatic control valves fully open to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.7 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

3.8 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.

5. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

3.9 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.
7. Starter size, rating, heater elements.
8. Sheave Make/Size/Bore.

B. Pumps:

1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

C. Combustion Equipment:

1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Heat input.
5. Heat output.
6. Entering water temperature
7. Leaving water temperature
8. Water flow

D. Heat Exchangers:

1. Identification/number.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Primary water entering temperature, design and actual.
6. Primary water leaving temperature, design and actual.
7. Primary water flow, design and actual.
8. Secondary water leaving temperature, design and actual.
9. Secondary water flow, design and actual.

E. Cooling Coils:

1. Identification/number.
2. Service.
3. Manufacturer.
4. Air flow, design and actual.

5. Entering air DB temperature, design and actual.
 6. Entering air WB temperature, design and actual.
 7. Leaving air DB temperature, design and actual.
 8. Leaving air WB temperature, design and actual.
 9. Water flow, design and actual.
 10. Entering water temperature, design and actual.
 11. Leaving water temperature, design and actual.
 12. Air pressure drop, design and actual.
- F. Heating Coils:
1. Identification/number.
 2. Service.
 3. Manufacturer.
 4. Air flow, design and actual.
 5. Water flow, design and actual.
 6. Entering water temperature, design and actual.
 7. Leaving water temperature, design and actual.
 8. Entering air temperature, design and actual.
 9. Leaving air temperature, design and actual.
- G. Air Moving Equipment:
1. Manufacturer.
 2. Model number.
 3. Serial number.
 4. Arrangement/Class/Discharge.
 5. Air flow, specified and actual.
 6. Return air flow, specified and actual.
 7. Outside air flow, specified and actual.
 8. Total static pressure (total external), specified and actual.
 9. Fan RPM.
- H. Return Air/Outside Air:
1. Identification/location.
 2. Design air flow.
 3. Actual air flow.
 4. Design outside air flow.
 5. Actual outside air flow.
- I. Exhaust Fans:
1. Manufacturer.
 2. Model number.
 3. Serial number.
 4. Air flow, specified and actual.
 5. Total static pressure (total external), specified and actual.
 6. Fan RPM.
- J. Terminal Unit Data:

1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.
4. Model number.
5. Size.
6. Minimum design air flow.
7. Maximum design air flow.
8. Maximum actual air flow.

K. Air Distribution Tests:

1. Air terminal number.
2. Room number/location.
3. Design air flow.
4. Test (final) air flow.
5. Percent of design air flow.

END OF SECTION 23 0593

SECTION 23 0713 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Duct insulation.
- B. Duct liner.
- C. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 23 0553 - Identification for HVAC Piping and Equipment.

1.3 REFERENCE STANDARDS

- A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- B. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- C. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- E. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- G. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- J. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- K. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

- L. UL 181A - Closure Systems for Use with Rigid Air Ducts; Current Edition, Including All Revisions.
- M. UL 181B - Closure Systems for Use with Flexible Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 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.
- C. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section with not less than three years of documented experience.

1.6 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.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturer:

1. CertainTeed Corporation; SoftTouch Duct Wrap
 2. Johns Manville; Microlite
 3. Knauf Insulation; Performance+ Duct Wrap
 4. Manson Insulation, a company of Knauf Insulation; Alley Wrap B
 5. Owens Corning Corporation; SOFTR All-Service Duct Wrap
- 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.
- 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.

2.3 GLASS FIBER, RIGID

- A. Manufacturer:
1. CertainTeed Corporation; Commerical Board
 2. Johns Manville; 800 Series Spin-Glas
 3. Knauf Insulation; Earthwool Insulation Board
 4. Manson Insulation, a company of Knauf Insulation; AK Board
 5. Owens Corning Corporation; 700 Series FIBERGLAS Insulation
 6. Fibrex Insulations Inc; FBX
- B. Insulation: ASTM C612; rigid, noncombustible blanket.
- 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.
- D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure-sensitive rubber-based adhesive.
- E. Indoor Vapor Barrier Finish:
1. Vinyl emulsion type acrylic, compatible with insulation, black color.

2.4 JACKETING AND ACCESSORIES

- A. Reinforced Tape:

1. FSK tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with UL 723 or ASTM E84.
3. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
4. Finish: Match insulation.

B. UL181 Tape for Rigid and Flexible Ductwork:

1. Comply with UL 181A for rigid ductwork.
2. Comply with UL 181B for flexible ductwork.
3. Aluminum foil coated with pressure-sensitive adhesive on paper release liner.
4. Foil tape suitable for sealing seams between insulation, insulated elbows, and fittings resulting in a tight, smooth surface without wrinkles.
5. Finish: Printed with UL Listing for identification.

2.5 DUCT LINER

A. Manufacturers:

1. Aeroflex USA; AEROFLEX Breathe-EZ
2. Armacell LLC; ArmaFlex Ultra with FlameDefense
3. Knauf Insulation; Performance+ Duct Liner
4. Manson Insulation, a company of Knauf Insulation; Akousti-Liner
5. Owens Corning Corporation; QuietR Rotary Duct Insulation

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. Apparent Thermal Conductivity: Maximum of 0.28 at 75 degrees F (0.045 at 24 degrees C).
4. Minimum Noise Reduction Coefficients:
 - a. 1/2 inch (13 mm) Thickness: 0.30.
 - b. 1 inch (25 mm) Thickness: 0.40.
5. Erosion Resistance: Does not show evidence of breaking away, flaking off, or delamination at velocities of 10,000 fpm (50.8 m/s) when tested in accordance with ASTM C1071.
6. Connection: Waterproof vapor barrier adhesive.

C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation. Comply with ASTM C916.

D. Adhesive: Waterproof, fire-retardant type, ASTM C916.

E. Liner Fasteners: Galvanized steel, self-adhesive pad with integral head.

2.6 GREASE DUCT

A. Grease Duct Insulation: Insulation system shall consist of a single layer flexible duct enclosure for commercial kitchen grease ducts. System shall allow for zero clearance to combustibles at

all points and shall feature high temperature bio-soluble insulation. Insulation shall be encased in an aluminum foil fiberglass reinforced scrim covering. Insulation shall be applied to exterior of hood exhaust ductwork.

- B. Accessories and Attachments:
 - 1. Bands: Carbon or stainless steel ½” wide.
 - 2. Weld-Attached Anchor Pins and Washers: 12 gauge steel with galvanized steel speed washers.
- C. Products: Subject to compliance with requirements, provide one of the following:
 - 1. FyreWrap by Unifrax.
 - 2. Or Approved Equal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Test ductwork for design pressure prior to applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.
- C. Verify that systems to be insulated have been tested and are free of defects.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Insulated Ducts Conveying Air Below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system, including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated Ducts Conveying Air Above Ambient Temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- E. Slope exterior ductwork to shed water.
- F. External Duct Insulation Application:
 - 1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 - 2. Secure insulation without vapor barrier with staples, tape, or wires.

3. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

G. Duct and Plenum Liner Application:

1. Adhere insulation with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, concealed exhaust within 20' from penetration of building exterior.
7. Indoor, exposed exhaust within 20' from penetration of building exterior.
8. Outdoor, concealed supply and return.
9. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed return air ductwork in a conditioned space
9. Concealed return air ductwork in a ceiling above a conditioned space

3.4 DUCT AND PLENUM APPLICATION SCHEDULE

A. Service: Round and rectangular, supply-air, ducts concealed.

1. Material: Mineral-fiber blanket.
2. Thickness: 2 inches.
3. Number of Layers: One.

B. Field-Applied Jacket: None, factory applied.

1. Vapor Retarder Required: Yes.

- 2. R-value: Minimum of 5.6 at 0.75 pcf.
- C. Service: Rectangular exhaust ducts concealed and exposed 20' from exterior penetrations.
 - 1. Material: Mineral-fiber board.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None, factory applied.
 - 5. Vapor Retarder Required: Yes.
- D. Service: Round exhaust ducts concealed and exposed 20' from exterior penetrations.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 2 inches.
- E. Number of Layers: One.
 - 1. Field-Applied Jacket: None, factory applied.
 - 2. Vapor Retarder Required: Yes.
 - 3. R-value: Minimum of 5.6 at 0.75 pcf.
- F. Service: Rectangular, Mixed-air and Outside-air, ducts concealed and exposed.
 - 1. Material: Mineral-fiber board.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None, factory applied.
 - 5. Vapor Retarder Required: Yes.
- G. Service: Round Mixed-air and Outside-air, ducts concealed and exposed.
 - 1. Material: Mineral-fiber blanket.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None, factory applied.
 - 5. Vapor Retarder Required: Yes.
 - 6. R-value: Minimum of 5.6 at 0.75 pcf.
- H. Service: Mechanical Room Supply ducts concealed and exposed.
 - 1. Material: Mineral-fiber board.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None, factory applied.
 - 5. Vapor Retarder Required: Yes.
- I. Service: Relief-air ducts concealed and exposed 20' from exterior penetrations.
 - 1. Material: Mineral-fiber board.
 - 2. Thickness: 2 inches.
 - 3. Number of Layers: One.
 - 4. Field-Applied Jacket: None, factory applied.
 - 5. Vapor Retarder Required: Yes.
- J. Service: Grease exhaust ducts concealed and exposed, from Type I kitchen hood to exterior wall or roof penetration.
 - 1. Material: Fyre Wrap.

2. Thickness: 1.5 inches.
 3. Number of Layers: Two.
 4. Field-Applied Jacket: Per Manufacturer's Requirements.
 5. Vapor Retarder Required: Yes.
- K. Service: Exhaust Air ducts concealed and exposed, from energy recovery discharge to exterior wall or roof penetration.
1. Material: Mineral-fiber board.
 2. Thickness: 2 inches.
 3. Number of Layers: One.
 4. Field-Applied Jacket: None, factory applied.
 5. Vapor Retarder Required: Yes.

END OF SECTION 23 0713

SECTION 23 0716 - HVAC EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 23 0553 - Identification for HVAC Piping and Equipment.
- B. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.
- C. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- D. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- E. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2022.
- F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- G. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2022a.
- H. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- I. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.

- J. ASTM C1775 - Standard Specification for Laminate Protective Jacket and Tape for Use Over Thermal Insulation for Outdoor Applications; 2022.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- L. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- M. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 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 equipment scheduled.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled 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.

1.7 FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

- A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.2 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible.
- B. Vapor Barrier Jacket: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 1. Secure with self-sealing longitudinal laps and butt strips.
 - 2. Secure with outward clinch expanding staples and vapor barrier mastic.
- C. Tie Wire: 0.048 inch (1.22 mm) stainless steel with twisted ends on maximum 12 inch (300 mm) centers.

2.3 FLEXIBLE REMOVABLE AND REUSABLE BLANKET INSULATION

- A. Insulation: ASTM C553 Type V; flexible, noncombustible.
 - 1. Minimum Service Temperature: 32 degrees F (0 degrees C).
 - 2. Maximum Service Temperature: 500 degrees F (260 degrees C).

2.4 GLASS FIBER, RIGID

- A. Insulation: ASTM C612 or ASTM C592; rigid, noncombustible.
- B. Aluminum-Foil Laminate Jacket:
 - 1. Factory-applied, pressure sensitive adhesive jacketing to comply with ASTM C1775.
- C. Vapor Barrier Jacket:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Secure with self-sealing longitudinal laps and butt strips.
 - 3. Secure with outward clinch expanding staples and vapor barrier mastic.
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.
- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.5 CELLULAR GLASS

- A. Pipe and Tubing Insulation: ASTM C552, Type II, Grade 6.
 - 1. K (Ksi) Value: 0.35 (0.050) at 100 degrees F (38 degrees C).
 - 2. Service Temperature Range: From 250 degrees F (121 degrees C) to 800 degrees F (427 degrees C).
 - 3. Water Vapor Permeability: 0.005 perm inch (0.007 ng/(Pa s m)) maximum per inch.
 - 4. Water Absorption: 0.5 percent by volume, maximum.

5. Density: At least 6.12 pcf (98 kg/cu m), minimum.

B. Block Insulation: ASTM C552, Type I, Grade 6.

2.6 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

A. 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: 220 degrees F (104 degrees C).
3. Connection: Waterproof vapor barrier adhesive.

B. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.7 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.

2.8 JACKETING AND ACCESSORIES

A. PVC Plastic:

1. Jacket: Sheet material, off-white color.
 - a. Minimum Service Temperature: Minus 40 degrees F (Minus 40 degrees C).
 - b. Maximum Service Temperature: 150 degrees F (66 degrees C).
 - c. Moisture Vapor Permeability: 0.02 perm inch (0.029 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
 - d. Thickness: 10 mil, 0.010 inch (0.25 mm).

B. 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: 0.016 inch (0.40 mm) sheet.
3. Finish: Embossed.
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; 0.010 inch (0.25 mm) thick stainless steel.

C. Stainless Steel Jacket: ASTM A666/A666M, Type 304 stainless steel.

1. Thickness: 0.010 inch (0.25 mm).
2. Finish: Smooth.
3. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.010 inch (0.25 mm) thick stainless steel.

- D. Reinforced Tape:
 - 1. FSK tape suitable for sealing seams in insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
 - 2. Comply with UL 723 or ASTM E84.
 - 3. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment has been tested before applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- E. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature; insulate entire system.
- G. Fiber glass insulated equipment containing fluids below ambient temperature; provide vapor barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapor barrier adhesive.
- H. For hot equipment containing fluids over 140 degrees F (60 degrees C), insulate flanges and unions with removable sections and jackets.
- I. Fiber glass insulated equipment containing fluids above ambient temperature; provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.
- J. Inserts and Shields:
 - 1. Application: Equipment 1-1/2 inches (40 mm) diameter or larger.
 - 2. Shields: Galvanized steel between hangers and inserts.
 - 3. Insert Location: Between support shield and equipment 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.

- K. Finish insulation at supports, protrusions, and interruptions.
- L. Exterior Applications:
 - 1. Provide vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement.
 - 2. Cover with aluminum or stainless steel.
- M. Cover glass fiber insulation with metal mesh and finish with heavy coat of insulating cement.
- N. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- O. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.3 SCHEDULE

- A. Heating Systems:
 - 1. Heat Exchangers/Converters:
 - a. Operating Temperature: 100 deg F (38 deg C) to 450 deg F (232 deg C).
 - b. Insulation Material: Rigid Mineral Fiber.
 - c. Insulation Thickness: 2 inches.
 - d. Vapor Retarder required: No.
 - e. Finish: None.
 - 2. Air Separators:
 - a. Operating Temperature: 100 deg F (38 deg C) to 450 deg F (232 deg C).
 - b. Insulation Material: Rigid Mineral Fiber.
 - c. Insulation Thickness: 2 inches.
 - d. Vapor Retarder required: No.
 - e. Finish: None.
 - 3. Hot Thermal Storage Tanks:
 - a. Operating Temperature: 100 deg F (38 deg C) to 450 deg F (232 deg C).
 - b. Insulation Material: Rigid Mineral Fiber.
 - c. Insulation Thickness: 2 inches.
 - d. Vapor Retarder required: No.
 - e. Finish: None.

END OF SECTION 23 0716

SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Piping insulation.
- B. Flexible removable and reusable blanket insulation.
- C. Weather barrier coatings.
- D. Jacketing and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 23 2113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.3 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 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).
- D. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2019).
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- F. ASTM C534/C534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2023.
- G. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2022a.
- H. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2024.
- I. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- J. ASTM C585 - Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing; 2022.
- K. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation; 2022.

- L. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2023).
- M. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation; 2023.
- N. ASTM C1423 - Standard Guide for Selecting Jacketing Materials for Thermal Insulation; 2021.
- O. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
- P. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2025.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- R. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- S. SAE AMS3779 - Tape, Adhesive, Pressure-Sensitive Thermal Radiation Resistant, Aluminum Coated Glass Cloth; 2016b.
- T. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.4 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.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 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.

2.2 GLASS FIBER, FLEXIBLE

- A. Manufacturers:
 - 1. CertainTeed Corporation
 - 2. Johns Manville
 - 3. Knauf Insulation
 - 4. Owens Corning
- 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: 850 degrees F (454 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.

2.3 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. CertainTeed Corporation
 - 2. Johns Manville Corporation
 - 3. Knauf Insulation
 - 4. Owens Corning Corporation
- 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-inches (0.029 ng/(Pa s m)).
- D. Vapor Barrier Lap Adhesive: Compatible with insulation.

- E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

2.4 EXPANDED POLYSTYRENE

- A. Insulation: ASTM C578; rigid closed cell.
 - 1. K (Ksi) Value: 0.23 at 75 degrees F (0.033 at 24 degrees C).
 - 2. Maximum Service Temperature: 165 degrees F (74 degrees C).
 - 3. Maximum Water Vapor Permeance: 5.0 perm (287 ng/(Pa s sq m)).

2.5 POLYISOCYANURATE CELLULAR PLASTIC

- A. Insulation Material: ASTM C591, rigid molded modified polyisocyanurate cellular plastic.
 - 1. Dimension: Comply with requirements of ASTM C585.
 - 2. K (Ksi) Value: 0.18 at 75 degrees F (0.026 at 24 degrees C), when tested in accordance with ASTM C518.
 - 3. Minimum Service Temperature: Minus 70 degrees F (Minus 57 degrees C).
 - 4. Maximum Service Temperature: 300 degrees F (150 degrees C).
 - 5. Water Absorption: 0.5 percent by volume, maximum, when tested in accordance with ASTM D2842.
 - 6. Moisture Vapor Transmission: 4.0 perm inch (5.8 ng/(Pa s m)).
 - 7. Connection: Waterproof vapor barrier adhesive.

2.6 FLEXIBLE ELASTOMERIC CELLULAR INSULATION

- A. Manufacturers:
 - 1. Aeroflex USA; AEROFLEX Self-Seal
 - 2. Armacell LLC; ArmaFlex Ultra with FlameDefense
 - 3. K-Flex USA LLC; K-Flex Titan
- 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.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.
- D. Weather Barrier Coating: Air dried, contact adhesive, compatible with insulation and ASTM E84 compliant.

2.7 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. Manufacturers:
 - a. H.B. Fuller Construction Products, Inc; Childers - CP Series Weather Barrier Coating

2. 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.
3. Water Vapor Permeance: Greater than 1.0 perm (57 ng/(Pa s m)) in accordance with ASTM E96/E96M.

2.8 JACKETING AND ACCESSORIES

A. PVC Plastic.

1. 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. Covering Adhesive Mastic: Compatible with insulation.

B. 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: 0.016 inch (0.40 mm) sheet.
3. Type: Factory-applied, self-adhesive jacketing.
4. Finish: Embossed.
5. Joining: Longitudinal slip joints and 2 inch (50 mm) laps.
6. Fittings: 0.016 inch (0.40 mm) thick die-shaped fitting covers with factory-attached protective liner.
7. Metal Jacket Bands: 3/8 inch (10 mm) wide; 0.015 inch (0.38 mm) thick aluminum.

C. Reinforced Tape:

1. FSK tape suitable for sealing seams between insulation, insulated pipe bends, and fittings resulting in a tight, smooth surface without wrinkles.
2. Comply with UL 723, ASTM E84.
3. Moisture Vapor Permeability: 0.00 perm inch (0.00 ng/(Pa s m)), when tested in accordance with ASTM E96/E96M.
4. Finish: Match insulation.

2.9 ACCESSORIES

A. General Requirements:

1. Provide required accessories in accordance with and subject to the recommendations of the insulation manufacturer.
2. Furnish compatible materials which do not contribute to corrosion, soften, or otherwise attack surfaces to which applied, in either the wet or dry state.
3. Comply with ASTM C795 requirements for materials to be used on stainless steel surfaces.
4. Supply materials that are asbestos free.

B. Corrosion Inhibitors:

1. Corrosion Control Gel:
 - a. Corrosion Protection: Comply with ASTM B117 and ASTM D610.

PART 3 EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Insulated Pipes Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system, including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- E. 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.
- F. For hot piping conveying fluids 140 degrees F (60 degrees C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
- G. For hot piping conveying fluids over 140 degrees F (60 degrees C), insulate flanges and unions at equipment.
- H. 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.
- I. 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 Configuration: Minimum 6 inches (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

- 4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
- J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, see Section 07 8400.
- K. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping. Provide two coats of UV resistant finish for flexible elastomeric cellular insulation without jacketing.
- L. Buried Piping: Provide factory-fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil, 0.001 inch (0.025 mm) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- M. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.4 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.5 PIPING INSULATION SCHEDULE

- A. Service: Domestic hot, recirculated hot and cold water.
 - 1. Operating Temperature: 35 to 140 deg F (2 to 60 deg C).
 - 2. Insulation Material: Mineral-fiber preformed pipe.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Copper Pipe, all sizes 1" thick.
 - 4. Vapor Retarder Required: Yes.

- B. Service: Storm Water Piping Above Grade.
 - 1. Operating Temperature: -30 to 100 deg F (-34.4 to 37.8 deg C).
 - 2. Insulation Material: Mineral-fiber preformed pipe.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. All Pipe Sizes, 1" thick.
 - 4. Vapor Retarder Required: Yes.
- C. Service: Indoor Hydronic hot water.
 - 1. Operating Temperature: 60 to 180 deg F.
 - 2. Insulation Material: Mineral-fiber preformed pipe.
 - 3. Insulation Thickness: Apply the following insulation thickness:
 - a. Pipe Sizes 1.5" and less, 1-1/2" thick.
 - b. Pipe Sizes 2" and larger, 2" thick.
 - 4. Vapor Retarder Required: Yes.
- D. Service: A/C Condensate Drain Lines.
 - 1. Operating Temperature: 50 to 75 deg F.
 - 2. Insulation Material: Mineral-fiber preformed pipe.
 - 3. Insulation Thickness: Apply the following insulation thicknesses:
 - a. Copper Pipe, all sizes 1" thick.
 - 4. Vapor Retarder Required: Yes.
- E. Service: All Refrigerant Piping Located Outdoors.
 - 1. Operating Temperature: 35 to 200 deg F (2 to 93.3 deg C).
 - 2. Insulation Material: Flexible elastomeric thermal insulation.
 - 3. Insulation Thickness: Apply the following insulation thickness:
 - a. All Pipe Sizes, 1" thick.
 - 4. Field Applied Jacket: Paint outdoor insulation to protect from ultra-violet rays.
- F. Service: All Refrigerant Piping Located Indoors.
 - 1. Operating Temperature: 35 to 200 deg F (2 to 93.3 deg C).
 - 2. Insulation Material: Flexible elastomeric thermal insulation.
 - 3. Insulation Thickness: Apply the following insulation thickness:
 - a. All Pipe Sizes, 3/4" thick.
 - 4. Vapor Retarder Required: Yes.
- G. Service: Aquatherm Piping
 - 1. Insulate domestic cold, hot and recirculating hot water piping, heating water supply and return piping and chilled water supply and return piping as indicated above. Insulation shall be on all piping, valves and fittings.

END OF SECTION 23 0719

SECTION 23 0923 - DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. System description.
- B. Operator interface.
- C. Controllers.
- D. Power supplies and line filtering.
- E. System software.
- F. Controller software.

1.2 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.

1.3 REFERENCE STANDARDS

- A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Addendum (2024).
- B. MIL-STD-810 - Environmental Engineering Considerations and Laboratory Tests; 2022h, with Editorial Revision.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for each system component and software module.
- C. Shop Drawings:
 - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.

2. List connected data points, including connected control unit and input device.
3. Indicate system graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations. Provide demonstration digital media containing graphics.
4. Show system configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
5. Indicate description and sequence of operation of operating, user, and application software.

D. Operation and Maintenance Data:

1. Include interconnection wiring diagrams complete field installed systems with identified and numbered, system components and devices.
2. Include keyboard illustrations and step-by-step procedures indexed for each operator function.
3. Include inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.

E. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for purpose specified and indicated.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a Two year period after Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Energy Tech Systems
- B. TRANE
- C. Johnson

2.2 SYSTEM DESCRIPTION

- A. Automatic temperature control field monitoring and control system using field programmable micro-processor based units.

- B. Base system on distributed system of fully intelligent, stand-alone controllers, operating in a multi-tasking, multi-user environment on token passing network, with central and remote hardware, software, and interconnecting wire and conduit.
- C. Include computer software and hardware, operator input/output devices, control units, local area networks (LAN), sensors, control devices, actuators.
- D. Controls for variable air volume terminals, radiation, reheat coils, unit heaters, fan coils, and the like when directly connected to the control units. Individual terminal unit control is specified in Section 23 0913.
- E. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories required to operate mechanical systems, and to perform functions specified.
- F. Include installation and calibration, supervision, adjustments, and fine tuning necessary for complete and fully operational system.

2.3 OPERATOR INTERFACE

- A. DDC system shall be Web based.
 - 1. Web-Based Access to DDC System:
 - a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet.
 - b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
 - c. Web access shall be password protected.
 - d. Web based DDC system shall allow full access to adjust, perform startup, and commission system without the requirement of additional software tools or subscription fees.

2.4 CONTROLLERS

- A. Building Controllers:
 - 1. General:
 - a. Manage global strategies by one or more, independent, standalone, microprocessor based controllers.
 - b. Provide sufficient memory to support controller's operating system, database, and programming requirements.
 - c. Share data between networked controllers.
 - d. Controller operating system manages input and output communication signals allowing distributed controllers to share real and virtual object information and allowing for central monitoring and alarms.
 - e. Utilize real-time clock for scheduling.

- f. Continuously check processor status and memory circuits for abnormal operation.
 - g. Controller to assume predetermined failure mode and generate alarm notification upon detection of abnormal operation.
 - h. Communication with other network devices to be based on assigned protocol.
 - 2. Communication:
 - a. Controller to reside on a BACnet network using ISO 8802-3 (ETHERNET) Data Link/Physical layer protocol.
 - b. Perform routing when connected to a network of custom application and application specific controllers.
 - c. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
 - b. Conditioned Space:
 - 1) Mount within dustproof enclosures.
 - 2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
 - 4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
 - 5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
 - 6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W. at 3 feet (1 m).
- B. Application Specific Controllers:
- 1. General:
 - a. Not fully user programmable, microprocessor based controllers dedicated to control specific equipment.
 - b. Customized for operation within the confines of equipment served.
 - c. Communication with other network devices to be based on assigned protocol.
 - 2. Communication:
 - a. Controller to reside on a BACnet network using MS/TP Data Link/Physical layer protocol.
 - b. Provide service communication port for connection to a portable operator's terminal or hand held device with compatible protocol.
 - 3. Anticipated Environmental Ambient Conditions:
 - a. Outdoors and/or in Wet Ambient Conditions:
 - 1) Mount within waterproof enclosures.
 - 2) Rated for operation at 40 to 150 degrees F (4 to 65 degrees C).
 - b. Conditioned Space:

- 1) Mount within dustproof enclosures.
- 2) Rated for operation at 32 to 120 degrees F (0 to 50 degrees C).
4. Provisions for Serviceability:
 - a. Diagnostic LEDs for power, communication, and processor.
 - b. Make all wiring connections to field removable, modular terminal strips, or to a termination card connected by a ribbon cable.
5. Memory: In the event of a power loss, maintain all BIOS and programming information for a minimum of 72 hours.
6. Power and Noise Immunity:
 - a. Maintain operation at 90 to 110 percent of nominal voltage rating.
 - b. Perform orderly shutdown below 80 percent of nominal voltage.
 - c. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet (1 m).
7. Smart Thermostat:
 - a. Alphanumeric display with button interface, white faceplate or fascia, multi-language support, surface or wall-mount over single gang box.
 - b. Sensor: 1,000 ohm Platinum RTD within insulated thermoplastic enclosure.
 - c. Adjustments: Setpoint, schedules, and point alarm criteria.
 - d. Temperature Control: Heating or cooling, On/Off control.
 - e. Fan Control: Two speed, On/Off.
 - f. Primary Interface: ASHRAE Std 135 BACnet MS/TP communications.
 - g. Certification: BACnet Testing Laboratory (BTL) certified device listed under the BACnet Smart Sensor (B-SS) device profile in compliance with ASHRAE Std 135.
- C. Input/Output Interface:
 1. Hardwired inputs and outputs tie into the DDC system through building, custom application, or application specific controllers.
 2. All Input/Output Points:
 - a. Protect controller from damage resulting from any point short-circuiting or grounding and from voltage up to 24 volts of any duration.
 - b. Provide universal type for building and custom application controllers where input or output is software designated as either binary or analog type with appropriate properties.
 3. Binary Inputs:
 - a. Allow monitoring of On/Off signals from remote devices.
 - b. Provide wetting current of 12 mA minimum, compatible with commonly available control devices and protected against the effects of contact bounce and noise.
 - c. Sense dry contact closure with power provided only by the controller.
 4. Pulse Accumulation Input Objects: Comply with all requirements of binary input objects and accept up to 10 pulses per second.
 5. Analog Inputs:
 - a. Allow for monitoring of low voltage 0 to 10 VDC, 4 to 20 mA current, or resistance signals (thermistor, RTD).
 - b. Compatible with and field configurable to commonly available sensing devices.
 6. Binary Outputs:
 - a. Used for On/Off operation or a pulsed low-voltage signal for pulse width modulation control.

- b. Outputs provided with three position (On/Off/Auto) override switches.
 - c. Status lights for building and custom application controllers to be selectable for normally open or normally closed operation.
- 7. Analog Outputs:
 - a. Monitoring signal provides a 0 to 10 VDC or a 4 to 20 mA output signal for end device control.
 - b. Provide status lights and two position (AUTO/MANUAL) switch for building and custom application controllers with manually adjustable potentiometer for manual override on building and custom application controllers.
 - c. Drift to not exceed 0.4 percent of range per year.
- 8. Tri State Outputs:
 - a. Coordinate two binary outputs to control three point, floating type, electronic actuators without feedback.
 - b. Limit the use of three point, floating devices to the following zone and terminal unit control applications:
 - 1) VAV terminal units.
 - 2) Duct mounted heating coils.
 - 3) Radiation.
 - c. Control algorithms run the zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.
- 9. System Object Capacity:
 - a. System size to be expandable to twice the number of input output objects required by providing additional controllers, including associated devices and wiring.
 - b. Hardware additions or software revisions for the installed operator interfaces are not to be required for future, system expansions.

2.5 POWER SUPPLIES AND LINE FILTERING

A. Power Supplies:

- 1. Provide UL listed control transformers with Class 2 current limiting type or over-current protection in both primary and secondary circuits for Class 2 service as required by the NEC.
- 2. Limit connected loads to 80 percent of rated capacity.
- 3. Match DC power supply to current output and voltage requirements.
- 4. Unit to be full wave rectifier type with output ripple of 5.0 mV maximum peak to peak.
- 5. Regulation to be 1 percent combined line and load with 100 microsecond response time for 50 percent load changes.
- 6. Provide over-voltage and over-current protection to withstand a 150 percent current overload for 3 seconds minimum without trip-out or failure.
- 7. Operational Ambient Conditions: 32 to 120 degrees F (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.

2.6 LOCAL AREA NETWORK (LAN)

- A. Provide communication between control units over local area network (LAN).
- B. LAN Capacity: Not less than 60 stations or nodes.
- C. Break in Communication Path: Alarm and automatically initiate LAN reconfiguration.
- D. LAN Data Speed: Minimum 19.2 Kb.
- E. Communication Techniques: Allow interface into network by multiple operation stations and by auto-answer/auto-dial modems. Support communication over telephone lines utilizing modems.
- F. Transmission Median: Fiber optic or single pair of solid 24 gauge twisted, shielded copper cable.
- G. Network Support: Time for global point to be received by any station, shall be less than 3 seconds. Provide automatic reconfiguration if any station is added or lost. If transmission cable is cut, reconfigure two sections with no disruption to system's operation, without operator intervention.

2.7 USER INTERFACE

- A. System Requirements:
 1. System Graphics:
 - a. Allow up to 10 graphic screens, simultaneously displayed for comparison and monitoring of system status.
 - b. Animation displayed by shifting image files based on object status.
 - c. Provide method for operator with password to perform the following:
 - 1) Move between, change size, and change location of graphic displays.
 - 2) Modify on-line.
 - 3) Add, delete, or change dynamic objects consisting of:
 - a) Analog and binary values.
 - b) Dynamic text.
 - c) Static text.
 - d) Animation files.
 2. Custom Graphics Generation Package:
 - a. Create, modify, and save graphic files and visio format graphics in PCX formats.
 - b. HTML graphics to support web browser compatible formats.
 - c. Capture or convert graphics from AutoCAD.
 3. Standard HVAC Graphics Library:

- a. HVAC Equipment:
 - 1) Chillers.
 - 2) Boilers.
 - 3) Air Handlers.
 - 4) Terminal HVAC Units.
 - 5) Fan Coil Units.
 - 6) Unit Ventilators.
 - b. Ancillary Equipment:
 - 1) Fans.
 - 2) Pumps.
 - 3) Coils.
 - 4) Valves.
 - 5) Piping.
 - 6) Dampers.
 - 7) Ductwork.
- B. System Applications:
- 1. Automatic System Database Save and Restore Functions:
 - a. Current database copy of each Building Controller is automatically stored on web.
 - b. Automatic update occurs upon change in any system panel.
 - 2. Manual System Database Save and Restore Functions by Operator with Password Clearance:
 - a. Save database from any system panel.
 - b. Clear a panel database.
 - c. Initiate a download of a specified database to any system panel.
 - 3. Software provided allows system configuration and future changes or additions by operators under proper password protection.
 - 4. On-line Help:
 - a. Context-sensitive system assists operator in operation and editing.
 - b. Available for all applications.
 - c. Relevant screen data provided for particular screen display.
 - d. Additional help available via hypertext.
 - 5. Security:
 - a. Operator log-on requires user name and password to view, edit, add, or delete data.
 - b. System security selectable for each operator.
 - c. System supervisor sets passwords and security levels for all other operators.
 - d. Operator passwords to restrict functions accessible to viewing and/or changing system applications, editor, and object.
 - e. Automatic, operator log-off results from keyboard or mouse inactivity during user-adjustable, time period.
 - f. All system security data stored in encrypted format.
 - 6. System Diagnostics:
 - a. Operations Automatically Monitored:
 - 1) Modems.
 - 2) Network connections.
 - 3) Building management panels.

- 4) Controllers.
- b. Device failure is annunciated to the operator.
- 7. Alarm Processing:
 - a. All system objects are configurable to "alarm in" and "alarm out" of normal state.
 - b. Configurable Objects:
 - 1) Alarm limits.
 - 2) Alarm limit differentials.
 - 3) States.
 - 4) Reactions for each object.
- 8. Alarm Messages:
 - a. Descriptor: English language.
 - b. Recognizable Features:
 - 1) Source.
 - 2) Location.
 - 3) Nature.
- 9. Configurable Alarm Reactions by Operator and Time of Day:
 - a. Logging.
 - b. Printing.
 - c. Starting programs.
 - d. Displaying messages.
 - e. Dialing out to remote locations.
 - f. Paging.
 - g. Providing audible annunciation.
 - h. Displaying specific system graphics.
- 10. Custom Trend Logs:
 - a. Definable for any data object in the system including interval, start time, and stop time.
 - b. Trend Data:
 - 1) Sampled and stored on the building controller panel.
 - 2) Archivable on hard disk.
 - 3) Retrievable for use in reports, spreadsheets and standard database programs.
 - 4) Archival on LAN accessible storage media including hard disk, tape, Raid array drive, and virtual cloud environment.
 - 5) Protected and encrypted format to prevent manipulation, or editing of historical data and event logs.
- 11. Alarm and Event Log:
 - a. View all system alarms and change of states from any system location.
 - b. Events listed chronologically.
 - c. Operator with proper security acknowledges and clears alarms.
 - d. Alarms not cleared by operator are archived to the workstation hard disk.
- 12. Object, Property Status and Control:
 - a. Provide a method to view, edit if applicable, the status of any object and property in the system.
 - b. Status Available by the Following Methods:
 - 1) Menu.
 - 2) Graphics.

- 3) Custom Programs.
13. Reports and Logs:
 - a. Reporting Package:
 - 1) Allows operator to select, modify, or create reports.
 - 2) Definable as to data content, format, interval, and date.
 - 3) Archivable to hard disk.
 - b. Real-time logs available by type or status such as alarm, lockout, normal, etc.
 - c. Stored on hard disk and readily accessible by standard software applications, including spreadsheets and word processing.
 - d. Set to be printed on operator command or specific time(s).
14. Reports:
 - a. Standard:
 - 1) Objects with current values.
 - 2) Current alarms not locked out.
 - 3) Disabled and overridden objects, points and SNVTs.
 - 4) Objects in manual or automatic alarm lockout.
 - 5) Objects in alarm lockout currently in alarm.
 - 6) Logs:
 - a) Alarm History.
 - b) System messages.
 - c) System events.
 - d) Trends.
 - b. Custom:
 - 1) Daily.
 - 2) Weekly.
 - 3) Monthly.
 - 4) Annual.
 - 5) Time and date stamped.
 - 6) Title.
 - 7) Facility name.
 - c. Tenant Override:
 - 1) Monthly report showing total, requested, after-hours HVAC and lighting services on a daily basis for each tenant.
 - 2) Annual report showing override usage on a monthly basis.
 - d. Weather:
 - 1) Weather:
 - a) Monthly showing minimum, maximum, average outdoor air temperature and heating/cooling degree-days for the month.
- C. Applications Editors:
 1. Provide editing software for each system application.
 2. Downloaded application is executed at controller panel.
 3. Full screen editor for each application allows operator to view and change:
 - a. Configuration.
 - b. Name.
 - c. Control parameters.

- d. Set-points.
- 4. Scheduling:
 - a. Monthly calendar indicates schedules, holidays, and exceptions.
 - b. Allows several related objects to be scheduled and copied to other objects or dates.
 - c. Start and stop times adjustable from master schedule.
- 5. Custom Application Programming:
 - a. Create, modify, debug, edit, compile, and download custom application programming during operation and without disruption of all other system applications.
 - b. Programming Features:
 - 1) English oriented language, based on BASIC, FORTRAN, C, or PASCAL syntax allowing for free form programming.
 - 2) Alternative language graphically based using appropriate function blocks suitable for all required functions and amenable to customizing or compounding.
 - 3) Insert, add, modify, and delete custom programming code that incorporates word processing features such as cut/paste and find/replace.
 - 4) Allows the development of independently, executing, program modules designed to enable and disable other modules.
 - 5) Debugging/simulation capability that displays intermediate values and/or results including syntax/execution error messages.
 - 6) Support for conditional statements (IF/THEN/ELSE/ELSE-F) using compound Boolean (AND, OR, and NOT) and/or relations (EQUAL, LESS THAN, GREATER THAN, NOT EQUAL) comparisons.
 - 7) Support for floating-point arithmetic utilizing plus, minus, divide, times, square root operators; including absolute value; minimum/maximum value from a list of values for mathematical functions.
 - 8) Language consisting of resettable, predefined, variables representing time of day, day of the week, month of the year, date; and elapsed time in seconds, minutes, hours, and days where the variable values can be used in IF/THEN comparisons, calculations, programming statement logic, etc.
 - 9) Language having predefined variables representing status and results of the system software enables, disables, and changes the set points of the controller software.

2.8 CONTROLLER SOFTWARE

- A. All applications reside and operate in the system controllers and editing of all applications occurs at the operator workstation.
- B. System Security:
 - 1. User access secured via user passwords and user names.
 - 2. Passwords restrict user to the objects, applications, and system functions as assigned by the system manager.
 - 3. User Log On/Log Off attempts are recorded.
 - 4. Automatic Log Off occurs following the last keystroke after a user defined delay time.

- C. Object or Object Group Scheduling:
 - 1. Weekly Schedules Based on Separate, Daily Schedules:
 - a. Include start, stop, optimal stop, and night economizer.
 - b. 10 events maximum per schedule.
 - c. Start/stop times adjustable for each group object.
 - 2. Holiday or Special Schedules:
 - a. Capability to define up to 99 schedules.
 - b. Repeated annually.
 - c. Length of each period is operator defined.
- D. Provide standard application for equipment coordination and grouping based on function and location to be used for scheduling and other applications.
- E. Alarms:
 - 1. Binary object is set to alarm based on the operator specified state.
 - 2. Analog object to have high/low alarm limits.
 - 3. All alarming is capable of being automatically and manually disabled.
 - 4. Alarm Reporting:
 - a. Operator determines action to be taken for alarm event.
 - b. Alarms to be routed to appropriate workstation.
 - c. Reporting Options:
 - 1) Logged.
 - 2) Graphical displays.
- F. Maintenance Management: System monitors equipment status and generates maintenance messages based upon user-designated run-time limits.
- G. Sequencing: Application software based upon specified sequences of operation in Section 23 0993.
- H. 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.
- I. Staggered Start Application:
 - 1. Prevents all controlled equipment from simultaneously restarting after power outage.
 - 2. Order of equipment startup is user selectable.
- J. 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.
- K. Anti-Short Cycling:

1. All binary output objects protected from short-cycling.
 2. Allows minimum on-time and off-time to be selected.
- L. 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.
- M. Run-Time Totalization:
1. Totalize run-times for all binary input objects.
 2. Provides operator with capability to assign high run-time alarm.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that conditioned power supply is available to the control units and to the operator work station. Verify that field end devices, wiring, and pneumatic tubing is installed prior to installation proceeding.

3.2 INSTALLATION

- A. Install control units and other hardware in position on permanent walls where not subject to excessive vibration.
- B. Install software in control units and in operator work station. Implement all features of programs to specified requirements and appropriate to sequence of operation. Refer to Section 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.

3.3 MANUFACTURER'S FIELD SERVICES

- A. Start and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

3.4 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate complete and operating system to Owner.

3.5 MAINTENANCE

- A. Provide service and maintenance of energy management and control systems for one years from Date of Substantial Completion.

- B. Provide two complete inspections, one in each season, to inspect, calibrate, and adjust controls as required, and submit written reports.

END OF SECTION 23 0923

SECTION 23 0923.10 - HVAC INSTRUMENTATION AND CONTROLS

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Sequence of Operation" for requirements that relate to this Section.
 - 2. Division 26 Section "Electrical Power Monitoring and Control."

1.3 DEFINITIONS

- A. BAS: Building Automation Controls.
- B. DDC: Direct-digital controls.
- C. LAN: Local area network.
- D. MS/TP: Master-slave/token-passing.
- E. PICS: Protocol Implementation Conformance Statement.

1.4 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.5 SYSTEM DESCRIPTION

- A. Contractor shall provide all equipment necessary to operate HVAC equipment as specified. This shall include software and controllers if required. It shall be at the contractors option to provide Electronic Controls or DDC Controls for all the HVAC equipment.
- B. Control system consists of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and (if chosen) software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems.

1.6 SUBMITTALS

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. Each control device labeled with setting or adjustable range of control.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
 - 3. Details of control panel faces, including controls, instruments, and labeling.
 - 4. Written description of sequence of operation.
 - 5. Schedule of dampers including size, leakage, and flow characteristics.
 - 6. Schedule of valves including leakage and flow characteristics.
 - 7. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
 - 8. Listing of connected data points, including connected control unit and input device.
 - 9. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.
 - 10. System configuration showing peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
- C. ASHRAE BACnet Statement: PICS for each DDC system component (panel, zone controller, field devices, and operator workstation) proposed.
- D. Samples: For each color required, of each type of thermostat cover.
- E. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.
- F. Maintenance Data: For systems to include in maintenance manuals specified in Division 1. Include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5. Calibration records and list of set points.
- G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

- H. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- E. Comply with ASHRAE 135 for DDC system control components.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.9 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- C. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- D. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Replacement Materials: One replacement diaphragm or relay mechanism for each unique valve motor, controller, thermostat, and positioning relay.
- C. Maintenance Materials: One thermostat adjusting key.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. TRANE
 - 2. Johnson Controls
 - 3. Energy Tech Systems (ETS)
 - 4. 75F
 - 5. Honeywell

2.2 CONTROL PANELS

- A. Central (Master) Control Panels: Fully enclosed, steel-rack-type cabinet with locking doors or locking removable backs. Match finish of panels and provide multicolor graphic displays, schematically showing system being controlled.
- B. Local Control Panels: Unitized cabinet with suitable brackets for wall or floor mounting, located adjacent to each system under automatic control. Provide common keying for all panels.
 - 1. Fabricate panels of 0.06-inch- (1.5-mm-) thick, furniture-quality steel, or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.
 - 2. Panel-Mounted Equipment: Temperature and humidity controllers, relays, and automatic switches; except safety devices. Mount devices with adjustments accessible through front of panel.
 - 3. Door-Mounted Equipment: Flush-mount (on hinged door) manual switches, including damper-positioning switches, changeover switches, thermometers, and gages.
 - 4. Graphics: Color-coded graphic, laminated-plastic displays on doors, schematically showing system being controlled, with protective, clear plastic sheet bonded to entire door.

2.3 ANALOG CONTROLLERS

- A. Step Controllers: Six- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.
- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
 - 1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig (89.63 kPa).
 - 2. Proportional band shall extend from 2 to 20 percent for 5 psig (34.47 kPa).
 - 3. Authority shall be 20 to 200 percent.
 - 4. Air-supply pressure of 18 psig (124.11 kPa), input signal of 3 to 15 psig (103.42 kPa), and output signal 0 to supply pressure.
 - 5. Gages: 1-1/2 inches (38 mm) in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.4 TIME CLOCKS

- A. Seven-day, programming-switch timer with synchronous-timing motor and seven-day dial; continuously charged, nickel-cadmium-battery-driven, eight-hour, power-failure carryover; multiple-switch trippers; minimum of two and maximum of eight signals per day with two normally open and two normally closed output contacts.
- B. Solid-state, programmable time control with 4 separate programs; 24-hour battery carryover; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; and system fault alarm.

2.5 SENSORS

- A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
 - 1. Thermistor temperature sensors as follows:
 - a. Accuracy: Plus or minus 0.36 deg F (0.2 deg C) at calibration point.
 - b. Wire: Twisted cable or shielded-pair cable.
 - c. Averaging Elements in Coils or Ducts: 72 inches (1828.8 mm) long, flexible; use where prone to temperature stratification or where ducts are larger than 4 sq. ft.; 120 inches (3048 mm) long, flexible where ducts are larger than 9 sq. ft (1 sq. m); length as required for large ducts.
 - d. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches (64 mm).
 - e. Room Sensors: Match room thermostats, locking cover.
 - f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - g. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- B. Equipment operation sensors as follows:

1. Status Inputs for Fans: Differential-pressure switch with adjustable range of 0 to 5 inches (127 mm) wg (0 to 1243 Pa).
 2. Status Inputs for Pumps: Differential-pressure switch piped across pump with adjustable pressure-differential range of 8 to 60 psig (413.69 kPa).
 3. Status Inputs for Electric Motors: Current-sensing relay with current transformers, adjustable and set to 175 percent of rated motor current.
- C. Electronic Valve/Damper Position Indication: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- D. Water-Flow Switches: Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.
- E. Carbon-Monoxide Detectors: Single or multichannel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C), calibrated for 50 and 100 ppm, with maximum 120-second response time to 100-ppm carbon monoxide.
- F. Nitrogen Dioxide Detectors: Single or multichannel, dual-level detectors, using solid-state sensors with 3-year minimum life, maximum 15-minute sensor replacement, suitable over a temperature range of 23 to 130 deg F (minus 5 to plus 55 deg C), calibrated for 1.0 and 5.0 ppm, with maximum 120-second response time to 5.0-ppm Nitrogen Dioxide.
- G. Carbon-Monoxide / Nitrogen-Dioxide Controller: Calibrated/programmed to activate equipment when the CO level reaches or exceeds 35 ppm of CO, adjustable and 1.0 ppm of NO₂. The system shall be wired such that outside air is introduced into the space as required. Coordinate two speed controls with sequence.
- H. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment, for flush mounting.

2.6 THERMOSTATS

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with two-, three-, or four-position, push-button or lever-operated fan switch.
1. Label switches "FAN ON-OFF," "FAN HIGH-LOW-OFF," "FAN HIGH-MED-LOW-OFF." Provide unit for mounting on two-gang switch box.
- B. Electric solid-state, microcomputer-based room thermostat with remote sensor.
1. Automatic switching from heating to cooling.
 2. Preferential rate control to minimize overshoot and deviation from set point.
 3. Set up for four separate temperatures per day.
 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 5. Short-cycle protection.
 6. Programming based on every day of week.
 7. Selection features include deg F or deg C display, 12- or 24-hour clock, keyboard disable, remote sensor, fan on-auto.
 8. Battery replacement without program loss.

9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater.
- D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
 1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
 2. Dead Band: Maximum 2 deg F (1 deg C).
- E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature, with copper capillary and bulb, unless otherwise indicated.
 1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit, adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches, with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
 1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Exposed.
 3. Thermometer: Exposed.
 4. Color: Standard colors.
 5. Orientation: Vertical.
- G. Room thermostat accessories include the following:
 1. Insulating Bases: For thermostats located on exterior walls.
 2. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
 3. Adjusting Key: As required for calibration and cover screws.
 4. Aspirating Boxes: For flush-mounted aspirating thermostats.
 5. Set-Point Adjustment: 1/2-inch- (13-mm-) diameter, adjustment knob.
- H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.

- I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type, with adjustable set point in middle of range and adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
- J. Electric Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches (304.8 mm) of bulb length is equal to or below set point.
 - 1. Bulb Length: Minimum 20 feet (609.6 cm).
 - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- K. Electric High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual- or automatic-reset switch that trips if temperature sensed across any 12 inches (304.8 mm) of bulb length is equal to or above set point.
 - 1. Bulb Length: Minimum 20 feet (609.6 cm).
 - 2. Quantity: One thermostat for every 20 sq. ft. (2 sq. m) of coil surface.
- L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig (172.37 kPa), and cast housing with position indicator and adjusting knob.

2.7 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 2. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 inch (3810 mm). x lbf (16.9 N x m) and breakaway torque of 300 inch (7620 mm). x lbf (33.9 N x m).
 - 3. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 inch (3810 mm). x lbf (16.9 N x m).
 - 4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 inch (3810 mm). x lbf (16.9 N x m) and breakaway torque of 300 inch (7620 mm). x lbf (33.9 N x m).
 - 5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 inch (3810 mm). x lbf (16.9 N x m).
- B. Electronic Damper and Large-Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
 - 2. Dampers: Sized for 25% more torque than required. Coupling: V-bolt and V-shaped, toothed cradle.
 - 3. Overload Protection: Electronic overload or digital rotation-sensing circuitry.

4. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
5. Power Requirements (Two-Position Spring Return): 24-V ac.
6. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
7. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
8. Temperature Rating: Minus 22 to plus 122 deg F (minus 30 to plus 50 deg C).
9. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (minus 30 to plus 121 deg C).
10. Run Time: 12 seconds open, 5 seconds closed.

2.8 CONTROL CABLE

- A. Electronic and Fiber-Optic Cable for Control Wiring: As specified in Division 26 Section "Control/Signal Transmission Media."

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices and wiring and pneumatic piping are installed before proceeding with installation.

3.2 INSTALLATION

- A. Install equipment level and plumb.
- B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- C. Connect and configure equipment and software to achieve sequence of operation specified.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate all 60 inches (1524 mm) above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:
 1. Entrances.
 2. Public areas.
 3. Where indicated.
- F. Install automatic dampers according to Division 23 Section "Duct Accessories."
- G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

- H. Install labels and nameplates to identify control components according to Division 20 Section "Identification For Piping and Equipment."
- I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- J. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- K. Install electronic and fiber-optic cables according to Division 26 Section "Control/Signal Transmission Media."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes."
- B. Install building wire and cable according to Division 26 Section "Conductors and Cables."
- C. Install signal and communication cable according to Division 26 Section "Control/Signal Transmission Media."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 4. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 5. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Install piping adjacent to machine to allow service and maintenance.
- B. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
 - 3. Calibration test electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Engage a factory-authorized service representative to perform startup service.
- C. Replace damaged or malfunctioning controls and equipment.
 - 1. Start, test, and adjust control systems.
 - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
 - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.
- D. Verify DDC as follows:
 - 1. Verify software including automatic restart, control sequences, scheduling, reset controls, and occupied/unoccupied cycles.
 - 2. Verify operation of operator workstation.
 - 3. Verify local control units including self-diagnostics.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain control systems and components.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 - 2. Provide operator training on data display, alarm and status descriptors, requesting data, executing commands, calibrating and adjusting devices, resetting default values, and requesting logs.
 - 3. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - 4. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 5. Schedule training with Owner, through Architect, with at least seven days' advance notice.

3.7 ON-SITE ASSISTANCE

- A. Occupancy Adjustments: Within one year of date of Substantial Completion, provide up to three Project site visits, when requested by Owner, to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions.

END OF SECTION 23 0923.10

SECTION 23 0923.30 - VARIABLE FREQUENCY CONTROLLERS

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. Section includes separately enclosed, pre-assembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. CE: Conformance Europeene (European Compliance).
- C. CPT: Control power transformer.
- D. EMI: Electromagnetic interference.
- E. IGBT: Insulated-gate bipolar transistor.
- F. LAN: Local area network.
- G. LED: Light-emitting diode.
- H. MCP: Motor-circuit protector.
- I. NC: Normally closed.
- J. NO: Normally open.
- K. OCPD: Overcurrent protective device.
- L. PCC: Point of common coupling.
- M. PID: Control action, proportional plus integral plus derivative.
- N. PWM: Pulse-width modulated.
- O. RFI: Radio-frequency interference.
- P. TDD: Total demand (harmonic current) distortion.
- Q. THD(V): Total harmonic voltage demand.
- R. VFC: Variable-frequency motor controller.

1.4 REFERENCE STANDARDS

- A. IEC 60068-2-6 - Environmental Testing – Part 2-6: Tests – Test Fc: Vibration (Sinusoidal); 2007.
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. 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.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, and furnished specialties and accessories.
- B. Shop Drawings: For each VFC indicated. Include dimensioned plans, elevations, and sections; and conduit entry locations and sizes, mounting arrangements, and details, including required clearances and service space around equipment.
 - 1. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Each installed unit's type and details.
 - b. Factory-installed devices.
 - c. Enclosure types and details.
 - d. Nameplate legends.
 - e. Short-circuit current (withstand) rating of enclosed unit.
 - f. Features, characteristics, ratings, and factory settings of each VFC and installed devices.
 - g. Specified modifications.
 - 2. Schematic and Connection Wiring Diagrams: For power, signal, and control wiring.
- C. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and MCP trip settings.
 - 2. Manufacturer's written instructions for setting field-adjustable overload relays.
 - 3. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - 4. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
- D. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.

- E. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.7 COORDINATION

- A. Coordinate features of motors, load characteristics, installed units, and accessory devices to be compatible with the following:
 - 1. Torque, speed, and horsepower requirements of the load.
 - 2. Ratings and characteristics of supply circuit and required control sequence.
 - 3. Ambient and environmental conditions of installation location.
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace VFCs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB.
 - 2. Danfoss Inc.; Danfoss Drives Div.
- B. General Requirements for VFCs: Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- C. VFC Description: Variable-frequency power converter (rectifier, dc bus, and IGBT, PWM inverter) factory packaged in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."

2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.
- D. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- E. Output Rating: Three-phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- F. Unit Operating Requirements:
1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 4. Minimum Efficiency: 96 percent at 60 Hz, full load.
 5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or speed condition.
 6. Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
 7. Ambient Temperature Rating: Not less than 14 deg F and not exceeding 104 deg F.
 8. Ambient Storage Temperature Rating: Not less than minus 4 deg F and not exceeding 140 deg F
 9. Humidity Rating: Less than 95 percent (noncondensing).
 10. Altitude Rating: Not exceeding 3300 feet (100584 cm).
 11. Vibration Withstand: Comply with IEC 60068-2-6.
 12. Overload Capability: 1.1 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 13. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 Hz.
 14. Speed Regulation: Plus or minus 5 percent.
 15. Output Carrier Frequency: Selectable; 0.5 to 15 kHz.
 16. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- G. Inverter Logic: Microprocessor based, 16 bit, isolated from all power circuits.
- H. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
1. Signal: Electrical.
- I. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 0.1 to 999.9 seconds.
 4. Deceleration: 0.1 to 999.9 seconds.
 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- J. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors to provide three-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.

3. Under- and overvoltage trips.
 4. Inverter overcurrent trips.
 5. VFC and Motor Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor overload alarm and trip; settings selectable via the keypad; NRTL approved.
 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 8. Loss-of-phase protection.
 9. Reverse-phase protection.
 10. Short-circuit protection.
 11. Motor overtemperature fault.
- K. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- L. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- O. Integral Input Disconnecting Means and OCPD: NEMA AB 1, instantaneous-trip circuit breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of VFC input current rating.
 2. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 3. Auxiliary Contacts: NO/NC, arranged to activate before switch blades open.
 4. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 5. NC and NO alarm contact that operates only when circuit breaker has tripped.

2.2 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.

1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:
 - a. A minimum of two programmable analog inputs: 0- to 10-V dc and 4- to 20-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BAS or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of three programmable analog output signal(s) (4- to 20-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:

- a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
 - 1. Number of Loops: Two.

2.3 LINE CONDITIONING

- A. Input Line Conditioning: Minimum 3% Impedance, provided as an integral part of the VFD.

2.4 OPTIONAL FEATURES

- A. Damper control circuit with end of travel feedback capability.
- B. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.
- C. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- D. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.5 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.

2.6 ACCESSORIES

- A. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- B. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.

2.7 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to its specified motor.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Wall-Mounting Controllers: Install VFCs on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2006.6 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.
- E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.

- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.4 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Division 26 Section "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
 - 2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
 - 3. Test continuity of each circuit.
 - 4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Owner before starting the motor(s).
 - 5. Test each motor for proper phase rotation.
 - 6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 8. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. VFCs will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to six times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required).
- D. Set field-adjustable pressure switches.

3.8 PROTECTION

- A. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, reprogram, and maintain VFCs.

END OF SECTION 23 0923.30

SECTION 23 0993 - SEQUENCE OF OPERATION

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 control sequences for HVAC systems, subsystems, and equipment.
- B. The control system shall consist of all controls required to provide the sequence of operations as specified. All hardware and software shall be provided by the temperature control contractor to operate equipment as described below.
- C. Related Sections include the following:
 - 1. Division 23 0923 "Direct Digital Control (DDC) System for HVAC" for control equipment and devices and submittal requirements.
- D. All setpoints mentioned are to be adjustable at the BAS.
- E. Every damper, valve, and VFD shall have its own output point controllable individually by the BAS.
- F. BAS contractor to coordinate all dampers and valve locations with mechanical contractor.

1.3 DEFINITIONS

- A. BAS: Building Automation System
- B. CFM: Cubic Feet per Minute.
- C. CHW: Chilled Water
- D. CHWS/CHWR: CHW Supply/ CHW Return
- E. DAT: Discharge Air Temperature
- F. DDC: Direct Digital Controls.
- G. DP: Differential Pressure
- H. EA: Exhaust Air
- I. EF: Exhaust Fan
- J. ERU: Energy Recover Unit.

- K. HW: Hot Water
- L. MOD: Motor Operated Damper.
- M. OA: Outside Air.
- N. OAD: Outside Air Damper
- O. OAT: Outside Air Temperature.
- P. RA: Return Air
- Q. SA: Supply Air
- R. VAV: Variable Air Volume.
- S. VFD: Variable Frequency Drive.

PART 2 SEQUENCE OF OPERATION

2.1 BOILERS SYSTEM & HW PUMP CONTROL

- A. Boiler Control: Boilers (B-1 & B-2) shall be enabled by the Temperature Control Contractor. The Outdoor Air Sensor, Building Supply Water Temperature Sensor and Boiler interconnecting wiring shall be completed by the Temperature Control Contractor. The BAS shall monitor the Alarm contact from each boiler and display at the Operators Workstation.
- B. The standalone microprocessor-based boiler control panel shall monitor & control firing rates in the boiler along with the boiler pump enable and boiler pump speed. Boiler controller shall automatically rotate lead/ lag boilers on a weekly basis.
- C. Boiler Pump (BP-1 & BP-2) Control: Control Contractor to wire start/ stop and 0-10 v command from each Boiler Controller to the Boiler Pump VFD or ECM Motor. Minimum pump speed shall be minimum boiler flow as determined with balancing contractor. Boiler and boiler pump should come as a complete system controlled by the boiler system, if not, contractor to plot 0-10v firing rate output plotted at 5 points with balancing contractor 0, 25, 50, 75 & 100% along with the required pump speed to equal 0, 25, 50, 75 & 100% flowrate of pumps.
- D. Temperature Reset: At an outside temperature of 0°F – 40°F, the Boiler supply temperature shall be reset from 160°F – 140°F (adj.).
- E. The status of the boiler system emergency shutdown mushroom switch shall be monitored by the BAS. Once the shutdown switch has been reset, the alarm shall require acknowledgement at the BAS workstation before the BAS controller enables the boiler factory control panel.
- F. Building Pump (P-1 & P-2) Control:
 - 1. Each of the hot water system building pumps shall be controlled by a variable frequency drive (VFD). The BAS shall modulate the speed of the VFD to maintain the water loop differential pressure setpoint as determined during balancing. The minimum flow at any given time shall be that of the pump minimum.

2. The BAS shall monitor and display the loop water system pressure located on the suction side of system pumps. An alarm will be generated when the system pressure falls below 8 psig (adj.).
3. The BAS shall automatically alternate the two pumps once per week as the lead pump. If the lead pump fails for 15 seconds or more, the lag pump shall start, and an alarm sent to the Operator workstation.
4. Alarm Monitoring: The BAS system shall monitor the following: HW Pump status and speed, hot water supply temperature, hot water return temperature, loop pressure differential setpoint, loop differential pressures, and boiler pump status. An alarm shall be displayed at the operator's workstation if supply water temp drops below 90°F (adj.), any boiler alarms, and any pump failures.

2.2 SINGLE-ZONE, SINGLE-DUCT, VARIABLE-VOLUME, OUTDOOR AIR-HANDLING UNIT CONTROL SEQUENCES (RTU-1 THRU RTU-5)

- A. System: Single Zone, Single Duct, VAV's with RHC's, Outdoor Air Handling Unit with Powered Relief, Modulating DX Cooling, and Hydronic Hot Water Heat.
- B. Rooftop Unit shall run continuously.
 1. When the VAV air system is in the cooling mode, the building automation system (BAS) shall continuously monitor the temperature in all the zones (excluding any zones that are in the UNOCCUPIED mode) and reset the discharge air temperature (DAT) setpoint, at a frequency of 10 minutes (adj.), as follows:
 - a. When the temperature in any zone is below the Occupied Heating setpoint - 2°F (adj.), the DAT setpoint shall be reset upward in increments of 1°F (adj.) until the temperature in every zone is above the Occupied Heating setpoint + 2°F (adj.), or until the DAT setpoint reaches the Maximum DAT Limit of 65°F (adj.).
 - b. When the temperature in every zone is above the Occupied Cooling setpoint + 2°F (adj.), the DAT setpoint shall be reset downward in increments of 1°F (adj.) until the temperature in any zone is below the Occupied Heating setpoint (adj.), or until the DAT setpoint reaches the Minimum DAT Limit of 55°F (adj.).
 - c. If the outdoor dry-bulb temperature is warmer than 70°F (adj.), the DAT Reset sequence shall be suspended and the DAT setpoint shall return to 55°F (adj.).
 2. The BAS shall have the capability to allow the operator to exclude "problem" or "rogue" zones that should not be considered when performing this sequence.
 3. If the outdoor dew point is greater than 60°F (adj.), the DAT Reset sequence shall be suspended and the DAT setpoint shall return to 55°F (adj.) until the outdoor dew point is lower than 57°F (adj.).
 4. If the relative humidity is higher than 60% (adj.) for 15 minutes (adj.), the DAT Reset sequence shall be suspended and the DAT setpoint shall return to 55°F (adj.) until all relative humidity zones are lower than 55% (adj.).
- C. If the outdoor air temperature is above 58°F (adj.) the economizer mode shall be disabled, and dampers shall be at minimum. If the outdoor air temperature is below 55°F (adj.) the economizer dampers shall modulate in sequence to act as first stage of cooling. If the economizer cannot maintain setpoint for 2 minutes the DX cooling control will be enabled to operate.
 1. DX cooling control will modulate to maintain setpoint (only after the economizer fails to maintain setpoint).

- D. Freeze Protection: Duct-mounted temperature sensor, located on the AHU discharge duct, signals alarm, closes outside-air dampers when temperature falls below 40°F.
- E. Supply Fan Control: BAS controls fan VFD(s) based on programmed schedule and temperature set point. The DDC system shall control the VAV AHU supply fan speed in response to a critical zone reset algorithm, with duct static monitoring.
 - 1. Signal alarm if fan fails to start as commanded.
 - 2. Static-pressure controller located in fan discharge stops fan and signals alarm when static pressure rises above excessive-static-pressure set point.
- F. Static Pressure Optimization of Discharge Air Temperature and Static Pressure Setpoints.
 - 1. The DDC shall monitor the damper position of all VAV terminal units and determine each VAV AHU's critical zone VAV terminal (CZ), which is the VAV terminal unit that is the widest open.
 - a. When the CZ is less than 95% open, the supply fan discharge static pressure setpoint shall be reset downward by 5% of the previous setpoint at a frequency of 10 minutes until the CZ is more than 95% open or the static pressure setpoint has reset downward to the system minimum setting (or Frequency Inverter) are at their minimum setting.
 - b. When the CZ is more than 98% open, the supply fan discharge static pressure setpoint shall be reset upward by 5% of the previous setpoint at a frequency of 5 minutes until the CZ is less than 97% open or the static pressure setpoint has reset upward to the system maximum setting (or Frequency Inverter) are at their maximum setting.
 - c. The control bands, setpoint increment values, setpoint decrement values and adjustment frequencies shall be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.
- G. Powered Relief Control: RTU controls fan based on programmed schedule and temperature set point. Fan shall be energized during the economizer operation and modulate to maintain a space differential pressure to outside.
- H. Ventilation Airflow:
 - 1. RTU-1: Scheduled Outside air shall be delivered via ERU-1. Addition ISO room makeup air shall be brought in through the RTU outside air damper. CFM shall be determined during balancing based on the total exhaust airflow from air valves: AV-1, AV-4, AV-5 & AV-6.
 - 2. RTU-2: Minimum outside air shall be delivered via ERU-1
 - 3. RTU-3: Minimum outside air shall be delivered via ERU-2
 - 4. RTU-4: Scheduled Outside air shall be delivered via ERU-2. Addition ISO room makeup air shall be brought in through the RTU outside air damper. CFM shall be determined during balancing based on the total exhaust airflow from air valve AV-3.
 - 5. RTU-5: Minimum outside air shall be delivered via ERU-3
- I. Mixed-Air Control: When fan is running, system modulates outside-air, return-air, and powered relief-air to maintain supply-air temperature. Outside airflow shall be set during balancing. Relief air shall be controlled to a differential pressure determined during air balancing. The return air dampers, outside air damper, and relief damper shall be closed when the system is off.

J. Virtual Operator Station Display: Indicate the following on operator workstation display terminal:

1. Full System Real Time Graphics.
2. System on-off indication
3. Supply Fan on-off indication.
4. Relief Fan on-off indication.
5. Outside-air-temperature indication.
6. Space relative humidity indication.
7. Relative humidity setpoint.
8. DX Cooling Coil air-temperature indication
9. DX Cooling Coil air-temperature set point
10. DX Cooling Coil modulation percentage
11. Hydronic Heating Coil air-temperature indication
12. Hydronic Heating Coil air-temperature set point
13. Hydronic Heating Coil modulation percentage
14. Supply-fan-discharge air-temperature indication.
15. Supply-fan-discharge air-temperature set point.
16. Supply-fan-discharge static-pressure indication.
17. Supply-fan-discharge static-pressure set point.
18. Supply-fan speed (Hz).
19. Relief -fan speed (Hz).
20. Mixed air temperature indication.
21. Fresh air minimum ventilation damper position.
22. Outdoor air economizer damper position.
23. Building zone static pressure.
24. Outside Air damper position.

2.3 PACKAGED AIR HANDLING UNIT WITH HYDRONIC HOT WATER HEAT & MODULATING DX COOLING & POWERED RELIEF (RTU-6)

- A. System: Single Zone, Single Duct, VAV's & Air Valves with RHC's, Outdoor Air Handling Unit with Powered Relief, Modulating DX Cooling, and Hydronic Hot Water Heat.
- B. Rooftop Unit shall run continuously.
1. When the air system is in the cooling mode, the building automation system (BAS) shall continuously monitor the temperature in all the zones (excluding any zones that are in the UNOCCUPIED mode) and reset the discharge air temperature (DAT) setpoint, at a frequency of 10 minutes (adj.), as follows:
 - a. When the temperature in any zone is below the Occupied Heating setpoint - 2°F (adj.), the DAT setpoint shall be reset upward in increments of 1°F (adj.) until the temperature in every zone is above the Occupied Heating setpoint + 2°F (adj.), or until the DAT setpoint reaches the Maximum DAT Limit of 65°F (adj.).
 - b. When the temperature in every zone is above the Occupied Cooling setpoint + 2°F (adj.), the DAT setpoint shall be reset downward in increments of 1°F (adj.) until the temperature in any zone is below the Occupied Heating setpoint (adj.), or until the DAT setpoint reaches the Minimum DAT Limit of 55°F (adj.).
 - c. If the outdoor dry-bulb temperature is warmer than 70°F (adj.), the DAT Reset sequence shall be suspended and the DAT setpoint shall return to 55°F (adj.).

2. The BAS shall have the capability to allow the operator to exclude “problem” or “rogue” zones that should not be considered when performing this sequence.
 3. If the outdoor dew point is greater than 60°F (adj.), the DAT Reset sequence shall be suspended and the DAT setpoint shall return to 55°F (adj.) until the outdoor dew point is lower than 57°F (adj.).
 4. If the relative humidity is higher than 60% (adj.) for 15 minutes (adj.), the DAT Reset sequence shall be suspended and the DAT setpoint shall return to 55°F (adj.) until all relative humidity zones are lower than 55% (adj.).
- C. If the outdoor air temperature is above 58°F (adj.) the economizer mode shall be disabled, and dampers shall be at minimum. If the outdoor air temperature is below 55°F (adj.) the economizer dampers shall modulate in sequence to act as first stage of cooling. If the economizer cannot maintain setpoint for 2 minutes the DX cooling control will be enabled to operate.
1. DX cooling control will modulate to maintain setpoint (only after the economizer fails to maintain setpoint).
- D. Freeze Protection: Duct-mounted temperature sensor, located on the AHU discharge duct, signals alarm, closes outside-air dampers when temperature falls below 40°F.
- E. Supply Fan Control: BAS controls fan VFD(s) based on programmed schedule and temperature set point. The DDC system shall control the VAV AHU supply fan speed in response to a critical zone reset algorithm, with duct static monitoring.
1. Signal alarm if fan fails to start as commanded.
 2. Static-pressure controller located in fan discharge stops fan and signals alarm when static pressure rises above excessive-static-pressure set point.
- F. Powered Relief Control: RTU controls fan based on programmed schedule and temperature set point. Fan shall be energized during the economizer operation and modulate to maintain a space differential pressure to outside.
- G. Ventilation Airflow:
1. RTU-5: Minimum outside air shall be delivered via ERU-3
- H. Mixed-Air Control: When fan is running, system modulates outside-air, return-air, and powered relief-air to maintain supply-air temperature. Outside airflow shall be set during balancing. Relief air shall be controlled to a differential pressure determined during air balancing. The return air dampers, outside air damper, and relief damper shall be closed when the system is off.
- I. Virtual Operator Station Display: Indicate the following on operator workstation display terminal:
1. Full System Real Time Graphics.
 2. System on-off indication
 3. Supply Fan on-off indication.
 4. Relief Fan on-off indication.
 5. Outside-air-temperature indication.
 6. Space relative humidity indication.
 7. Relative humidity setpoint.
 8. DX Cooling Coil air-temperature indication

9. DX Cooling Coil air-temperature set point
 10. DX Cooling Coil modulation percentage
 11. Hydronic Heating Coil air-temperature indication
 12. Hydronic Heating Coil air-temperature set point
 13. Hydronic Heating Coil modulation percentage
 14. Supply-fan-discharge air-temperature indication.
 15. Supply-fan-discharge air-temperature set point.
 16. Supply-fan-discharge static-pressure indication.
 17. Supply-fan-discharge static-pressure set point.
 18. Supply-fan speed (Hz).
 19. Relief -fan speed (Hz).
 20. Mixed air temperature indication.
 21. Fresh air minimum ventilation damper position.
 22. Outdoor air economizer damper position.
 23. Building zone static pressure.
 24. Outside Air damper position.
- J. VARIABLE AIR VOLUME BOX WITH HOT WATER REHEAT & RETURN AIR VAV (VAV-6-1, & VAV-6-2)
1. VAV box is constant volume air flow with hot water reheat coil. VAV box shall maintain its set airflow and modulate the hot water control valve to maintain the space temperature setpoint.
 2. The return VAV shall be set to maintain constant CFM matching the supply airflow.
- K. AIR VALVE (AV-7 & AV-9) WITH HYDRONIC HOT WATER REHEAT COIL (RHC-1 & RHC-2), EXHAUST AIR VALVE (AV-8 & AV-10)
1. Provide each space with critical space controller as required to monitor and control Air Valves (AV) to the sequence below.
 2. Supply air valve is constant volume air flow with hot water reheat coil. Air valve shall maintain its set airflow and modulate the hot water control valve to the reheat coil (RHC) to maintain the space temperature setpoint.
 3. The exhaust air valve shall be set to maintain the space at a negative pressure setpoint of at least 0.02 inches WC.
 4. Room pressure monitoring: provide room pressure monitor with audio and visual display outside of each room (see plans for locations). Monitor shall have ability to silence rogue alarms from doors being held open into room.
 5. BAS shall log and monitor the following information for the laminar flow room and ante room (2 year storage with ability to export data):
 - a. Air Changes per hour (ACH)
 - b. Room pressure
 - c. Room temperature
 - d. Humidity
 6. Fan Filter Units (FFU) fan shall operate continuously. BAS shall monitor and display the following:
 - a. Motor RPM & Status
 - b. CFM output
 - c. Motor Hours
 - d. Filter Status & Pressure drop

e. Filter Hours

2.4 SINGLE-ZONE, SINGLE-DUCT, OUTDOOR AIR-HANDLING UNIT CONTROL SEQUENCES (RTU-7)

- A. System: Single Zone, Single Duct, Outdoor Air Handling Unit with Powered Relief, Modulating DX Cooling, and Hydronic Hot Water Heat.
- B. Rooftop Unit shall run continuously.
 - 1. Unit shall be controlled by space thermostat or BAS. Unit shall modulate heating or cooling to maintain space temperature setpoint.
- C. If the outdoor air temperature is above 58°F (adj.) the economizer mode shall be disabled, and dampers shall be at minimum. If the outdoor air temperature is below 55°F (adj.) the economizer dampers shall modulate in sequence to act as first stage of cooling. If the economizer cannot maintain setpoint for 2 minutes the DX cooling control will be enabled to operate.
 - 1. DX cooling control will modulate to maintain setpoint (only after the economizer fails to maintain setpoint).
- D. Freeze Protection: Duct-mounted temperature sensor, located on the AHU discharge duct, signals alarm, closes outside-air dampers when temperature falls below 40°F.
- E. Supply Fan Control: BAS controls fan VFD(s) based on programmed schedule and temperature set point.
 - 1. Signal alarm if fan fails to start as commanded.
 - 2. Static-pressure controller located in fan discharge stops fan and signals alarm when static pressure rises above excessive-static-pressure set point.
- F. Powered Relief Control: RTU controls fan based on programmed schedule and temperature set point. Fan shall be energized during the economizer operation and modulate to maintain a space differential pressure to outside.
- G. Ventilation Airflow:
 - 1. RTU-7: Minimum outside air shall be delivered via ERU-3
- H. Mixed-Air Control: When fan is running, system modulates outside-air, return-air, and powered relief-air to maintain supply-air temperature. Outside airflow shall be set during balancing. Relief air shall be controlled to a differential pressure determined during air balancing. The return air dampers, outside air damper, and relief damper shall be closed when the system is off.
- I. Virtual Operator Station Display: Indicate the following on operator workstation display terminal:
 - 1. Full System Real Time Graphics.
 - 2. System on-off indication
 - 3. Supply Fan on-off indication.
 - 4. Relief Fan on-off indication.
 - 5. Outside-air-temperature indication.
 - 6. Space relative humidity indication.
 - 7. Relative humidity setpoint.

8. DX Cooling Coil air-temperature indication
9. DX Cooling Coil air-temperature set point
10. DX Cooling Coil modulation percentage
11. Hydronic Heating Coil air-temperature indication
12. Hydronic Heating Coil air-temperature set point
13. Hydronic Heating Coil modulation percentage
14. Supply-fan-discharge air-temperature indication.
15. Supply-fan-discharge air-temperature set point.
16. Supply-fan-discharge static-pressure indication.
17. Supply-fan-discharge static-pressure set point.
18. Supply-fan speed (Hz).
19. Relief -fan speed (Hz).
20. Mixed air temperature indication.
21. Outdoor air economizer damper position.
22. Building zone static pressure.
23. Outside Air damper position.

2.5 VARIABLE AIR VOLUME TERMINAL UNIT - DDC CONTROL

- A. General. DDC Controls, actuator, and costs to mount, calibrate and test the system shall be the responsibility of Section 23 0923 ATC/Building Management System Contractor.
- B. Multi-point, multi-axis flow ring or cross sensor to be furnished and mounted by terminal unit manufacturer. Single point or flow bar sensors are not acceptable. Shall be capable of maintaining airflow to within +/- 5 percent of rated unit airflow setpoint with 1.5 duct diameters straight duct upstream from the unit.

2.6 VAV TERMINAL UNITS - DDC CONTROL SEQUENCE OF OPERATION

- A. VAV terminals with hot water reheat
 1. On a rise in temperature above the cooling setpoint, the VAV terminal unit shall modulate to its maximum CFM. As the space temperature drops below the cooling setpoint, the terminal unit shall modulate to its minimum CFM. As the space temperature continues to fall to the heating setpoint, the terminal shall modulate to its heating minimum CFM. At this point, the 2-way hot water reheat control valve shall begin to modulate open to maintain space temperature.
 2. Unoccupied Mode: The terminal unit shall modulate to minimum CFM, if the space temperature drops below the unoccupied heating setpoint, the 2-way hot water reheat control valve shall begin to modulate open to satisfy the setpoint. On a rise in space temperature above the unoccupied cooling setpoint, the VAV terminal unit shall modulate open to satisfy space temperature.
 3. Override Button - The VAV box shall be capable of being placed in the "occupied" mode by pressing an override button mounted on the zone temperature sensor.

2.7 FIRE ALARM SHUT DOWN RELAY

- A. Provide a Fire Alarm Shut down relay for interconnection to the building fire alarm system for each RTU, MAU and EF. If signal from the fire alarm is given to the BAS, BAS shall shutdown each RTU/MAU/EF in a safe shut down sequence.

2.8 UNIT HEATERS

- A. Unit Heaters & Cabinet Unit Heaters
 - 1. DDC controller shall modulate 2-way or 3-way control valve (see plan) open and start fan on a call for heat. The space setpoint shall be adjustable from either the room thermostat or the BAS.
 - 2. Rooms with split AC units and unit heaters: unit heater space setpoint shall be set to 4 deg (adj) below AC unit heating setpoint.

2.9 GLYCOL MAKEUP UNITS

- 1. The Glycol Makeup Unit shall be controlled by the controller supplied with the unit. Audible alarm shall sound when tank levels reach low level limit.

2.10 HOT WATER LOW PRESSURE

- A. The BAS shall monitor and display the loop water system pressure located on the suction side of system pumps. An alarm will be generated when the system pressure falls below 8 psig (adj.).

2.11 ISOLATION ROOM PRESSURE CONTROL

- A. BAS shall integrate into air pressure controllers/monitors & monitor pressure between the Ante room & corridor as well as the Ante room & Isolation room. The exhaust air valves shall modulate to maintain a minimum negative pressure differential of -0.01" of water (adj.) to adjacent spaces.
- B. Supply air VAV shall maintain a fixed supply air CFM as scheduled.
- C. BAS shall monitor and log ante room & isolation room pressure data.
- D. Visual displays shall be provided at entrance to ante room & isolation room for control & monitoring of pressure relationships described above & shall provide a local visual means of indicating current pressure & if requirement is being maintained.
- E. Implement 30 second (adj) delays on alarms at BAS to mitigate nuisance alarms due to open doors.

2.12 EXHAUST FANS:

- A. EF-1: Exhaust shall run continuously. BAS shall monitor fan status and send an alarm to the operator workstation if there is a fan failure.
- B. EF-2: Shall operate when dryer is in operation. No connection to the BAS
- C. EF-3: Exhaust shall run continuously. BAS shall monitor fan status and send an alarm to the operator workstation if there is a fan failure.

- D. KEF-1: Fan shall be interlocked with kitchen hood and MAU-1. Fan status shall be monitored by the BAS and alarm if fan fails to start.
 - E. KEF-2: Fan shall be controlled by wall switch at the dishwasher. Fan status shall be monitored by the BAS and alarm if fan fails to start
- 2.13 KITCHEN HOOD (KH-1), MAKEUP AIR UNIT (MAU-1), AND EXHAUST FAN (KEF-1):
- A. Interlock kitchen hood KH-1 controls with KEF-1 and MAU-1. MAU-1 controller to modulate burner to maintain a discharge air temperature of 65°F (adj.). Discharge temperature to be adjustable from room.
- 2.14 ENERGY RECOVERY UNITS (ERU-1, ERU-2, & ERU-3)
- A. ERU shall operate continuously.
 - 1. When associated RTUs are economizing greater than 50% outside air, SA fan on ERU shall be shut off and associated motorized damper shall be closed. EA fan shall continue to operate continuously.
 - B. Virtual Operator Station Display: Indicate the following on operator workstation display terminal:
 - 1. Full System Real Time Graphics.
 - 2. System on-off indication
 - 3. Supply Fan on-off indication.
 - 4. Exhaust Fan on-off indication.
 - 5. Outside-air-temperature indication.
 - 6. ERU System on-off indication
 - 7. ERU Outside air temperature indication leaving energy recovery core.
 - 8. ERU Exhaust air temperature indication entering energy recovery core.
- 2.15 SPLIT SYSTEM AC
- A. AC-1, AC-2, AC-3A, AC-3B, AC-4, AC-6 & AC-7
 - 1. All controls are self-contained, BAS to monitor room space temperature and alarm if space temperature rises above 85 Deg F (ADJ). On a call for cooling or heating the unit shall turn on and run until space temperature setpoint is met then shut off.
 - 2. Units with additional unit heaters within the space: see Unit Heater sequence of operation.
 - B. AC-5 & RHC-3
 - 1. All controls are self-contained, BAS to monitor room space temperature and alarm if space temperature rises above 85 Deg F (ADJ). On a call for cooling or heating the unit shall turn on and run until space temperature setpoint is met then shut off. Unit shall automatically control supplementary heating coil (RHC-3) when unit is locked out on low temperature. SA fan shall operate even unit is locked out on low temperature.
- 2.16 SMOKE DAMPER ALARM SHUT DOWN RELAY
- A. If any smoke damper or fire/smoke damper end-switch over 2.5ft² doesn't prove open, shut down the associated AHU in a safe shutdown sequence.

- B. Show smoke damper & fire/smoke damper status on separate background graphic at operator's workstation.

2.17 DOMESTIC WATER HEAT EXCHANGER (DHX-1 & DHX-2) & PUMP (RCP-2 & RCP-3)

- A. Domestic hot water storage tank temperature shall be monitored through tank mounted sensors and shall sequence the operation of the heat exchangers and corresponding circulating pump in order to maintain tank temperature.
- B. Domestic hot water tank temperature shall be set at 135 deg F (Adj.).
- C. When storage tank temperature drops below 133 deg F (Adj.), the lead heat exchanger pump shall be started to circulate domestic water through the heat exchanger. The hot water heating control valve shall modulate to maintain a heat exchanger discharge temperature of 137 deg F (Adj.). The circulating pump shall be cycled off when the storage tank temperature reaches 137 deg F (Adj.)
- D. When the storage tank temperature drops below 130 deg F (Adj.), the lag heat exchanger pump shall be started to circulate domestic water through the heat exchanger. The hot water heating control valve shall modulate to maintain a heat exchanger discharge temperature of 137 deg F (Adj.). Both heat exchangers shall remain on until the storage tank temperature reaches 137 deg F (Adj.).
- E. The lag heat exchanger shall be cycled to the lead heat exchanger on one week intervals.
- F. Alarm Monitoring: The BAS system will monitor the following: Pump status, Storage tank temperature, Tank Outlet water temperature, and Domestic water heat exchanger inlet and outlet temperatures. An alarm shall be displayed at the operators work station if the tank temperature falls below 130 Deg. F (Adj.).
- G. BAS shall monitor and show the following:
 - 1. Domestic water entering and leaving water temperatures
 - 2. Hydronic heating water entering and leaving water temperatures

2.18 DOMESTIC WATER

- A. BAS shall monitor and show the following:
 - 1. Mixing Valve (MV-1) discharge water temperature
 - 2. Domestic Water Storage Tank (DST-1) temperature

2.19 DOMESTIC WATER RECIRC PUMP (RCP-1)

- A. RCP-1 SHALL RUN CONTINUOUSLY 24/7

2.20 ELECTRICAL PHASE MONITORING

- A. BAS shall monitor electrical phase meter (meter provided and installed by Div 26) and if a loss of phase is determined the BAS shall shutdown all 3-phase equipment in a safe manner and restart. Phase meter will have BACNET connection.

- B. Phasing Monitoring Points List:
 - 1. Loss of Phase A Normal Power
 - 2. Loss of Phase B Normal Power
 - 3. Loss of Phase C Normal Power
 - 4. Generator Loss of Phase A
 - 5. Generator Loss of Phase B
 - 6. Generator Loss of Phase C

2.21 ELECTRICAL GENERATOR MONITORING

- A. BAS shall monitor each generator start, stop and display any fault alarms.
- B. Generator Monitoring Points List:
 - 1. Generator Running
 - 2. Generator Fault
 - 3. Generator Offline

END OF SECTION 23 0993

SECTION 23 1123 - FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.2 RELATED REQUIREMENTS

- A. Section 09 9113 - Exterior Painting.
- B. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.
- C. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- D. Section 23 0553 - Identification for HVAC Piping and Equipment.

1.3 REFERENCE STANDARDS

- A. ANSI Z21.18/CSA 6.3 - Gas Appliance Pressure Regulators; 2019.
- B. ANSI Z21.80/CSA 6.22 - Line Pressure Regulators; 2019.
- C. ANSI Z223.1 - National Fuel Gas Code; 2024.
- 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. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- F. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- G. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- H. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.
- I. ASME B31.1 - Power Piping; 2022.
- J. ASME B31.9 - Building Services Piping; 2020.
- K. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- L. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- M. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.

- N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- P. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.
- Q. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.
- R. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- S. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- T. MSS SP-78 - Gray Iron Plug Valves, Flanged and Threaded Ends; 2011.
- U. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010, with Errata .

1.4 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.
- C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.
- D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.
- E. Project Record Documents: Record actual locations of valves.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with applicable codes.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Welder Qualifications: Certified in accordance with ASME BPVC-IX.
- D. Identify pipe with marking including size, ASTM material classification, and ASTM specification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. 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

2.1 NATURAL GAS PIPING, BURIED

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type F, 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.
- B. Copper Tubing: Listed, ASTM B88 (ASTM B88M), Type L (B), annealed.
 - 1. Fittings: ASME B16.18 cast copper or ASME B16.22 wrought copper.
 - 2. Joints: Compression connection or AWS A5.8M/A5.8, BCuP silver braze.
- C. Polyethylene Pipe: ASTM D2513, SDR 11
 - 1. Fittings: ASTM D2683 or ASTM D2513 socket type.
 - 2. Joints: Fusion welded.

2.2 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Grade B, Type E, 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. Copper Tube: ASTM B88 (ASTM B88M), Type L (B) annealed.
 - 1. Fittings: Flared: ASME B16.26, cast bronze, Copper: ASME B16.22, wrought copper

2.3 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:
 - 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 - 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- 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. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

2.4 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.

6. 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 polypropylene.
 - 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.

2.5 BALL VALVES

- A. Manufacturers:
 1. BrassCraft Manufacturing Co.; a Masco Company
 2. Conbraco Industries, Inc.
 3. Lyall, R W & Company, Inc
- B. Construction, 4 Inches (100 mm) and Smaller: MSS SP-110, Class 150, 600 psi (4137 kPa) CWP, brass or bronze body, 304 stainless steel or chrome plated brass ball, regular port, Teflon seats and stuffing box ring, blowout proof stem, lever handle, solder, threaded, or grooved ends with union.

2.6 PLUG VALVES

- A. Construction 2-1/2 Inches (65 mm) and Larger: MSS SP-78, 175 psi (1200 kPa) CWP, cast iron body and plug, pressure lubricated, Teflon or Buna N packing, flanged ends. Provide lever operator with set screw.

2.7 STRAINERS

- A. 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.
- B. 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.

2.8 LINE PRESSURE REGULATORS AND APPLIANCE REGULATORS INDICATORS

- A. Manufacturers:
 1. American Meter Company
 2. Fisher Control Valves & Instruments, an Emerson Process Management brand

3. Maxitrol Company
- 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. Maximum Inlet Operating Pressure: 10 psi (68.9 kPa).
 1. Appliance Regulator: 2 psi (13.8 kPa).
 2. Line Pressure Regulator: 10 psi (68.9 kPa).

2.9 PIPING SPECIALTIES

- A. Appliance flexible connectors:
 1. Indoor, fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
 4. Corrugated stainless-steel tubing with polymer coating.
- B. Operating-Pressure Rating: 0.5 psig.
 1. End Fittings: Zinc-coated steel.
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Maximum Length: 72 inches
- C. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 1. Copper-allow convenience outlet and matching plug connector
 2. Nitrile seals.
 3. Hand operated with automatic shutoff when disconnected.
 4. For indoor or outdoor applications.
 5. Adjustable, retractable restraining cable.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.
- E.
- F. Joint Compound and Tape: Suitable for natural gas.
- G. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.10 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 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 access where valves and fittings are not exposed.
- I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. 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.

- L. Install valves with stems upright or horizontal, not inverted.
- M. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
- N. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813.
- O. Sleeve pipes passing through partitions, walls and floors.
- P. 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. Provide copper plated hangers and supports for copper piping.
 - 7. 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 exterior piping systems and components is specified in Section 09 9113.
 - 8. Provide hangers adjacent to motor driven equipment with vibration isolation; refer to Section 23 0548.

3.4 APPLICATION

- A. Install unions downstream of valves and at equipment or apparatus connections.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- D. Install ball valves for throttling, bypass, or manual flow control services.

3.5 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
 - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
 - 2. Cut threads full and clean using sharp dies.
 - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
 - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
 - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
 2. Bevel plain ends of steel pipe.
 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Braze Joints: Construct joints according to AWS's "Braze Handbook," "Pipe and Tube" Chapter.
- F. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- G. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End Pipe and Fittings: Use butt fusion.
 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.6 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 23 0553 "Identification for HVAC Piping & Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.7 FIELD QUALITY CONTROL

- A. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.
- B. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.8 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).
 - e. Pipe Size: 8 inches (200 mm) to 12 inches (300 mm):
 - 1) Maximum Hanger Spacing: 14 ft (4.25 m).
 - 2) Hanger Rod Diameter: 7/8 inch (22 mm).
 - f. Pipe Size: 14 inches and Over (350 mm and Over):
 - 1) Maximum Hanger Spacing: 20 ft (6 m).
 - 2) Hanger Rod Diameter: 1 inch (25 mm).
- B. Outdoor Piping
 1. Aboveground natural-gas piping shall be one of the following:
 - a. Steel pipe with malleable-iron fittings and threaded joints for pipes smaller than 2-1/2".
 - b. Steel pipe with wrought-steel fittings and welded joints for pipes 2-1/2" and larger.
 2. Paint all exterior piping with two coats of exterior paint with color selected by Architect.
- C. Indoor Piping
 1. Aboveground, distribution piping shall be one of the following:
 - a. Steel pipe with malleable-iron fittings and threaded joints for pipes smaller than 2-1/2"..
 - b. Steel pipe with wrought-steel fittings and welded joints for pipes 2-1/2" and larger.
 2. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
 3. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.
- D. Aboveground Manual Gas Shutoff Valve
 1. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
 - a. Two-piece, full -port, bronze ball valves with bronze trim.
 - b. Bronze plug valve.
 2. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
 - a. Two-piece, full -port, bronze ball valves with bronze trim.
 - b. Bronze plug valve.
 3. Valves in branch piping for single appliance shall be one of the following:
 - a. Two-piece, full -port, bronze ball valves with bronze trim.
 - b. Bronze plug valve.

END OF SECTION 23 1123

SECTION 23 2113 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hydronic system requirements.
- B. Heating water piping, above grade.
- C. Pipe hangers and supports.
- D. Unions, flanges, mechanical couplings, and dielectric connections.

1.2 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels.
- B. Section 09 9123 - Interior Painting.
- C. Section 23 0516 - Expansion Fittings and Loops for HVAC Piping.
- D. Section 23 0719 - HVAC Piping Insulation.
- E. Section 23 2500 - HVAC Water Treatment: Pipe cleaning.

1.3 REFERENCE STANDARDS

- A. 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.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard; 2020.
- D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.
- E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2021.
- F. ASME B31.9 - Building Services Piping; 2020.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2024.
- H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

- I. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2023a.
- J. ASTM A536 - Standard Specification for Ductile Iron Castings; 2024.
- K. ASTM B32 - Standard Specification for Solder Metal; 2020.
- L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- M. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.
- N. ASTM D2774 - Standard Practice for Underground Installation of Thermoplastic Pressure Piping; 2021a.
- O. ASTM F1960 - Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-Linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing; 2023b.
- P. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 2024.
- Q. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).
- R. ASTM F2389 - Standard Specification for Pressure-Rated Polypropylene (PP) Piping Systems; 2023.
- S. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2019.
- T. AWS D10.12M/D10.12 - Guide for Welding Mild Steel Pipe; 2000.
- U. AWWA C606 - Grooved and Shouldered Joints; 2022.
- V. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.
- C. Product Data:
 - 1. Include data on pipe materials, pipe fittings, valves, and accessories.
 - 2. Provide manufacturers catalog information.
- D. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- E. Project Record Documents: Record actual locations of valves.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

- A. Provide all grooved joint couplings, fittings, valves, specialties, and grooving tools from a single manufacturer.
- B. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary protective coating on cast iron and steel valves.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. 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

2.1 HYDRONIC SYSTEM REQUIREMENTS

- A. Comply with ASME B31.9 and applicable federal, state, and local regulations.
- B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:
 - 1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
 - 2. Use non-conducting dielectric connections whenever jointing dissimilar metals.
 - 3. Grooved mechanical joints may be used in accessible locations only.
 - a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Architect.
 - b. Grooved mechanical connections and joints comply with AWWA C606.
 - 1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.
 - c. Use rigid joints unless otherwise indicated.
 - 4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.
- C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.
- D. Valves: Provide valves where indicated:
 - 1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch (20 mm) gate valves with cap; pipe to nearest floor drain.
 - 2. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.
 - 3. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.
- E. Welding Materials and Procedures: Comply with ASME BPVC-IX.

2.2 HEATING WATER PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:
 - 1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D10.12M/D10.12 welded.
 - 2. Threaded Joints: ASME B16.3, malleable iron fittings.
 - 3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
- B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:
 - 1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
 - a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
 - b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.
- C. Pressure-Rated Polypropylene Pipe: ASTM D2774 or ASTM F2389, PP-RCT resin pipe with fiber layer, SDR 11 or SDR 9.
 - 1. Fittings: ASTM F2389, butt, socket, or saddle-weld heat fusion. Transitions to comply with ASTM F1960 or ASME B16.5.
 - 2. Manufacturers:
 - a. Aquatherm
 - b. Aquatechnik
 - c. Niron
 - d. Uponor

2.3 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.
- B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.
- C. 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:
 - 1. Bases: High-density polypropylene.
 - 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 3. Steel Components: Stainless steel or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 - 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion-resistant material.
 - 5. Height: Provide minimum clearance of 6 inches (150 mm) under pipe to top of roofing.

2.4 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

- A. Unions for Pipe of 2 Inches (50 mm, DN) and Less:
- B. Flanges for Pipe 2 Inches (50 mm, DN) and Greater:
- C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.
 - 1. Dimensions and Testing: In accordance with AWWA C606.
 - 2. Mechanical Couplings: Comply with ASTM F1476.
 - 3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
 - 4. When pipe is field grooved, provide coupling manufacturer's grooving tools.
- D. Dielectric Connections:
 - 1. Unions:
 - a. 1/2 to 1 Inches (15 to 25 mm): Brass solder to galvanized FPT.
 - b. 1/2 to 2 Inches (15 to 50 mm): Brass solder to galvanized FPT.
 - c. 1/2 to 1 Inches (15 to 25 mm): Brass to galvanized FPT or FIP (Female Iron Pipe).
 - d. 3/4 to 1/2 Inch (20 to 15 mm) Reducer: Brass solder to galvanized FPT.
 - e. Service: 250 psi (1,723.6 kPa), minus 20 to 180 deg F (minus 28.9 to 82.2 deg F).

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment using jointing system specified.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- F. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. PP-RCT Pipe: Make heat fusion joint per manufacturers instructions.
- C. Route piping in orderly manner, parallel to building structure, and maintain gradient.
- D. Install piping to conserve building space and to avoid interference with use of space.
- E. Group piping whenever practical at common elevations.

- F. Sleeve pipe passing through partitions, walls, and floors.
- G. Slope piping and arrange to drain at low points.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 0516.
- I. Grooved Joints:
 - 1. Install in accordance with the manufacturer's latest published installation instructions.
 - 2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.
- J. Pipe Hangers and Supports:
 - 1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.
 - 2. Install hangers to provide minimum 1/2-inch (13 mm) space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches (300 mm) of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inches (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every other 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.
 - 8. Prime coat exposed steel hangers and supports. See Section 09 9123. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
 - 9. Install the following pipe attachments:
 - a. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - b. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - d. Spring hangers to support vertical runs.
 - e. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - f. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
 - 10. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 3/4: Maximum span, 7 feet.
 - b. NPS 1: Maximum span, 7 feet.
 - c. NPS 1-1/2: Maximum span, 9 feet.
 - d. NPS 2: Maximum span, 10 feet.
 - e. NPS 2-1/2: Maximum span, 11 feet.
 - f. NPS 3 and Larger: Maximum span, 12 feet.
 - 11. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

- a. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
- b. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
- c. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
- d. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- e. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
- f. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
- g. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- 12. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- 13. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. See Section 23 0719.
- L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 3100 .
- M. Use eccentric reducers to maintain top of pipe level.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welds.
- O. Prepare unfinished pipe, fittings, supports, and accessories, ready for finish painting. See Section 09 9123.
- P. Install valves with stems upright or horizontal, not inverted.

3.3 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 : Use dielectric flanges or nipples.

3.4 PIPING APPLICATIONS

- A. Hot Water and Chilled Water, NPS 1 and Smaller: Aboveground exposed in Mechanical room and at terminal heating and cooling devices only, use Type L (Type B) drawn-temper copper tubing with soldered joints, Schedule 40 steel pipe with threaded joints, or Polypropylene PP-R. All main hydronic heating and cooling piping shall be Schedule 40 steel pipe or Polypropylene PP-R.
- B. Hot Water and Chilled Water, NPS 1-1/4 to NPS 2: Aboveground exposed in Mechanical room and at terminal heating and cooling devices only, use Type L (Type B) drawn-temper copper tubing with soldered joints, Schedule 40 steel pipe with threaded joints, or Polypropylene PP-R. All main hydronic heating and cooling piping shall be Schedule 40 steel pipe or Polypropylene PP-R.

- C. Hot Water and Chilled Water, NPS 2-1/2 and Larger: Use schedule 40 steel pipe with welded and flanged joints, grooved mechanical-joint couplings, or Polypropylene PP-R.
- D. Condensate-Drain Piping: Type L (Type B) drawn-temper copper tubing with soldered joints.

3.5 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 200519 "Meters and Gages for Piping."

3.6 CHEMICAL TREATMENT

- A. See section 23 2513 "Water Treatment for Closed-Loop Hydronic Systems".

3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 7. Verify lubrication of motors and bearings.

END OF SECTION 23 2113

SECTION 23 2114 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion tanks.
- B. Air vents.
- C. Air separators.
- D. Strainers.
- E. Magnetic filters.
- F. Suction diffusers.
- G. Balancing valves.
- H. Flow meters.

1.2 REFERENCE STANDARDS

- A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2023.

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.
- C. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. 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

2.1 EXPANSION TANKS

- A. Manufacturers:
 - 1. Bell & Gossett, a brand of Xylem, Inc
 - 2. Taco, Inc
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi (80 kPa), and steel support stand , unless otherwise noted on the plans. .
- C. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

- A. Manual Air Vent: Short vertical sections of 2-inch (50 mm, DN) diameter pipe to form air chamber, with 1/8 inch (6 mm, DN) brass needle valve at top of chamber.
- B. Float Air Vent:
 - 1. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.
- C. Maximum Fluid Pressure: 150 psi (1,034 kPa).
- D. Maximum Fluid Temperature: 250 degrees F (121.1 degrees C).

2.3 AIR SEPARATORS

- A. In-line Air Separators:
 - 1. Manufacturers:
 - a. Armstrong International, Inc
 - b. Bell & Gossett, a brand of Xylem, Inc
 - c. Taco, Inc
 - 2. Cast iron for sizes 1-1/2 inch (40 mm, DN) and smaller, or steel for sizes 2 inch (50 mm, DN) and larger; tested and stamped in accordance with ASME BPVC-VIII-1; for 125 psi (860 kPa) operating pressure.
 - 3. Maximum Allowable Service Temperature: 450 degrees F (232.2 degrees C).
- B. Centrifugal Air Separators/Strainers:
 - 1. Manufacturers:
 - a. Armstrong International, Inc
 - b. Bell & Gossett, a brand of Xylem, Inc
 - c. Taco, Inc
 - 2. Primed steel body, tested and stamped in accordance with ASME BPVC-VIII-1 with integral bronze strainer, tangential flanged inlet and outlet connections, and internal stainless steel air collector tube.
 - 3. Maximum Service Flow and Pressure: 16 gpm (60.6 Lpm) at 125 psi (860 kPa).

2.4 STRAINERS

- A. Size 2 inch (50 mm, DN) and Under:
 - 1. Provide threaded or sweat brass or iron body for up to 175 psi (1,200 kPa) working pressure, Y-pattern strainer with 1/32 inch (0.8 mm) stainless steel perforated screen.
- B. Size 2-1/2 inch (65 mm, DN) to 4 inch (100 mm, DN):
 - 1. Provide flanged or grooved iron body for up to 175 psi (1,200 kPa) working pressure, up to 250 degrees F (121.1 degrees C) working temperature, Y-pattern strainer with 1/16 inch (1.6 mm) or 3/64 inch (1.2 mm) stainless steel perforated screen.
- C. Size 5 inch (125 mm, DN) and Larger:
 - 1. Provide flanged or grooved iron body for up to 175 psi (1200 kPa) working pressure, basket pattern with 1/8 inch (3.2 mm) stainless steel perforated screen.
- D. Accessories: Provide air vent, hanging tag, outlet ball valve, and PT test plug extension.

2.5 MAGNETIC FILTERS

- A. Manufacturers:
 - 1. ADEY Innovation LLC
 - 2. Wessels Company.
- B. Description: ASME BPVC-VIII-1 compliant, packaged oxide filtration assembly configured to remove dissolved ferrous metals from hydronic systems.
- C. Performance:
 - 1. Maximum Design Temperature: 250°F
 - 2. Maximum Design Pressure: 150 PSIG
- D. Construction:
 - 1. Shell: Carbon Steel Exterior
 - 2. Coalescing Medium: Stainless Steel
 - 3. Magnet: Neodymium
- E. Options:
 - 1. Bronze Blow Down Valve
 - 2. Bronze Skim Valve
 - 3. Cast Iron Vent

2.6 SUCTION DIFFUSERS

- A. See Section 23 2123 Hydronic Pumps

2.7 PUMP CONNECTORS

- A. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
 - 1. Maximum Operating Service: 150 psi (1030 kPa) at 240 degrees F (115.6 degrees C).
 - 2. End Connections: Same as specified for pipe jointing.

3. Provide necessary accessories including, but not limited to, swivel joints.

2.8 BALANCING VALVES

- A. Manufacturers:
 1. Bell & Gossett, a brand of Xylem, Inc
 2. Conbraco Industries, Inc
 3. Spence Engineering Company, Inc
 4. Watts, a Watts Water Technologies Company
- B. Size 2 inch (50 mm, DN) and Smaller:
 1. Provide ball or globe style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and female sweat, NPT threaded, or soldered connections.
 2. Metal construction materials consist of bronze or brass.
 3. Non-metal construction materials consist of Teflon or EPDM.
- C. Size 2-1/2 inch (65 mm, DN) and Larger:
 1. Provide butterfly style with flow balancing, shut-off capabilities, memory stops, and minimum of two metering ports and flanged, grooved, or weld-end connections.
 2. Valve body construction materials consist of cast iron, carbon steel, or ductile iron.
 3. Internal components construction materials consist of brass, aluminum bronze, bronze, Teflon, EPDM, or NORYL.

2.9 FLOW METERS

- A. Manufacturers:
 1. Dwyer Instruments, Inc
- B. Orifice principle by-pass circuit with direct reading gauge, soldered or flanged piping connections for 125 psi (860 kPa) working pressure, with shut off valves, and drain and vent connections.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install specialties in accordance with manufacturer's instructions.
- B. Provide manual air vents at system high points and as indicated.
- C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.
- D. Provide air separator on suction side of system circulation pump and connect to expansion tank.
- E. Provide valved drain and hose connection on strainer blowdown connection.
- F. Provide pump suction fitting on suction side of base-mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.

- G. Support pump fittings with floor-mounted pipe and flange supports.
- H. Provide relief valves on pressure tanks, low-pressure side of reducing valves, heat exchangers, and expansion tanks.
- I. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.
- J. Pipe relief valve outlet to nearest floor drain.
- K. Where one line vents several relief valves, make cross-sectional area equal to sum of individual vent areas.

END OF SECTION 23 2114

SECTION 23 2123 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. In-line pumps.
- B. End-suction pumps.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 0934 - Variable-Frequency Motor Controllers for HVAC.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bell & Gossett, a Xylem Inc. brand
- B. Grundfos Pumps Corporation
- C. TACO Incorporated

2.2 GENERAL

- A. Provide pumps that 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.

- B. Base Mounted Pumps: Aligned by qualified millwright.
- C. Electrical Requirements:
 - 1. Listed and classified by UL or testing agency acceptable to authority having jurisdiction as suitable for the purpose specified and indicated.
 - 2. Variable Frequency Drives (VFDs): Provide in accordance with Section 23 0934, except for integral-VFDs.

2.3 IN-LINE PUMPS

- A. Closed-Coupled, Single-Stage Pump: Vertical pump with radially-split casing; rated for discharge pressures up to 175 psi (1200 kPa).
- B. Casing: Cast iron with seal flush connection, threaded suction, and discharge ports with gauge port and drain plug.
- C. Impeller: Stainless steel, fully enclosed, keyed directly to motor shaft or extension.
- D. Shaft: Stainless steel with stainless steel impeller cap screw or nut and bronze sleeve.
- E. Seal: Silicon Carbide (EPR/SiC), 225 degrees F maximum continuous operating temperature.
- F. Electrical:
 - 1. Motor: 1,750 rpm, open drip-proof (ODP); see Section 23 0513.
 - 2. 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.
- G. Capacities and Characteristics:
 - 1. See Schedule on Drawings

2.4 END-SUCTION PUMPS

- A. Close-Coupled Pump: Base-mounted, long-coupled, single-stage pump with horizontal shaft and radially- or horizontally-split casing rated for discharge pressures up to 360 psi (2482 kPa).
- B. Casing: Cast iron with renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction, and discharge flanged connections with gauge ports.
- C. Impeller: Bronze, balanced, fully enclosed, keyed to shaft.
- D. Bearings: Grease lubricated roller or ball bearings.
- E. Shaft: Stainless steel with copper, bronze, or stainless steel shaft sleeve.
- F. Shaft Grounding: All motors driven by a variable frequency PWM drive shall include a maintenance free, circumferential, conductive micro fiber bearing protection ring (AEGIS SGR) to discharge shaft currents to ground
- G. Seal: Silicon Carbide (EPR/SiC/SiC), 225 degree F maximum continuous operating temperature.
- H. Drive: Flexible coupling with coupling guard.

- I. Baseplate: Cast iron or fabricated steel with integral drain rim.
- J. Electrical:
 - 1. Motor: 1,750 rpm, open drip-proof (ODP); see Section 23 0513.
 - 2. 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.
- K. Capacities and Characteristics:
 - 1. See Schedule on Drawings

2.5 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser:
 - 1. Angle pattern
 - 2. 175-psig (1204-kPa) pressure rating, cast or ductile-iron body and end cap, pump-inlet fitting
 - 3. Bronze startup and bronze or stainless-steel permanent strainers
 - 4. Bronze or stainless-steel straightening vanes
 - 5. Drain plug
 - 6. Factory-fabricated support leg

PART 3 EXECUTION

3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.
- C. 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. For close-coupled or base-mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches (102 mm) and over.
- D. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.
- E. Provide air cock and drain connection on horizontal pump casings.
- F. Provide drains for bases and seals, piped to and discharging into floor drains.
- G. Check, align, and certify alignment of base-mounted pumps prior to start-up.
- H. Install close-coupled and base-mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. See Section 03 3000.

- I. Lubricate pumps before start-up.
- J. Provide side-stream filtration system for closed loop systems. Install across pump with flow from pump discharge to pump suction from pump tapings.
- K. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.
- L. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.
- M. Retain first two paragraphs below for automatic condensate pump units.
- N. Install check valve and gate or ball valve on each condensate pump unit discharge.
- O. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- P. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 ALIGNMENT

- A. Engage a factory-authorized service representative to perform alignment service.
- B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
- C. Comply with pump and coupling manufacturers' written instructions.
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

END OF SECTION 23 2123

SECTION 23 2513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following water treatment for closed-loop hydronic systems:
 - 1. Approved companies and materials for hydronic systems.
 - 2. Approved chemical feeding and filtering equipment.
 - 3. De-ionized water requirements.
 - 4. Hydronic system fluid requirements.
 - 5. Preparation for hydronic system.
 - 6. Cleaning and filling sequence.
 - 7. Expansion tank installation guidelines.
 - 8. Hydronic system fluid testing.
 - 9. Warranty of hydronic system.

1.3 DEFINITIONS

- A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- B. RO: Reverse osmosis.
- C. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for the following products:
 - 1. Hydronic system cleaner.
 - 2. Glycol.
 - 3. Inhibitors.
 - 4. System volume.
 - 5. Gage readings.
 - 6. Chemical material safety data sheets.

1.5 INFORMATIONAL SUBMITTALS

- A. Water Analysis Provider Qualifications: Verification of experience and capability of HVAC water-treatment service provider.
- B. Field quality-control reports.
- C. Other Informational Submittals:
 - 1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in "Performance Requirements" Article.
 - 2. Water Analysis: Illustrate water quality available at Project site.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

1.8 REGULATORY REQUIREMENTS

- A. Conform to applicable code for addition of non-potable chemical to building mechanical system and to public sewage systems.
- B. Conform to Sewer Use Rules and Regulations published by Minot Municipal Utilities.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Contractor shall be responsible for the delivery, storage, protection and handling of the products before, during, and after installation.
- B. Contractor shall be responsible for accepting all products from the manufacturers of the equipment in factory-fabricated protective containers. Contractor shall inspect for damage.
- C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.10 MAINTENANCE SERVICE

- A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion and scale formation for hydronic piping and equipment. The hydronic system fluid warranty period shall expire one year after warranty start date established by final fluid Acceptance or by the one year contractors warranty for the entire project, whichever is later.

- B. Services and chemicals shall include the following:
1. Initial water analysis and HVAC water-treatment recommendations.
 2. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
 3. Periodic field service and consultation.
 4. Customer report charts and log sheets.
 5. Laboratory technical analysis.
 6. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

PART 2 PRODUCTS

2.1 MANUFACTURERS (ALL NEW HEATING GLYCOL SOLUTION SHALL BE THE SAME MANUFACTURER AS THE EXISTING FLUID)

- A. Dow Chemical Company
1. Inhibited Propylene Glycol (DowFrost) color coded clear.
- B. Cleaning chemicals shall be designed for hydronic systems and compatible with pipes, fittings, coils, valves, equipment and etc.

2.2 DE-IONIZED WATER REQUIREMENTS (FOR FINAL RINSES AND FINAL FILL)

- A. Sulfate < 25 ppm
- B. Chloride < 25 ppm
- C. Calcium < 1 ppm
- D. Magnesium < 1 ppm
- E. Silica < 25 ppm
- F. Electrical Conductivity < 5.0 umho/cm @ 77 degrees Fahrenheit (25 degrees Celsius)
- G. Total water hardness < 60 ppm

2.3 HYDRONIC SYSTEM FLUID REQUIREMENTS (FOR WATER OR GLYCOL SYSTEMS)

- A. Iron < 5 ppm
- B. Copper < 5 ppm
- C. Zinc < 5 ppm
- D. Magnesium < 1 ppm
- E. Calcium < 1 ppm
- F. Silica < 25 ppm

- G. Nitrate < 25 ppm
- H. Molybdenum < 25 ppm
- I. Lead < 5 ppm
- J. Arsenic < 5 ppm
- K. Chloride < 25 ppm
- L. Sulfate < 25 ppm
- M. Acidity < 1000 ppm
- N. Phosphate, 2250-3750 ppm
- O. Boron > 150 ppm
- P. PH acceptable range: 8.0 to 9.5
- Q. Tolyltriazole > 150 ppm
- R. Reserve Alkalinity 3.0 to 6.0 mils (0.1524 mm)/lite
- S. Heating System Glycol Concentration = 40% Propylene Glycol, +/-2%
- T. Sediments = none

2.4 PREPARATION FOR HYDRONIC SYSTEM

- A. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.
- B. Place terminal control valves in open position during cleaning.
- C. Systems containing any amount of glycol will not be allowed to be dumped down any sanitary waste line or on the ground. All glycol that is removed from a system shall be drained and disposed of properly or taken to an off-site location for recycling. Any damage caused by improper disposal of glycol, or subsequent remediation required, shall be at contractor's expense.
- D. Once system pressure is relieved, open air vents at high point(s) in the system to facilitate draining.
- E. If drain point doesn't exist at low point(s) in the system, contractor shall be responsible for installing one.
- F. Install a sample test line between the air separator and the suction side of the pump. Test line shall have a valve with a locking handle. See plans for details.
- G. Remove any strainer screens from the system, clean and replace.

- H. Permanently install a pressure gage at a high point in the system in a location approved by the Owner and Engineer. Record the location of pressure gage on the Record Drawings.
- I. Verify that electric power is available and of the correct characteristics.

2.5 CLEANING AND FILLING SEQUENCE

- A. Ensure all isolation valves, automatic control valves, etc. are wide open to facilitate complete filling of the system. Coordinate with temperature controls contractor as required to lock automatic control valves in open position during filling operation. Return control valves to automatic mode upon completion. Make sure expansion tank is valved off to the system.
- B. Install a water meter on the fill line to record the system volume.
- C. Fill system with water (use soft water if readily available at site, otherwise hard water is acceptable for this step). Contractor shall not use the system pumps to fill the hydronic system. Filling shall be done from a pump provided by contractor and shall connect to a low point in the system to facilitate air removal. Once system volume is known, add appropriate system cleaner. Refer to manufacturer's instructions on cleaner concentration, how long to circulate cleaner and at what temperature. Depending on cleanliness of hydronic system, more than one cleaning might be necessary to properly clean the hydronic system. In accordance with Sewer Use Rules and Regulations test all pH levels of water before draining the water and cleaner solution. Contractor shall adjust the pH levels as needed before draining the fluid. Drain the system down.
- D. Once the contractor has determined the cleaner has properly cleaned the hydronic system and pH levels meet the Sewer Use Rules and Regulations, fill and rinse the hydronic system with soft water) as many times as necessary in order to get clear, non-colored fluid. Meter all filling processes to insure an accurate system volume. During all rinse processes, contractor shall add chemical to prevent flash rusting. Remove all system strainer screens, clean and replace as many times as necessary throughout rinse process. Blowdown all equipment containing drain points where sediments may collect such as, air separators, boilers, chillers, etc. FINAL RINSE(S) shall be done with de-ionized water to insure that all calcium, magnesium, sulfate, and chloride ions left behind by flushing are removed. The hydronic system shall be filled with de-ionized water and rinsed as many times as necessary in order to insure the hydronic system fluid meets the de-ionized water requirements.
- E. Once the hydronic system meets the de-ionized water requirements, notify Engineer and Owner's Representative to demonstrate cleanliness and approve test results before filling the system. Using the metered volume obtained earlier, drain the required water in order to add the required glycol to achieve the specified level of protection as stated in the Hydronic System Fluid specifications.
- F. Refer to expansion tank installation guidelines before proceeding. Once the contractor has met the expansion tank guidelines, the hydronic system meets all of the requirements, then notify Owner's Representative. Within 7 days of notification, the Owner's representative will take a sample to be tested to show compliance with these specifications. Sample results may take 2-4 weeks. A copy of the sample results will be given to contractor along with recommendation, if needed, to meet the hydronic fluid requirements.

2.6 DIAPHRAGM EXPANSION TANK INSTALLATION GUIDELINES

- A. When filling a system keep the isolation valve between the system and the expansion tank closed.
- B. Fill system with system pumps off.
- C. Manually bleed air from system, as required, and circulate hydronic system as long as needed to ensure that all the air is out of the hydronic system.
- D. The gage pressure at the high point in the system shall read at least 6-8 psig (55.16 kPa) . If no gage exists at the high point then install a gage wherever feasible. Once 6-8 psig is reached, stop filling. If you exceed 10 psig (68.95 kPa) drain system fluid until 6-8 psig is reached.
- E. Record all pressure readings as indicated and the hydronic fluid temperatures with system pumps still off and at fill temperature. (It is understood that once the fill water is in the system the water temperature will try to reach the temperature of the surrounding environment. Throughout the diaphragm expansion tank installation guidelines the system fluid temperature will be referred to as fill temperature (before it gets heated or cooled by the mechanical equipment). Pressure reading can be from any gage at the low point of the system. When the pumps are off the suction and discharge pressure readings should be the same. if not check and repair pressure gages or gage line as needed.
- F. The pressure reading at the low point (with pumps off and system at fill temperature) is what you charge the air-side of the diaphragm tank. The expansion tank arrives from the manufacturer with an unknown charge. Test tank charge before adding compressed air or nitrogen. Testing tank charge can be done with a tire gage. Depending on hydronic system, you might have to lower expansion tank charge by releasing some air through the air port.
 - 1. Example: Assume pumps off and system at fill temperature. If the pressure reading at the low point in the system is 25 psig (172.37 kPa) then charge the diaphragm tank, with dry compressed air or nitrogen, until 25 psig is reached in the tank.
- G. Once the expansion tank is charged with proper air-side pressure, open the isolation valve between the expansion tank and system.
- H. Turn on the appropriate number of systems pumps. Do not over pump the system by running backup pumps when not intended.
- I. Bleed air from system as required and add water or glycol as needed. Do not make any further adjustments to the expansion tank air-side pressure at this time. Continue to circulate fluid until contractor is satisfied that all air is bled from system.
- J. To insure that the expansion tank has been charged correctly, turn pumps off to system and leave the expansion tank online with the system.
- K. Check the pressure at the high point in the system. As long as the gage reading at the high point is between 4-8 psig (55.16 kPa), (if gage reading at the high point isn't at least 4 psig (27.58 kPa) then add de-ionized water or proper glycol mixture to system until gage at high point is at least 6-8 psig.)

- L. If the pressure reading at the low point is +/- 2 psig (13.79 kPa) of the air-side charge in the expansion tank then no changes needed and skip guidelines N-S.
- M. If the pressure reading at the low point (with pumps off and system at fill temperature) is greater than +/- 2 psig (13.79 kPa) of the expansion tank air-side charge, then follow the below instructions.
- N. Valve off expansion tank from system.
- O. Open expansion tank fill port. This should release any water that might be in it.
- P. Close fill port.
- Q. Charge the expansion tank air-side charge (with pumps off and system at fill temperature) to the same pressure as the pressure reading from the low point of the system.
- R. Open valve and bring expansion tank back online with system.
- S. Start the appropriate number of pumps and bring the heating system within 10 degrees of the maximum leaving temperature and entering temperature. For cooling systems, start pumps and bring the cooling system within 5 degrees of the maximum leaving temperature and entering temperature. Coordinate with controls contractor and trades to assure systems are operated properly to achieve these temperatures.
- T. All data recorded shall be included in the Operation and Maintenance manuals.

2.7 HYDRONIC SYSTEM FLUID TESTING

- A. Contractor shall provide testing services by Dow Chemical Lab for the glycol heating systems prior to modifying any existing piping. Any adjustments required on the existing fluid will be at the Owners cost.
- B. consult with the Engineer and Owner's project manager for recommendations. However, it solely remains the contractor's responsibility to bring the system into compliance, which may involve increasing the glycol concentration, adding more inhibitors, filtering out the sediment or complete draining, flushing and re-filling in accordance with these specifications.

2.8 WARRANTY OF HYDRONIC SYSTEM

- A. The hydronic system warranty shall commence with Final Acceptance of the building, but only if the sample results prove that the hydronic system meets de-ionized water and hydronic fluid requirements. If initial sample does not meet requirements, then contractor shall remediate as required and request additional sample(s) to be taken at the end of the remediation process. Warranty period for the hydronic system shall not commence any sooner than final approved test result of hydronic system.
- B. After the hydronic system is initially approved, it shall be tested by Owner periodically during the warranty period to evaluate on-going condition of system. Contractor shall provide any necessary service and materials during the warranty period to maintain proper system pressure

levels, glycol concentration, inhibitor concentrations, etc. to maintain system in accordance with these specifications.

- C. The hydronic system fluid warranty period shall expire one year after warranty start date established by final fluid Acceptance or by the one year contractors warranty for the entire project, whichever is later.

2.9 SCOPE OF WORK

A. Heating System

- 1. The Base Bid scope of work shall include a complete chemical cleaning as specified in this section of all new piping. Contractor is responsible for all system fluid for the new piping system and equipment.

2.10 FINAL SYSTEM FLUID

- A. Final system fluid for the Heating Water System shall be 40% inhibited Propylene glycol and 60% purified water solution.

2.11 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

END OF SECTION 23 2513

SECTION 23 3113 - METAL DUCTS

PART 1 GENERAL

1.1 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 A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2025a.
- D. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- E. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- 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; 2024.
- H. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023, with Editorial Revision (2024).
- I. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018 (Reapproved 2024).
- J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2024a.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2025.
- L. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- M. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- N. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- O. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- P. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.2 SUMMARY

- A. Section Includes:
 - 1. Rectangular ducts and fittings.
 - 2. Outdoor Rectangular duct and fittings
 - 3. Round ducts and fittings.
 - 4. Sheet metal materials.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.
 - 7. Related Sections:
 - 8. Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 9. Section 23 3300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7.
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Paragraph below is defined in Section 013300 "Submittal Procedures" as a "Delegated-Design Submittal." Retain with "Performance Requirements" Article if design responsibilities have been delegated to Contractor.
- C. QUALITY ASSURANCE
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.1 RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 OUTDOOR RECTANGULAR DUCT AND FITTINGS

- A. Product: Provide product listed below or an approved equal.
 - 1. Therma duct.
 - 2. Q-Duct, AQC Ind.
 - 3. Pro-R, by Ducts and Cleats.
- B. The panel shall be manufactured of CFC-free closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, 39 mil (0.9906 mm) high impact resistant titanium infused vinyl is factory bonded to the outer surfaces to provide a zero-permeability watertight barrier.
- C. The thermal conductivity shall be no greater than 0.13BTU • in/Hr •ft²•°F, the thermal conductivity shall be no greater than 0.13BTU • in/Hr •ft²•°F
- D. The density of the foam shall not be less than 3.5 pcf with a minimum compressive strength of 28 psi (193.05 kPa).
- E. The standard panel is 1.26 inch (32 mm) thickness panel with R-8.1 shall be utilized unless indicated otherwise on the print.
 - 1. Maximum Temperature: Continuous rating of 185 degrees Fahrenheit (85 degrees Celsius) inside ducts or ambient temperature surrounding ducts.

2. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 degrees Fahrenheit (23.89 degrees Celsius) mean temperature.
3. Permeability: 0.00 perms maximum when tested according to ASTM E96/E96M, Procedure A.
4. Antimicrobial Agent: Compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
5. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C423, Mounting A.
6. Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.
7. All insulation materials shall be closed cell with a closed cell content of >90%.
8. R-value:
 - a. 1 3/16 inch (4.76 mm) Thick Panel: 8.1 R
 - b. 1 3/4 Thick Panel: 12.0 R
 - c. Double wall Thick Panel: 16.2 R
 - d. Double wall Thick Panel: 20.1 R

F. Closure Materials:

1. V-Groove Adhesive: Silicone (interior).
2. UV stable 38 mil (0.9652 mm) high impact resistant titanium infused vinyl (exterior).
 - a. Factory manufactured seamless corners.
 - b. Cohesive bonded over-lap at corner seam covers.
 - c. Water resistant titanium infused welded vinyl seams.
 - d. Mold and mildew resistant.
3. Polymeric Sealing System:
 - a. Structural Membrane: Aluminum scrim with woven glass fiber with UV stable vinyl clad applied
 - b. Minimum Seam Cover Width: 2 7/8" inches
 - c. Sealant: Low VOC.
 - d. Color: White (colors, matched by architect optional).
 - e. Water resistant.
 - f. Mold and mildew resistant.
4. Duct Connectors.
 - a. Factory manufactured cohesive bonded strips (low pressure only).
 - b. Factory manufactured all aluminum grip flange.
 - 1) Grip flange
 - 2) F-flange
 - 3) H-flange
 - 4) U-flange
 - c. Factory manufactured galvanized 4-bolt flange.

G. Outdoor Cladding

1. Outdoor Installations: Duct segments shall incorporate UV stable 39 mil (0.9906 mm) high impact resistant titanium infused vinyl which is introduced during the manufacturing process.

H. Flange coverings

1. Flanges are field sealed airtight before flange covers are installed. Flange covering consists of the following:
 - a. Foam tape insulation with molded 39 mil (0.9906 mm) covers.
 - b. Air gap (heating only application) with molded 39 mil (0.9906 mm) covers.

I. Weight

1. Duct shall provide low weight stresses on the building framing and support members. The R-8.1 Duct shall have a maximum weight of 3 lbs. per square foot. Hangers and tie-downs are to be detailed on the manufacturer's installing contractors detail drawings prior to installation but not exceeding 13' for duct girth <84" and 8' for duct girth >85" between hangers and designed to carry the weight and wind load of the ductwork.

2.3 ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- B. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 1. Fabricate round ducts larger Than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
- C. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Carbon-Steel Sheets: Comply with ASTM A1008/A1008M, with oiled, matte finish for exposed ducts.
- D. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- F. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches (914.4 mm) or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.5 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.
 - 1. Manufacturers:
 - a. K-Flex USA
 - b. Armacell Engineered Foams
 - 2. Thickness: 1/2 inch (12.7 mm).
 - 3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
 - 4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
- B. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- C. Refer to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for a detailed discussion on seam and joint sealing methods and their applications.
- D. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- E. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- F. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.6 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches (101.6 mm).
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Water-Based Joint and Seam Sealant:
1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C920.
1. General: Single-component, acid-curing, silicone, elastomeric.
 2. Type: S.
 3. Grade: NS.
 4. Class: 25.
 5. Use: O.
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.7 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

- H. Install ducts with a clearance of 1 inch (25.4 mm), plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 3300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
- M. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction" Intermediate Level.
- N. OUTDOOR DUCT Shop Fabrication
 - 1. Certification:
 - a. Ducts shall be detailed and fully factory manufactured by Outdoor Duct Manufacturers facility system guidelines. All fabrication labor will be certified "yellow label" building trade professionals, compliant to SMWIA and SMACNA labor guidelines (work preservation observed).
 - 2. Fabrication:
 - a. Fabricated joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to manufacturer's written and detailed instructions.
 - b. Fabricated 90-degree mitered elbows to include turning vanes.
 - c. Fabricated duct segments in accordance with manufacturer's written details.
 - d. Duct Fittings shall include 6 inches (152.4 mm) of connecting material, as measured, from last bend line to the end of the duct. Connections on machine manufactured duct may be 4 inches (101.6 mm).
 - e. Fabricated duct segments utilizing v-groove method of fabrication. Factory welded or cohesively bonded seams will apply to fully manufactured ductwork and fittings. Internal seams will be supplied with an unbroken layer of low VOC silicone or bonding (for paint shop applications). Each duct segment will be factory supplied with either aluminum grip pro-file or pre-insulated duct connectors in accordance with manufacturer's detailed submittal guide. Applied duct reinforcement to protect against side deformation from both positive and negative pressure per manufacturer's design guide based on specified ductwork size and system pressure.
 - f. Designed and fabricated duct segments and fittings will be in accordance with "SMACNA HVAC Duct Construction Standards" latest edition.
 - g. Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 ADDITIONAL INSTALLATION REQUIREMENTS FOR COMMERCIAL KITCHEN HOOD EXHAUST DUCT

- A. Install commercial kitchen hood exhaust ducts without dips and traps that may hold grease and sloped a minimum of 2 percent to drain grease back to the hood.
- B. Install fire-rated access panel assemblies per NFPA 96, at each change in direction and at maximum intervals of 12 feet (365.76 cm) in horizontal ducts, and at every floor for vertical ducts, or as indicated on Drawings. Locate access panel on top or sides of duct a minimum of 1-1/2 inches (38 mm) from bottom of duct.
- C. Do not penetrate fire-rated assemblies except as allowed by applicable building codes and authorities having jurisdiction.

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Outdoor, Supply-Air Ducts: Seal Class A.
 - 3. Outdoor, Exhaust Ducts: Seal Class A.
 - 4. Outdoor, Return-Air Ducts: Seal Class A.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class A.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class A.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
11. Conditioned Space, Exhaust Ducts: Seal Class A.
12. Conditioned Space, Return-Air Ducts: Seal Class B.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (101.6 mm) thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (101.6 mm) thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (609.6 mm) of each elbow and within 48 inches (1219.2 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet (487.68 cm).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 3300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 START UP

- A. Air Balance: Comply with requirements in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
 - 1. Retain applicable subparagraphs in this Article to set criteria for pressure class, duct seal-class level, and duct-leakage class; or delete applicable subparagraphs and indicate pressure class, duct seal-class level, and duct-leakage class on Drawings. If retaining duct seal and leakage requirements in this article, retain first paragraph in "Duct Sealing" Article. Both seal class and leakage class are included in this article and either one can be deleted, or both can remain if they are consistent.
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 1-inch wg (250 Pa).
 - b. SMACNA Leakage Class for Rectangular: 12.
 - c. SMACNA Leakage Class for Round and Flat Oval: 12.
 - 2. Ducts Connected to Variable-Air-Volume Air-Handling Units (Between AHU and terminal units):
 - a. Pressure Class: Positive 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
 - 3. Ducts Connected to Variable-Air-Volume Air-Handling Units (in Mechanical Rooms):
 - a. Pressure Class: Positive 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
 - 4. Return Ducts:
 - 5. Pressure Class: Positive or negative 3-inch wg.
 - a. SMACNA Leakage Class for Rectangular: 8.
 - b. SMACNA Leakage Class for Round and Flat Oval: 4.
 - 6. Exhaust Ducts:
 - 7. Ducts Connected to Air-Handling Equipment:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
 - 8. Ducts Connected to Air-Handling Equipment(in Mechanical Rooms):
 - a. Pressure Class: Positive or negative 4-inch wg.
 - b. SMACNA Leakage Class for Rectangular: 4.
 - c. SMACNA Leakage Class for Round and Flat Oval: 2.
 - 9. Ducts Connected to Type I Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Exposed to View: Carbon Steel.
 - b. Concealed: Carbon Steel.
 - c. Welded seams and joints.
 - d. Pressure Class: Positive or negative 3-inch wg.
 - e. Welded seams, joints, and penetrations.
 - f. SMACNA Leakage Class: 3.
 - 10. Ducts Connected to Type II Hoods:
 - a. Exposed to View: Aluminum.
 - b. Concealed: Aluminum.
 - c. Sealed water tight.

- d. Pressure Class: Positive or negative 2-inch wg.
- e. SMACNA Leakage Class for Rectangular: 3.
- f. SMACNA Leakage Class for Round and Flat Oval: 3.
- 11. Outdoor-Air (Not Filtered, Pressurized, Heated, or Cooled) Ducts:
- 12. Pressure Class: Positive or negative 3-inch wg.
 - a. SMACNA Leakage Class for Rectangular: 6.
 - b. SMACNA Leakage Class for Round and Flat Oval: 4.
- 13. Intermediate Reinforcement:
- 14. Galvanized-Steel Ducts: Galvanized steel.
- 15. Elbow Configuration:
- 16. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 17. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
- 18. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.

- b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
- c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam .

C. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
- 2. Round: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: High Efficiency 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

3.9 CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect the system. Vacuum ducts before final acceptance to remove dust and debris.

END OF SECTION 23 3113

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 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 B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- D. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- E. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- F. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- G. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.2 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Fire dampers.
 - 5. Smoke dampers.
 - 6. Flange connectors.
 - 7. Turning vanes.
 - 8. Duct-mounted access doors.
 - 9. Flexible connectors.
 - 10. Flexible ducts.
 - 11. Duct accessory hardware.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Control-damper installations.
 - b. Fire-damper and smoke-damper installations, including sleeves; and duct-mounted access doors.
 - c. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

PART 2 PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
 1. Galvanized Coating Designation: G90.
 2. Exposed-Surface Finish: Mill phosphatized.
- B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Extruded Aluminum: Comply with ASTM B221, Alloy 6063, Temper T6.
- D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches (914.4 mm) or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Ruskin Company.

- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 1250 fpm.
- D. Maximum System Pressure: 3-inch wg.
- E. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: Galvanized steel or Aluminum.
 - 2. Diameter: 0.20 inch (5.08 mm).
- J. Tie Bars and Brackets: Aluminum or Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Standard leakage rating, with linkage outside airstream.
 - 2. Suitable for horizontal or vertical applications.
 - 3. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel .
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized -steel, 0.064 inch (1.63 mm) thick.
 - 5. Blade Axles: Galvanized steel
 - 6. Bearings:
 - a. Oil-impregnated bronze
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 7. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 - 1. Standard leakage rating, with linkage outside airstream.
 - 2. Suitable for horizontal or vertical applications.

3. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 4. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
 5. Blade Axles: Galvanized steel.
 6. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 7. Tie Bars and Brackets: Aluminum.
- C. Jackshaft:
1. Size: 0.5-inch diameter.
 2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
 3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.
- D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
 2. Include center hole to suit damper operating-rod size.
 3. Include elevated platform for insulated duct mounting.

2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Ruskin Company.
 4. NCA Manufacturing.
- B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed, 0.034-inch- thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.138 inch (3.51 mm) thick, as indicated, and of length to suit application.

- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Resettable link and switch package, factory installed, 165 deg F rated.

2.6 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Greenheck Fan Corporation.
 - 2. Nailor Industries Inc.
 - 3. Ruskin Company.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with welded interlocking, gusseted corners and mounting flange.
- D. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.034-inch- thick, galvanized sheet steel.
- E. Leakage: Class I.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Mounting Sleeve: Factory-installed, 0.05-inch- thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- H. Damper Motors: two-position action.
- I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC"
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 inch (3810 mm). x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 inch (3810 mm). x lbf and breakaway torque rating of 300 inch (7620 mm). x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz .

J. Accessories:

1. Test and reset switches, damper mounted.

2.7 FLANGE CONNECTORS

- A. If permitted by authorities having jurisdiction, flange connectors can substitute for slip-and-drive connections for smoke dampers.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Nexus PDQ.
 3. Ward Industries, Inc.
- C. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- D. Material: Galvanized steel.
- E. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.
 4. SEMCO Incorporated.
 5. Ward Industries, Inc.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Double wall.

2.9 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a Mestek Architectural Group company.

2. Cesco Products; a division of MESTEK, Inc.
 3. Ductmate Industries, Inc.
 4. Flexmaster U.S.A., Inc.
 5. Greenheck Fan Corporation.
 6. McGill AirFlow LLC.
 7. Nailor Industries Inc.
 8. Pottorff.
 9. Ventfabrics, Inc.
 10. Ward Industries, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Flexmaster U.S.A., Inc.
 4. Ward Industries, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 1. Minimum Weight: 24 oz./sq. yd..
 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 3. Service Temperature: Minus 50 to plus 250 deg F.

2.11 FLEXIBLE DUCTS

- A. UL 181 defines two categories of flexible ducts. Ducts listed according to UL 181 must pass all UL 181 tests. Air connectors listed according to UL 181 must pass most, but not all, UL 181 tests and are limited to lengths of 14 feet (426.72 cm) or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.
- C. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
- D. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 210 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1 .
- E. Flexible Duct Connectors:
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (457.2 mm), to suit duct size.

2.12 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches (127 mm).
 - 2. Two-Hand Access: 12 by 6 inches (152.4 mm).
 - 3. Head and Hand Access: 18 by 10 inches (254 mm).

4. Head and Shoulders Access: 21 by 14 inches (355.6 mm).
 5. Body Access: 25 by 14 inches (355.6 mm).
 6. Body plus Ladder Access: 25 by 17 inches (431.8 mm).
- K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment.
- M. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- N. Connect flexible ducts to metal ducts with liquid adhesive plus tape and draw bands .
- O. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 3300

SECTION 23 3423 - HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Roof exhausters.
- B. Upblast roof exhausters.
- C. Inline centrifugal fans and blowers.

1.2 RELATED REQUIREMENTS

- A. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- B. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- C. Section 23 0553 - Identification for HVAC Piping and Equipment
- D. Section 23 3300 - Air Duct Accessories: Backdraft dampers.

1.3 REFERENCE STANDARDS

- A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.
- B. AMCA 99 - Standards Handbook; 2016.
- C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.
- D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016, with Errata (2018).
- E. AMCA 300 - Reverberation Room Methods of Sound Testing of Fans; 2024.
- F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2022.
- G. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- H. UL 705 - Power Ventilators; Current Edition, Including All Revisions.
- I. UL 762 - Outline of Investigation for Power Roof Ventilators for Restaurant Exhaust Appliances; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate fan roof curbs and service utilities installation according to fan size.

1.5 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 plotted, power, rpm, sound power levels at rated capacity, and electrical characteristics and connection requirements.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 PRODUCTS

2.1 POWER VENTILATORS - GENERAL

- A. Static and Dynamically Balanced: Comply with AMCA 204.
- B. Performance Ratings: Comply with AMCA 210, bearing certified rating seal.
- C. Sound Ratings: Comply with AMCA 301, tested to AMCA 300, bearing certified sound ratings seal.
- D. Fabrication: Comply with AMCA 99.
- E. UL Compliance: UL 705, listed, labeled, designed, manufactured, and tested.
- F. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
- G. Kitchen Hood Exhaust Fans: Comply with requirements of NFPA 96 and UL 762.

2.2 ROOF EXHAUSTERS

- A. Manufacturers:
 - 1. Greenheck
 - 2. Loren Cook

3. Twin City Fan
 4. ACME
 5. PennBarry
 6. CaptiveAire
- B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch (13 mm) mesh, 0.62 inch (1.6 mm) thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
 - C. Roof Curb: Minimum 12 inch (300 mm) high self-flashing of galvanized steel with continuously welded seams, factory installed nailer strip or as scheduled on the drawings.
 - D. Disconnect Switch: Factory wired, nonfusible, in housing for thermal overload protected motor.
 - E. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, or as scheduled on drawings.
 - F. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm gets attained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.
 - G. Performance Ratings: As indicated on drawings.

2.3 UPBLAST ROOF EXHAUSTERS

- A. Manufacturers:
 1. Greenheck
 2. Loren Cook
 3. Twin City Fan
 4. Acme
 5. PennBarry
 6. CaptiveAire
 7. Grease Master
 8. Accurex
- B. Belt or Direct Drive Fan:
 1. Fan Wheel:
 - a. Type: Non-overloading, backward inclined centrifugal.
 - b. Material: Aluminum, statically and dynamically balanced.
 2. Housing:
 - a. Construct of heavy gauge aluminum including curb cap, windband, and motor compartment.
 - b. Rigid internal support structure.
 - c. One-piece fabricated or fully welded curb-cap base to windband for leak proof construction.
 - d. Construct drive frame assembly of heavy gauge steel, mounted on vibration isolators.
 - e. Provide breather tube for fresh air motor cooling and wiring.

- 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. Drive Assembly:
 - 1. Belts, pulleys, and keys oversized for a minimum of 150 percent of driven horsepower.
 - 2. Belts: Static free and oil resistant.
 - 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 - 4. Motor pulley adjustable for final system balancing.
 - 5. Readily accessible for maintenance.
- E. Disconnect Switches:
 - 1. Factory mounted and wired.
 - 2. Wired from fan motor to junction box installed within motor compartment.
- F. Roof Curb: Minimum 12 inch (300 mm) high or as scheduled, self-flashing of galvanized steel with continuously welded seams, factory installed nailer strip.
- G. Drain Trough: Allows for single-point drainage of water, grease, and other residues.
- H. Options/Accessories:
 - 1. Birdscreen:
 - a. Provide galvanized steel construction.
 - 2. Roof Curb Extension: Vented curb extension where required for compliance with minimum clearances required by NFPA 96. For Type I kitchen hood exhaust applications.
 - 3. Dampers: Provide damper as scheduled on drawings.
 - 4. Grease Trap (Type I kitchen hood exhaust fan application):
 - a. Container system to collect grease residue.
 - 5. Hinge Kit:
 - a. Allows fan to tilt away for access to wheel and ductwork for inspection and cleaning.
- I. Performance Ratings: As indicated on drawings.

2.4 INLINE CENTRIFUGAL FANS AND BLOWERS

- A. Manufacturers:
 - 1. Greenheck
 - 2. Loren Cook
 - 3. Twin City Fan
 - 4. ACME
 - 5. PennBarry
 - 6. CaptiveAire

- B. Centrifugal Fan Unit: V-belt or direct driven, with galvanized steel housing, resiliently-mounted motor, gravity backdraft damper in discharge.
- C. Fan Wheels: Steel, mixed flow design. Aluminum, airfoil blades welded to alluminum hub.
- D. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm gets reached with sheaves set at mid-position; fan shaft with self-aligning prelubricated ball bearings.
- E. Performance Ratings: As indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Hung Cabinet Fans:
 1. Install fans with resilient mountings and flexible electrical leads, see Section 23 0548.
 2. Install flexible connections between fan and ductwork; see Section 23 3300. Ensure metal bands of connectors are parallel with minimum 1 inch (25 mm) flex between ductwork and fan while running.
- E. Provide sheaves required for final air balance.
- F. Install backdraft dampers on inlet to roof and wall exhausters.
- G. Provide backdraft dampers on outlet from cabinet and ceiling exhauster fans and as indicated.
- H. Install units with clearances for service and maintenance.
- I. Label units according to requirements specified in Section 23 0553 Identification for HVAC Piping and Equipment.

3.2 CONNECTIONS

- A. Coordinate duct installation and specialty arrangements with schematics on Drawings and with requirements specified in duct systems.
- B. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 3300 "Air Duct Accessories."
- C. Install ducts adjacent to power ventilators to allow service and maintenance.
- D. Ground equipment according to Section 26 0526 "Grounding and Bonding for Electrical Systems."

- E. Connect wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 3. Verify that cleaning and adjusting are complete.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Adjust belt tension.
 - 6. Adjust damper linkages for proper damper operation.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 - 9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 10. Shut unit down and reconnect automatic temperature-control operators.
 - 11. Remove and replace malfunctioning units and retest as specified above.
- C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Comply with requirements in Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

END OF SECTION 23 3423

SECTION 23 3600 - AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single-duct terminal units.
 - 1. Variable-volume units.
- B. Venturi-type air valves.

1.2 RELATED REQUIREMENTS

- A. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- B. Section 23 0993 - Sequence of Operations for HVAC Controls.
- C. Section 23 3100 - HVAC Ducts and Casings.
- D. Section 23 8200 - Convection Heating and Cooling Units: Air coils.

1.3 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017 (Reaffirmed 2023).
- C. ASHRAE Std 62.1 - Ventilation for Acceptable Indoor Air Quality; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.
- E. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2019).
- F. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.
- H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2024.
- I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.

1.4 SUBMITTALS

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

- B. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.
- C. Shop Drawings: Indicate configuration, general assembly, and materials used in fabrication, and electrical characteristics and connection requirements.
- D. Certificates: Certify that coils are tested and rated in accordance with AHRI 410.
- E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide one year manufacturer warranty for air terminal units.

PART 2 PRODUCTS

2.1 SINGLE-DUCT, VARIABLE-VOLUME UNITS

- A. Manufacturers:
 - 1. Price
 - 2. Titus
 - 3. Trane
 - 4. Daikin
 - 5. Enviro-tec
 - 6. Nailor
- B. 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.
- C. Unit Casing:
 - 1. Minimum 22 gauge, 0.034 inch (0.85 mm) galvanized steel.

2. Air Inlet Collar: Provide round stub connection or S-slip and drive connections for duct attachment
 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.
- D. Damper Assembly:
1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
 2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
 3. Incorporate low leak damper blades for tight airflow shutoff.
 - a. Air Leakage Past Closed Damper: Maximum two percent of unit maximum airflow at 3 in-wc (750 Pa) inlet static pressure, tested in accordance with ASHRAE Std 130.
- E. Hot Water Heating Coil:
1. Coil Casing: Minimum 22 gauge, 0.0299 inch (0.76 mm) galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
 2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
 3. Coil leak tested to minimum 350 psig (2413 kPa).
 4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.
- F. Controls:
1. DDC (Direct-Digital Controls):
 - a. Include a factory-installed, unit-mounted, direct-digital controller.
 - b. Bi-directional Damper Actuator: 24 volt, powered closed, spring return open.
 - c. Microprocessor-Based Controller: Air volume controller, pressure-independent with electronic airflow transducers, factory-calibrated maximum and minimum CFMs.
 - d. See Section 25 1400.

2.2 VENTURI-TYPE AIR VALVES

- A. Manufacturers:
1. Antec Controls, a brand of Price Industries, Inc; _____: www.antecontrols.com/sle#.
 2. Phoenix Controls, a company of Honeywell International, Inc; _____: www.phoenixcontrols/sle#.
 3. Triatek, a company of Johnson Controls International, Plc; _____: www.triatek.com/sle#.
- B. Type: Pressure independent, field adjustable, maintenance-free, directional-flow tagged, factory calibrated to operate across body-stamped flow curve.

- C. Construction:
 - 1. Body Material: Aluminum, 14 gauge, 0.064 inch (1.63 mm), uncoated.
 - 2. Cone Material: Aluminum, 14 gauge, 0.064 inch (1.63 mm), uncoated.
 - 3. Shaft, Bearings, and Links Material: 316 stainless steel.
 - 4. Valve-Assembly Orientation: Horizontal flow.
 - 5. Flow-Valve Type:
 - a. General Exhaust: Variable volume, partially closed.
 - b. Supply: Variable volume, partially closed.
 - 6. Actuator Configuration: As indicated on drawings, fail open.
 - 7. Flow Feedback: Built-in calibrated potentiometer with pressure switch.
 - 8. Thermal Insulation (Supply): Fiber-free foam, 3/4 inch (19 mm).
- D. Operating Range:
 - 1. Flow: As indicated on drawings.
 - 2. Accuracy: Plus or minus 5 percent of scheduled flow setpoints.
 - 3. Valve Pressure Drop: Low pressure, 0.3 to 3.0 in-wc (75 to 750 Pa).
- E. Auxiliary Heating or Reheating: Provide hot water booster coil.
- F. Terminal Unit Controls:
 - 1. Controller: Built-into valve, extend power and communication bus to other system valves.
 - 2. Control Sequence: Dynamic space volume matching to attain area offset setpoint.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that conditions are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.2 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. Wire rope to be stainless steel.
 - 1. Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with automatic-locking and clamping device.
- E. Hanger Rods for corrosive environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation
- F. Do not support from ductwork.

- G. Connect to ductwork in accordance with Section 23 3100.
- H. Install heating coils in accordance with Section 23 8200.

3.3 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. Leak Test:
 - a. After installation, fill water coils and test for leaks.
 - b. Repair leaks and retest until no leaks exist.
 - 2. 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.

3.4 CLEANING

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. Vacuum clean coils and inside of units.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training for additional requirements.

3.6 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units

END OF SECTION 23 3600

SECTION 23 3700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Diffusers:
 - 1. Perforated ceiling diffusers.
- B. Rectangular ceiling diffusers.
- C. Slot ceiling diffusers.
- D. Registers/grilles:
 - 1. Ceiling-mounted, egg crate exhaust and return register/grilles.
 - 2. Ceiling-mounted, register/grilles.
- E. Duct-mounted supply and return registers/louvers.
- F. Fan filter units.

1.2 RELATED REQUIREMENTS

- A. Section 09 9123 - Interior Painting: Painting of ducts visible behind outlets and inlets.

1.3 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; 2023.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
- C. AMCA 550 - Test Method for High Velocity Wind Driven Rain Resistant Louvers; 2022.
- D. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Air Inlets; 2023.
- 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. IEST-RP-CC001 - HEPA and ULPA Filters; 2016, with Errata (2017).
- H. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; 2015b.
- I. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.
- J. UL 900 - Standard for Air Filter Units; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.5 QUALITY ASSURANCE

- A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
- B. Test and rate louver performance in accordance with AMCA 500-L.

PART 2 PRODUCTS

2.1 RECTANGULAR CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Krueger
 - 5. Tuttle & Bailey
 - 6. Metalaire, Inc.
- B. Type: Provide rectangular and square formed adjustable, backpan stamped, core removable, and multi-louvered ceiling diffusers constructed to maintain 360 degree discharge air pattern with sectorizing baffles where indicated.
- C. Connections: Round.
- D. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.
- E. Fabrication: Steel with baked enamel finish.
- F. Color: As indicated.

2.2 PERFORATED FACE CEILING DIFFUSERS

- A. Manufacturers:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Krueger
 - 5. Tuttle & Bailey
 - 6. Metalaire, Inc.
- B. Type: Perforated face.

- C. Fabrication: Steel with steel frame and baked enamel finish.
- D. Color: As indicated.

2.3 CEILING SLOT DIFFUSERS

- A. Manufacturers:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Krueger
 - 5. Tuttle & Bailey
 - 6. Metalaire, Inc.
- B. Type: Continuous slot, with adjustable vanes for left, right, or vertical discharge.
- C. Fabrication: Aluminum extrusions with factory baked enamel finish.
- D. Color: As indicated.
- E. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket, mitered end border.
- F. Plenum: Integral, galvanized steel, insulated.

2.4 DUCT-MOUNTED SUPPLY AND RETURN REGISTERS/LOUVERS

- A. Manufacturers:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Krueger
 - 5. Tuttle & Bailey
 - 6. Metalaire, Inc.
- B. Type: Duct-mounted, rectangular register with adjustable pivot-ended blades, end caps, and dual cover flanges to lay flush on duct surface regardless of diameter. Performance to match manufacturer's catalog data.
- C. Color: As indicated on drawings.

2.5 CEILING & WALL REGISTERS/GRILLES

- A. Manufacturers:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Krueger
 - 5. Tuttle & Bailey
 - 6. Metalaire, Inc.

- B. Type: Streamlined and individually adjustable curved blades to discharge air along face of grille, two-way deflection.
- C. Frame: 1-1/4 inch (32 mm) margin with countersunk screw mounting and gasket.
- D. Construction: Made of aluminum extrusions with factory enamel finish.
- E. Color: As indicated.

2.6 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

- A. Manufacturers:
 - 1. Titus
 - 2. Price
 - 3. Nailor
 - 4. Krueger
 - 5. Tuttle & Bailey
 - 6. Metalaire, Inc.
- B. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch (13 by 13 by 13 mm) grid core.
- C. Fabrication: Grid core consists of aluminum with baked enamel finish.
- D. Color: As indicated.
- E. Frame: Channel lay-in frame for suspended grid ceilings.

2.7 FAN FILTER UNITS

- A. Manufacturers:
 - 1. Price Industries.
 - 2. Titus.
- B. General Requirements:
 - 1. Nominal Size: As .
 - 2. Comply with UL 900.
- C. Performance Rating:
 - 1. Provide unit factory sealed and tested to ensure leakage consistent with filter.
 - 2. Filter Efficiency: 99.99 percent (HEPA) at 0.30 microns or higher particle size when tested in accordance with DOP-smoke (Dioctyl Phthalate) penetration test on MIL-STD-282.
- D. Face Gasket: Silicone.
- E. Filters:
 - 1. Filter Type: HEPA in accordance with IEST-RP-CC001.
 - 2. Filter Replacement Type:
 - a. Room side removable and replaceable, mounted in extruded aluminum frame with integral cavity filled with urethane gel to provide leak-tight seal between filter frame and border.

- F. Plenum:
 - 1. Construction: 304 stainless steel.
 - 2. Provide diffuser plenum with eyebolts at each plenum corner for securing unit to structural supports above ceiling. Each eyebolt to support a maximum of 75 lb (34.02 kg).
- G. Inlet: Standard round or optional square collar for nonducted applications.
- H. Face and Frame:
 - 1. Face: 304 stainless steel expanded metal grille with powder-coat paint finish.
- I. Fan:
 - 1. Provide centrifugal type supplied with rubber mounts to isolate motor and blower assembly from diffuser plenum.
- J. Fan Motor:
 - 1. Electrically Commutated Motor (ECM):
 - 2. Fan Motor with Motor Speed Controller:
 - a. ECM Standard Speed Controller:
 - b. BACnet Flow Controller:
 - 1) Controller to Monitor and Adjust the Following Parameters through Building Networks:
 - a) Airflow rate.
 - b) Motor rpm.
 - c) Motor hours.
 - d) Filter status.
 - e) Filter pressure drop displayed in inches of water column.
 - f) Filter hours.
 - g) Filter reset.
- K. Accessories:
 - 1. Aerosol Test System:
 - a. Provide room-side accessible aerosol test system for injecting aerosol challenge into diffuser to allow filter to be scanned for leaks during commissioning or after filter replacement.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to ductwork with air tight connection.
- D. Provide balancing dampers on duct take-off to diffusers and grilles and registers, despite whether dampers are specified as part of diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black, see Section 09 9123.

F. For Installation of Fan Filter Units:

1. Do not begin installation until substrates and openings have been properly prepped.
2. Verify location of cleanroom fan filter units for installation.
3. Verify supports, surfaces, and openings are ready for fit out.
4. Clean and prepare surfaces per manufacturer's instructions.
5. Install in accordance with manufacturer's written instructions and recommendations and in proper relationship with adjacent work.
6. Rigidly mount fan filter units level and plumb with fasteners recommended by manufacturer.
7. Startup equipment in accordance with manufacturer's instructions.
8. Seal perimeter of both sides of openings as required.
9. Record changes to system design that differs from what is shown on drawings.

3.2 CLOSEOUT ACTIVITIES

- A. Demonstrate operational system to Owner's representative.
- B. Instruct Owner's representative to maintain system and use occupant controls or interfaces, as required.

3.3 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 3813 - COMMERCIAL-KITCHEN HOODS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cooking hoods (Type I).

1.2 RELATED REQUIREMENTS

- A. Section 11 4000 - Foodservice Equipment: General provisions for hoods.

1.3 REFERENCE STANDARDS

- A. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
- B. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; 2024.
- C. NSF 2 - Food Equipment; 2022.
- D. SMACNA (KVS) - Kitchen Ventilation Systems and Food Service Equipment Fabrication and Installation Guidelines; 2001.
- E. UL 710 - Standard for Exhaust Hoods for Commercial Cooking Equipment; Current Edition, Including All Revisions.
- F. UL 1046 - Standard for Grease Filters for Exhaust Ducts; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: For each custom fabricated unit, provide drawings showing details of construction, dimensions, and interfaces with adjacent construction.
- C. Operation and Maintenance Data.
- D. Welding Certificates
- E. Field quality-control test reports

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D 1.1M, "Structural Welding Code - Steel," for hangers and supports; and AWS D9.1/D9.1M, "Sheet Metal Welding Code," for joint and seam welding.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

PART 2 PRODUCTS

- 2.1 KITCHEN EXHAUST HOOD PROVIDED BY KITCHEN EQUIPMENT SUPPLIER AND INSTALLED BY MECHANICAL CONTRACTOR. REFERENCE KITCHEN SUPPLIER PLANS, SPECIFICATIONS, AND RESPONSIBILITY MATRIX FOR REQUIREMENTS ON WHO IS PROVIDING WHAT EQUIPMENT AND WHO IS INSTALLING THE EQUIPMENT. MECHANICAL CONTRACTOR RESPONSIBLE TO PROVIDE A FULL WORKING SYSTEM.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that overhead supports are installed in correct locations.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and NFPA 96.
- B. Install hoods level and plumb, securely fastened, with seismic restraints as specified, and free of vibration during normal operation.
- C. Weld hood duct collars to ductwork, liquid-tight.
- D. Connect to utilities.

- E. Complete field assembly of hoods where required.
 - 1. Make closed butt and contact joints that do not require filler.
 - 2. Grind field welds on stainless-steel equipment smooth, and polish to match adjacent finish. Comply with welding requirements in Part 2 "General Hood Fabrication Requirements" Article.
- F. Install hoods and associated services with clearances and access for maintaining, cleaning, and servicing hoods, filters/baffles, grease extractor, and fire-suppression systems according to manufacturer's written instructions and requirements of authorities having jurisdiction.
- G. Make cutouts in hoods where required to run service lines and to make final connections, and seal openings according to UL 1978.
- H. Securely anchor and attach items and accessories to walls, floors, or bases with stainless-steel fasteners, unless otherwise indicated.
- I. Install hoods to operate free from vibration.
- J. Install trim strips and similar items requiring fasteners in a bed of sealant. Fasten with stainless-steel fasteners at 48 inches o.c. maximum.
- K. Install sealant in joints between equipment and abutting surfaces with continuous joint backing, unless otherwise indicated. Provide airtight, watertight, vermin-proof, sanitary joints.
- L. Install lamps, with maximum recommended wattage, in equipment with integral lighting.
- M. Set initial temperatures, and calibrate sensors.
- N. Set field-adjustable switches.
- O. Connect ducts according to requirements in Section 23 3300 "Air Duct Accessories." Install flexible connectors on makeup air supply duct. Weld exhaust-duct connections with continuous liquidtight joint.
- P. Install fire-suppression piping for remote-mounted suppression systems according to NFPA 17A, "Wet Chemical Extinguishing Systems."
- Q. Install all emergency pulls, control panels, emergency gas shutoff valve, etc.. as shown on plans.

3.4 SYSTEM STARTUP

- A. Obtain the services of the manufacturer's representative experienced in the installation, adjustment, and operation of the equipment to supervise the starting and adjusting of equipment.
- B. Prepare equipment for startup, start and operate equipment for sufficient period to verify proper operation; correct equipment not operating correctly.
- C. Demonstrate operation to Owner's designated personnel.
- D. Tests and Inspections:

1. Test each equipment item for proper operation. Repair or replace equipment that is defective, including units that operate below required capacity or that operate with excessive noise or vibration.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 3. Perform hood performance tests required by authorities having jurisdiction.
 4. Perform fire-suppression system performance tests required by authorities having jurisdiction.
- E. Report deficiencies in writing to Architect.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Conduct training of Owner's designated personnel in the operation and maintenance of equipment.
- D. Perform at least 2 hours of training, for minimum of 2 people, at project site.
- E. Arrange training sessions with Owner at least 2 weeks in advance.
- F. Have operation and maintenance data on hand for training sessions.

3.6 CLEANING

- A. Clean surfaces of equipment.
- B. See Section 01 7419 - Construction Waste Management and Disposal, for additional requirements.

3.7 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 23 3813

SECTION 23 5216 - CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured units.
- B. Boiler construction.
- C. Boiler trim.
- D. Fuel burning system.
- E. Factory installed controls.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 23 2114 - Hydronic Specialties.
- C. Section 23 2123 - Hydronic Pumps.
- D. Section 23 2500 - HVAC Water Treatment.
- E. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.3 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. ANSI Z21.13 - American National Standard for Gas-Fired Low-Pressure Steam and Hot Water Boilers; 2022.
- 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 103 - Method of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2022.
- E. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2025, with Errata.
- F. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.
- G. NFPA 54 - National Fuel Gas Code; 2021.

- H. NFPA 58 - Liquefied Petroleum Gas Code; 2024.
- I. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.
- C. Manufacturer's Field Reports: Burner manifold gas pressure, percent carbon monoxide (CO), percent oxygen (O), percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide a ten year warranty to include coverage for heat exchanger.
- C. All parts and controls shall have a one year warranty against defects in manufacturing, materials, and workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Thermal Solutions
- B. Lochinvar

2.2 MANUFACTURED UNITS

- A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

- B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.
- C. Annual Fuel Utilization Efficiency (AFUE): 94% in accordance with ASHRAE Std 103.

2.3 BOILER CONSTRUCTION

- A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.
- B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.
- C. Required Directory Listings:
 - 1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
 - 2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.
- D. Heat Exchanger: Stainless Steel
- E. Provide adequate tapings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.
- F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.
- G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, or painted finish.

2.4 BOILER TRIM

- A. ASME rated pressure relief valve.
- B. Flow switch.
- C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.
- D. Temperature and pressure gauge.
- E. Pressure Switches:
 - 1. High gas pressure.
 - 2. Low gas pressure.
- F. Manual reset high limit.

2.5 FUEL BURNING SYSTEM

- A. Provide forced draft automatic burner, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.

1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
 2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
 3. Combustion Air Filter: Protects fuel burning system from debris.
- B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.
- C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.
- D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.6 FACTORY INSTALLED CONTROLS

- A. Option for internal or external (0-10) VDC control.
- B. Temperature Controls:
1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
 2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
 3. Low-fire start time delay relay.
- C. Electronic PI setpoint/modulation control system.
- D. Microprocessor-based, fuel/air mixing controls.

2.7 BOILER CONTROL SYSTEM

- A. Scope of Supply: Supply a boiler control system to provide safety interlocks and water temperature control. The control system shall be fully integrated into the boiler control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of up to eight (8) fully modulating hot water boilers and boiler pumps. The control system shall simply control boiler modulation and on/off outputs based on the boiler water supply temperature and an operator-adjusted setpoint. However, using parameter menu selections, the control system shall allow the boiler to respond to remote system water temperature and outside air temperatures with domestic hot water priority (DHWP) and warm weather shut down (WWSD) or building automation system (BAS) firing rate demand, remote setpoint or remote start/stop commands
- B. Boiler Control: Using PID (proportional-integral-derivative) based control, the remote system water temperature shall be compared with a setpoint to establish a target boiler firing rate. If the secondary loop flow speed is greater than the primary loop flow speed, firing rate is increased in response to the decrease in secondary loop temperature. When the remote system temperature is near the boiler high limit temperature, the boiler supply sensor shall limit the maximum boiler supply temperature to prevent boiler high limit events. Alternately, using parameter menu selections, the control system shall allow the boiler to respond directly to boiler supply

temperature and setpoint to establish a target boiler firing rate while remote system water temperature is used for display purposes only. Each boiler's fuel flow control valve shall be mechanically linked to the air flow control device to assure an air rich fuel/air ratio. All the automated logic required to ensure that pre-purge, post-purge, light-off, and burner modulation shall be provided.

- C. Hot Water Temperature Setpoint: When the controller is in the local control mode, the control system shall establish the setpoint based on outside air temperature and a reset function curve, or be manually adjusted by the operator. When enabled, the setpoint shall be adjusted above a preset minimum setpoint upon sensing a domestic hot water demand contact input.
- D. Multiple Boiler Sequence: Multiple boilers shall be modulated in "unison" (all at the same firing rate). The control system shall utilize both water temperature and boiler firing rate percent to start and stop the boilers and shall minimize the total number of boilers in operation. The control system shall start and stop boilers when the water temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize temperature deviations, the control system shall start and stop the next boiler when the "lead" boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. When rotation is enabled the lead boiler shall automatically rotate every 1 to 168 hours. The boiler shall be run at low fire for warm-up for a preset low fire hold time. When enabled, warm weather shut down control logic shall prevent boiler operation.
- E. User Interface: A touch-screen message display with two-tone backlight shall be provided to display numeric data, startup and shutdown sequence status, alarm, system diagnostic, first-out messages and boiler historical information. The two-tone backlight, shall light red, in the event of an alarm and green in any other condition. Historical information shall include the last ten lockout and alarm conditions, number of boiler cycles, boiler hours and last ten low boiler return temperature events. When boiler return water temperature is below a minimum setpoint a low temperature events shall be stored with time, date, "lowest temperature for event" and "duration below setpoint" data. At a minimum, the boiler system shall display the following:
 - 1. The display must be accessible through the front of the jacket, so that users can read displays, without removal of the boiler jacket.
 - 2. Numeric Display with Engineering Units:
 - a. Boiler Supply Water Temperature
 - b. Boiler Return Water Temperature
 - c. Remote System Temperature (when required by contract drawings)
 - d. Outside Air Temperature
 - 1) A factory supplied outdoor air temperature sensor must be supplied with the boiler.
 - e. Firing Rate %
 - f. Boiler Temperature Setpoint
 - g. Mixing Valve % (when required by contract drawings)
 - 3. Status Startup And Shutdown Sequence English language Messages:
 - a. Boiler disabled
 - b. Warm Weather Shutdown
 - c. Lockout
 - d. Pump Purge

- e. Limit Hold
 - f. Purge/Pilot Ignition
 - g. Low Fire/Pilot Ignition
 - h. Main Burner Ignition
 - i. Boiler Running
 - j. Fan Post Purge
 - k. Pump Cooldown
 - l. Standby
4. Alarm, System Diagnostic, First-Out English language Messages: (numeric code numbers shall not be acceptable):
- a. Low Water Level (when required by contract drawings)
 - b. Low Water Flow (when required by contract drawings)
 - c. Fuel Limit (gas pressure or oil temperature)
 - d. High Boiler Supply Temperature Limit
 - e. Low Return Water Temperature
 - f. Low Air Flow
 - g. Flame Safeguard Internal Fault
 - h. High Supply Temperature
 - i. Supply Temperature Sensor Fault
 - j. Return Temperature Sensor Fault
 - k. Outside Air Temperature Sensor Fault
 - l. Remote System Temperature Sensor Fault
 - m. Remote Input Signal Fault
 - n. Modbus Communication Fault
 - o. Memory Fault
- F. Flame Safeguard (FSG): The boiler controller shall also be the primary flame safeguard, overseeing operation of the burner, firing sequence and safe operation of the complete unit. Thus eliminating the need to program and troubleshoot multiple electronic components during installation, setup and service.
- G. Boiler Pump Sequence: Include primary water pump control to allow boiler warm-up to the return water temperature before the boiler start; continue water flow for an adjustable cool down period after the boiler has stopped; and ensure water is always moving past the remote system temperature sensor even after the last boiler has been stopped. The pump shall immediately stop if any trips occur during pre-purge, pilot, or main flame trial for ignition.
- H. Communication: Include an RS485 modbus slave or peer-to-peer communications data highway on each boiler control system. When peer-to-peer communication is enabled the data highway shall allow the connected boilers to exchange signals as required to provide coordinated fully modulating lead/lag functions. It shall not be required to wire individual control signals between boilers. When modbus communication is enabled the data highway shall allow individual boiler limits, lockout, boiler and system temperatures and firing rate status to be readable and water setpoint, boiler firing rate, and start/stop command to be readable and writable. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA (Supervisory Control And Data Acquisition system, typically a desk top personal computer) system is not included in this project.

- I. Quality Assurance: The boiler control system shall be supplied as part of a factory assembled and tested boiler control cabinet.

2.8 VENTING AND COMBUSTION AIR

- A. Vent Material - The boiler shall be vented using double wall AL-29-4C stainless steel venting. PVC Venting will not be allowed for boiler venting.
- B. Combustion Air Material - Air intake piping shall be PVC that is sealed and pressure tight. Pipe must be at least the same size as the inlet air connection on the boiler.

2.9 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Provide factory tests to check construction, controls, and operation of unit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.
- C. Install boiler and provide connection of liquified petroleum gas service in accordance with requirements of NFPA 58 and applicable codes.
- D. Install boiler on concrete housekeeping base, sized minimum of 4 inches (100 mm) larger than boiler base in accordance with Section 03 3000.
- E. Coordinate provisions for water treatment in accordance with Section 23 2500.
- F. Pipe relief valves to nearest floor drain or as shown on plan.
- G. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.
- H. Install primary boiler pump in accordance with Section 23 2123.
- I. Provide piping connection and accessories in accordance with Section 23 2114.
- J. Provide for connection to electrical service in accordance with Section 26 0583.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Perform installation and startup checks according to manufacturer's written instructions.
 - 2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment
 - a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level, and water temperature.
 - b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Prepare test and inspection reports.
- F. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion , provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

3.3 CLOSEOUT ACTIVITIES

- A. See Section 01 7900 - Demonstration and Training for additional requirements.
- B. Demonstrate proper operation of equipment to Owner's designated representative.
- C. Demonstration: Demonstrate operation of system to Owner's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.
- D. 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.

3.4 SYSTEMS STARTUP

- A. Provide the services of manufacturer's field representative for starting and testing unit. Provide a second on-site verification of boiler performance during the first heating season to verify boilers are operating at peak efficiency. There shall be a minimum of 45 days between the original start-up and the second follow-up trip.

END OF SECTION 23 5216

SECTION 23 7200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Energy recovery units.

1.2 RELATED REQUIREMENTS

- A. Section 07 7200 - Roof Accessories: Equipment roof curb.
- B. Section 23 0548 - Vibration and Seismic Controls for HVAC.
- C. Section 23 0923 - Direct-Digital Control System for HVAC.
- D. Section 26 0583 - Wiring Connections.

1.3 REFERENCE STANDARDS

- A. AHRI 1060 (I-P) - Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment; 2023.
- B. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).
- 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. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's installation instructions, product data, and engineering calculations.
- C. Shop Drawings: Show design and assembly of energy recovery unit and installation and connection details.
- D. Closeout Submittals: Submit manufacturer's operation and maintenance instructions.
- 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 Stock Materials: Two sets of filters.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store equipment and products to be installed indoors in dry heated area.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 1-year manufacturer warranty for equipment including parts, materials, workmanship, and operation commencing on date of Substantial Completion. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.1 ENERGY RECOVERY UNIT

- A. Manufacturers:
 1. Renewaire
 2. Greenheck
 3. Fantech
 4. S & P
 5. Oxygen 8
- B. ERV Equipment Construction Requirements:
 1. Energy Recovery Exchanger Type: Membrane plate.
 2. ERV Equipment Location: As indicated on drawings.
 3. Supply and Return Duct Connection Orientation: As indicated on drawings.
 4. Duct Connection Collars: Aluminum, continuously welded 0.08 inch (2 mm), minimum.
 5. Casing and Frame:
 - a. Frame: Galvanized steel body or welded extruded aluminum tubular frame capable of supporting components and casings including integral base lifting holes.
 - b. Double Wall Panels: Minimum of 18 gauge, 0.040 inch (1.02 mm) galvanized steel.
 - c. Housing: Manufacturer's standard construction with corrosion-protection coating and exterior finish, gasketed and calked weathertight, hinged access doors, removable panels with neoprene gaskets for inspection and access to internal parts, minimum 1-inch- (25-mm-) thick thermal insulation, knockouts for electrical and piping connections, exterior drain connection, and lifting lugs.
 - d. Doors: Construct doors of same construction and thickness as wall panels. Include p-shaped extruded neoprene gasket, prop rod, chain with spring, exterior handle, and

- interior 3-point latching device. Label each door to identify equipment located within.
- e. Isolation and Sealing: Form continuous, thermally isolated, weathertight seal between inner wall of panels and structural framing with closed cell PVC foam gasketing and seal seams to prevent job site caulking.
 - f. Access Panels: Provide access to components through a large, tightly sealed and easily removable hinged or screwed access panel.
 - g. Finish: Baked powder paint over weather-protected, corrosion-resistant assembly.
 - h. Nameplate: Permanent name plate listing manufacturer, model number, serial number, voltage with tolerance, and amp ratings mounted inside door near electrical panel.
6. Supply and Exhaust Fans:
- a. Provide separate non-overloading, statically and dynamically balanced, draw-through, forward curved centrifugal fan or fan-array for each air stream.
 - b. Fan Motor: high efficiency, load matched, open drip proof, thermal overload protected ODP or TEFC direct drive motor, and adjustable-removable motor-slide base.
 - c. Motor Bearings: Permanently lubricated sealed ball bearings rated for not less than 200,000 hours of operation with accessible greased fittings.
7. Dampers and Louvers:
- a. Service Ratings: Up to 6 in-wc (1.5 kPa) closed and 3,000 fpm (15.24 m/s) when open.
 - b. Frame: Minimum of 20 gauge, 0.0359 inch (0.91 mm) galvanized steel channel with rear flange, prepunched mounting holes, and welded corner clips for maximum rigidity.
 - c. Exhaust Damper: Parallel blade, barometric damper for exhaust air stream isolation.
 - d. Outdoor-Intake Louver: Parallel blade, for exhaust air stream isolation. Provide weatherhood with intake insect screen and mist eliminator on outdoor units.
8. Filter Sections:
- a. Outdoor-Intake and Exhaust Sides: 1 inch (25 mm) thick, pleated, _____ filters, ASHRAE Std 52.2.
 - 1) MERV rating as called out on the drawings and schedules.
 - b. Filter Racks: Bolt-on rack constructed of aluminum with minimum size of 1/12 inch (2 mm) thick. Include hinged side access door and snap fasteners.
9. Roof Curbs (if applicable):
- a. Curbs: Provide full perimeter, watertight, sloped, weight-supporting roof curb fabricated from minimum of 10 gauge, 0.1345 inch (3.42 mm) aluminized steel.
 - b. Isolation Rails: Provide factory-installed, 12 gauge, 0.1046 inch (2.66 mm) aluminized steel angles top and bottom, connected with flexible, outdoor rated membrane and factory-installed vibration isolation springs.
 - c. Gaskets: Provide closed cell PVC foam, field installed top of curb.
10. Vibration Isolation: Provide corrosion-resistant vibration isolation products for internal motors and other revolving parts. See Section 23 0548.
11. Electrical:
- a. Install internal wiring in accordance with NFPA 70 within flexible, liquid tight steel conduit.
12. Controls and Local Control Panel:

- a. Unit Controls: Factory supplied DDC with sensors, limit switches, and frost control.
 - b. Provide fused disconnect within local control panel with power supplies, transformers, terminal strip or terminal blocks for interface of field installed components.
 - c. Freeze Protection Thermostat: Provide and configure to stop unit when outdoor air intake temperature drops below 38 degrees F (3.3 degrees C), adjustable.
13. Configuration: Adjust listed requirements in conformance with ASHRAE Std 90.1 I-P.
14. Certification: AHRI 1060 (I-P) labeled, include copy of published ratings for operating conditions.
15. PERFORMANCE
- a. Energy Transfer: The energy recovery core shall be capable of transferring both sensible and latent energy between air streams. Latent energy transfer shall be accomplished through molecular transport by hydroscopic resin.
 - b. Positive Air stream Separation: Exhaust and fresh airstreams shall at all times travel in separate passages, and airstreams shall not mix. The exhaust air transfer ratio (EATR) shall be ARI-1060 certified as 0% at balanced pressure.
 - c. Laminar Flow: Airflow through the energy recovery core shall be laminar, avoiding deposition of particulates on the interior of the exchange plate material.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that structure is ready for installation including openings, ductwork, mechanical utilities, and electrical utilities.
- B. Rooftop Installation: Verify that equipment supplied roof curbs are installed and ready to receive intended unit otherwise provide equipment matched roof curbs; see Section 07 7200.

3.2 INSTALLATION

- A. Install equipment in accordance with manufacturer's written installation instructions.
- B. Do not obstruct maintenance access to equipment piping, electrical conduit, or any other utility.
- C. Vibration Isolation: Provide corrosion-resistant equipment isolation products; see Section 23 0548.
- D. Outdoor Installation: Use concealed means of attachment. Minimize penetrations through roof. Provide weather tight seal at required penetrations. Provide drip edge around roof perimeter. Do not locate roof panel joints above doors.
- E. Electrical: Provide equipment raceway, wiring, and cables; see Section 26 0583.
- F. Coordinate installation and fire alarm system interface of system compatible duct-mounted smoke detectors and other appurtenances following NFPA 90A guidelines.
- G. Start system and adjust controls and equipment for satisfactory operation.

- H. Coordinate hardwired or software interfacing links to enable coordinate as minimum start-stop, occupied, unoccupied functions as well as specific schedules and setpoints functions with other DDC controls onboard airside systems serving common spaces; see Section 23 0923.
- I. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

3.3 SYSTEM STARTUP

- A. Provide services of manufacturer's authorized representative to provide start up of unit.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 - 1. Inspect for visible damage to unit casing.
 - 2. Inspect internal insulation.
 - 3. Verify that labels are clearly visible.
 - 4. Verify that clearances have been provided for servicing.
 - 5. Verify that controls are connected and operable.
 - 6. Verify that filters are installed.
 - 7. Remove packing from vibration isolators.
 - 8. Inspect operation of dampers.
 - 9. Verify lubrication on fan and motor bearings.
 - 10. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 11. Adjust fan belts to proper alignment and tension.
 - 12. Start unit according to manufacturer's written instructions.
 - a. Complete startup sheets and attach copy with Contractor's startup report.
 - 13. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 14. Operate unit for an initial period as recommended or required by manufacturer.
 - 15. Calibrate thermostats.
 - 16. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 - 17. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.4 CLEANING

- A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
- B. Clean filters, air plenums, interior and exposed-to-view surfaces prior to Substantial Completion.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals for additional submittals.
- B. See Section 01 7900 - Demonstration and Training for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION 23 7200

SECTION 23 7413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

SECTION 237413 - PACKAGED, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

2.1 RELATED DOCUMENTS

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

2.2 SUMMARY

- A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
 - 1. Direct-expansion cooling.
 - 2. Economizer outdoor- and return-air damper section.
 - 3. Roof curbs.

2.3 DEFINITIONS

- A. DDC: Direct-digital controls.
- B. ECM: Electrically commutated motor.
- C. Outdoor-Air Refrigerant Coil: Refrigerant coil in the outdoor-air stream to reject heat during cooling operations and to absorb heat during heating operations. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- D. Outdoor-Air Refrigerant-Coil Fan: The outdoor-air refrigerant-coil fan in RTUs. "Outdoor air" is defined as the air outside the building or taken from outdoors and not previously circulated through the system.
- E. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
- F. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.
- G. Supply-Air Refrigerant Coil: Refrigerant coil in the supply-air stream to absorb heat (provide cooling) during cooling operations and to reject heat (provide heating) during heating operations. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

- H. VVT: Variable-air volume and temperature.

2.4 REFERENCE STANDARDS

- A. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.
- B. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- F. UL 1995 - Heating and Cooling Equipment; Current Edition, Including All Revisions.

2.5 ACTION SUBMITTALS

- A. Product Data: Include manufacturer's technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.

2.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.
- B. Warranty: Special warranty specified in this Section.

2.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

2.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: 4 sets of filters for each unit.

2.9 QUALITY ASSURANCE

- A. ARI Compliance:

1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
1. Comply with ASHRAE 15 for refrigeration system safety.
 2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
 3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- E. UL Compliance: Comply with UL 1995.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- 2.10 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.
1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 PRODUCTS

3.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AAON, Inc.
 2. Carrier Corporation.
 3. McQuay International.
 4. Trane
 5. YORK
 6. Daikin

3.2 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

- B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 - 1. Exterior Casing Thickness: 0.052 inch (1.32 mm) thick.
- C. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - 1. Materials: ASTM C1071, Type I.
 - 2. Thickness: 2 inch (50.8 mm).
- D. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches (50.8 mm) deep, and complying with ASHRAE 62.1.
 - 1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
 - 2. Drain Connections: Threaded nipple.
 - 3. Pan-Top Surface Coating: Corrosion-resistant compound.
- E. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

3.3 FANS

- A. Direct-Driven Supply-Air Fans: Direct drive; with permanently lubricated, factory mounted VFD or ECM motor resiliently mounted in the fan inlet. Aluminum wheels and fan scrolls.
- B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.
- C. Relief-Air Fan: Backward inclined, shaft mounted on permanently lubricated motor. Provide factory mounted VFD or ECM motor.
- D. Fan Motor: Comply with requirements in Section 20 0513 "Common Motor Requirements."

3.4 COILS

- A. Supply-Air Refrigerant Coil:
 - 1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
 - 3. Coil Split: Interlaced.
 - 4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1.
- B. Outdoor-Air Refrigerant Coil:
 - 1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor, or continuously wrapped, corrosion resistant all aluminum with minimum brazed joints.

3.5 REFRIGERANT CIRCUIT COMPONENTS

- A. Number of Refrigerant Circuits: One.

- B. Compressor: Variable Speed or digital scroll, hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.
- C. Refrigeration Specialties:
 - 1. Refrigerant: As indicated on drawings
 - 2. Expansion valve with replaceable thermostatic element.
 - 3. Refrigerant filter/dryer.
 - 4. Manual-reset high-pressure safety switch.
 - 5. Automatic-reset low-pressure safety switch.
 - 6. Minimum off-time relay.
 - 7. Automatic-reset compressor motor thermal overload.
 - 8. Brass service valves installed in compressor suction and liquid lines.

3.6 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated: As indicated on the drawings.

3.7 WATER COIL SECTION

- A. General Requirements for Coil Section:
 - 1. Comply with ARI 410.
 - 2. Fabricate coil section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
 - 3. Coils shall not act as structural component of unit.
 - 4. Piping for coils shall be routed through curb and connect inside of RTU casing.
- B. Water Coils: Continuous circuit coil fabricated according to ARI 410.
 - 1. Piping Connections: Threaded, on same end.
 - 2. Tubes: Copper.
 - 3. Fins: Aluminum.
 - 4. Fin and Tube Joint: Silver brazed.
 - 5. Headers: Cast iron or copper with drain and air vent tappings.
 - 6. Frames: Galvanized-steel channel frame, 0.052 inch (1.32 mm) (0.05 inch (1.3 mm)).
 - 7. Ratings: Design tested and rated according to ASHRAE 33 and ARI 410.
 - a. Working-Pressure Ratings: 200 psig (1378.95 kPa), 325 deg F (163 deg C).
 - 8. Source Quality Control: Test to 300 psig (2068.43 kPa) and to 200 psig (1378.95 kPa) underwater.

3.8 DAMPERS

- A. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet as required for full economizer operation. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.

1. Damper Motor: Modulating with adjustable minimum position.

3.9 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

3.10 CONTROLS

- A. Control equipment and sequence of operation are specified in Section 23 0923 "Direct Digital Control (DDC) System for HVAC" and Section 23 0993.11 "Sequence of Operations for HVAC DDC."
- B. Basic Unit Controls:
 1. Control-voltage transformer.
- C. Interface Requirements for HVAC Instrumentation and Control System:
 1. Provide BACnet or LonWorks compatible interface for central HVAC control workstation for the following:
 - a. Adjusting set points.
 - b. Monitoring supply fan start, stop, and operation.
 - c. Inquiring data to include outdoor-air damper position.
 - d. Monitoring variable-frequency drive operation.
 - e. Monitoring cooling load.
 - f. Monitoring economizer cycles.
 - g. Monitoring air-distribution static pressure and ventilation air volume.

3.11 ACCESSORIES

- A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.
Powered from unit power
- B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.
- C. Hail guards of galvanized steel, painted to match casing.
- D. Supply fan Piezo Ring

3.12 ROOF CURBS

- A. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C1071, Type I or II.
 - b. Thickness: 1-1/2 inches (38 mm).

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
 - a. Liner Adhesive: Comply with ASTM C916, Type I.
 - b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
 - c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
 - d. Liner Adhesive: Comply with ASTM C916, Type I.

B. Curb Height: As indicated on the drawings.

3.13 CAPACITIES AND CHARACTERISTICS

A. As indicated on the drawings.

PART 3 EXECUTION

4.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.
- B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where RTUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 INSTALLATION

- A. Roof Curb: Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 07 7200 "Roof Accessories." Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

4.3 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap.
- B. Install piping adjacent to RTUs to allow service and maintenance.
- C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 1. Install ducts to termination at top of roof curb.
 2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.

3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 23 3300 "Air Duct Accessories."
4. Install return-air duct continuously through roof structure.

4.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Perform tests and inspections and prepare test reports.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.
- C. Tests and Inspections:
 1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Remove and replace malfunctioning units and retest as specified above.

4.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
 1. Inspect for visible damage to unit casing.
 2. Inspect for visible damage to furnace combustion chamber.
 3. Inspect for visible damage to compressor, coils, and fans.
 4. Inspect internal insulation.
 5. Verify that labels are clearly visible.
 6. Verify that clearances have been provided for servicing.
 7. Verify that controls are connected and operable.
 8. Verify that filters are installed.
 9. Clean condenser coil and inspect for construction debris.
 10. Clean furnace flue and inspect for construction debris.
 11. Connect and purge gas line.
 12. Remove packing from vibration isolators.
 13. Inspect operation of relief dampers.
 14. Verify lubrication on fan and motor bearings.
 15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.

16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing. Adjust burner for peak efficiency.
 - a. Measure gas pressure on manifold.
 - b. Inspect operation of power vents.
 - c. Measure combustion-air temperature at inlet to combustion chamber.
 - d. Measure flue-gas temperature at furnace discharge.
 - e. Perform flue-gas analysis. Measure and record flue-gas carbon dioxide and oxygen concentration.
 - f. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Calibrate thermostats.
22. Adjust and inspect high-temperature limits.
23. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F (8 deg C) above return-air temperature:
 - a. Coil leaving-air, dry- and wet-bulb temperatures.
 - b. Coil entering-air, dry- and wet-bulb temperatures.
 - c. Outdoor-air, dry-bulb temperature.
 - d. Outdoor-air-coil, discharge-air, dry-bulb temperature.
25. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Simulate maximum cooling demand and inspect the following:
 - a. Compressor refrigerant suction and hot-gas pressures.
 - b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.
27. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
 - a. High-temperature limit on gas-fired heat exchanger.
 - b. Low-temperature safety operation.
 - c. Filter high-pressure differential alarm.
 - d. Economizer to minimum outdoor-air changeover.
 - e. Relief-air fan operation.
 - f. Smoke and firestat alarms.
28. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

4.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

4.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs. Refer to Section 01 7900 "Demonstration and Training."

END OF SECTION 23 7413

SECTION 23 7423.13 - PACKAGED, DIRECT-FIRED, OUTDOOR, HEATING-ONLY MAKEUP- AIR UNITS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- A. ANSI LC 1/CSA 6.26 - Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing; 2023.
- B. NFPA 54 - National Fuel Gas Code; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.2 SUMMARY

- A. Section includes direct-fired heating and ventilating units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type and configuration of outdoor, direct-fired heating and ventilating unit.
- B. Shop Drawings: For each type and configuration of outdoor, direct-fired heating and ventilating unit.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and maintenance data.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

- C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of direct-fired heating and ventilating units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than five years from date of Substantial Completion.

PART 2 PRODUCTS

- 2.1 MAKE UP AIR UNIT PROVIDED BY KITCHEN EQUIPMENT SUPPLIER AND INSTALLED BY MECHANICAL CONTRACTOR. REFERENCE KITCHEN SUPPLIER PLANS, SPECIFICATIONS, AND RESPONSIBILITY MATRIX FOR REQUIREMENTS ON WHO IS PROVIDING WHAT EQUIPMENT AND WHO IS INSTALLING THE EQUIPMENT. MECHANICAL CONTRACTOR RESPONSIBLE TO PROVIDE A FULL WORKING SYSTEM.

2.2 CONTROLS

- A. Fan Control: Interlock fan to start with exhaust fan(s) to which this heating and ventilating unit is associated for makeup air.
- B. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
- C. Temperature Control: Operates gas valve to maintain supply-air temperature.
 - 1. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
 - 2. Burner Control: Two or four steps of control using one or two burner sections in series.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- B. Unit Support: Install heating and ventilating unit level on structural curbs . Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.
- C. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."

- D. Install controls and equipment shipped by manufacturer for field installation with direct-fired heating and ventilating units.
- E. Roof Curb: Install on roof structure or concrete base, level and secure, according to AHRI Guideline B. Install units on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure units to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.
- F. Unit Support: Install unit level on structural curbs . Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

3.2 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 1. Gas Piping: Comply with requirements in Section 231123 "Facility Natural-Gas Piping." Connect gas piping with shutoff valve and union, and with sufficient clearance for burner removal and service. Make final connections of gas piping to unit with corrugated, stainless-steel tubing flexible connectors complying with ANSI LC 1/CSA 6.26 equipment connections.
- B. Drain: Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for traps and accessories on piping connections to condensate drain pans under condensing heat exchangers. Where installing piping adjacent to heating and ventilating units, allow space for service and maintenance.
- C. Duct Connections: Connect supply ducts to direct-fired heating and ventilating units with flexible duct connectors. Comply with requirements in Section 233300 "Air Duct Accessories" for flexible duct connectors.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.
- B. Units will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain heating and ventilating units.

END OF SECTION 23 7423.13

SECTION 23 8126 - SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.2 RELATED DOCUMENTS

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

1.3 SUMMARY

- A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 - 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 - 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: One year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mitsubishi
 - 2. Panasonic
 - 3. Samsung
 - 4. TRANE
 - 5. Daikin
 - 6. Gree

2.2 INDOOR UNITS (5 TONS (18 KW) OR LESS)

- A. Wall-Mounted, Evaporator-Fan Components:
 - 1. Cabinet: Enameled steel with removable panels on front and ends, and discharge drain pans with drain connection.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive, centrifugal.
4. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 200513 "Common Motor Requirements."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - b. Single-wall, polymer tank with foam insulation and moisture-tight seal.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on both ends of pan.
7. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

2.3 OUTDOOR UNITS (5 TONS (18 KW) OR LESS)

- A. Air-Cooled, Compressor-Condenser Components:
 1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
 2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Variable speed Scroll.
 - b. Variable speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-407C or R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
 3. Fan: Aluminum-propeller type, directly connected to motor.
 4. Motor: Permanently lubricated, with integral thermal-overload protection.
 5. Ultra Low Ambient Kit: Permits operation down to -40 deg F.

- 6. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 - 1. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 2. Fan-speed selection including auto setting.
- B. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line and liquid line with flared fittings at both ends.
- C. Drain Hose: For condensate.

2.5 CAPACITIES AND CHARACTERISTICS

- A. As Scheduled on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07 7200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
 - C. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - D. Remove and replace malfunctioning units and retest as specified above.
 - E. Prepare test and inspection reports.
- 3.4 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
- 3.5 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 8126

SECTION 23 8200 - CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hydronic unit heaters.
- B. Hydronic cabinet unit heaters.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 23 0513 - Common Motor Requirements for HVAC Equipment.
- C. Section 23 0993 - Sequence of Operations for HVAC Controls.
- D. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

- A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.
- B. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- C. AHRI 440 - Performance Rating of Room Fan-Coils; 2008.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate air coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
 - 2. 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.
 - 3. Submit the following for blower-coil units indicating:
 - a. Overall dimensions including installation, operation, and service clearances.

- b. Unit shopping, installation, and operating weights including dimensions.
 - c. Fan curves with specified operating point clearly plotted.
 - d. Safety and start-up instructions.
- C. Selection Samples: For each finish product specified, color chart representing manufacturer's full range of available colors.
- D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.
- E. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Provide One year manufacturer's warranty from date of Substantial Completion.

PART 2 PRODUCTS

2.1 HYDRONIC UNIT HEATERS

- A. Manufacturers:
 - 1. Zehnder Rittling
 - 2. McQuay
 - 3. Trane
 - 4. Vulcan
 - 5. Sigma
 - 6. Sterling
 - 7. Modine
- B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- C. Perform factory run test under normal operating conditions, water, and steam flow rates.
- D. Casing: Minimum 18 gauge, 0.0478 inch (1.21 mm) thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch (1.21 mm) thick sheet steel top and bottom plates for vertical projection models.
- E. Finish: Factory applied baked enamel of standard manufacturer color.

- F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- G. Air Outlet: Adjustable pattern diffuser on vertical projection models and two- or four- way louvers on horizontal projection models.
- H. Motors: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models. See Section 23 0513
- I. Control: Local solid state disconnect switch with electropneumatic wall-mounted thermostat.

2.2 HYDRONIC CABINET UNIT HEATERS

- A. Manufacturers:
 - 1. Zehnder Rittling
 - 2. McQuay
 - 3. Trane
 - 4. Vulcan
 - 5. Sigma
 - 6. Sterling
 - 7. Modine
- 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 purpose indicated.
- C. Coils:
 - 1. Evenly spaced aluminum fins mechanically bonded to copper tubes.
 - 2. Heating Hot Water: Suitable for working temperatures up to a maximum not less than 200 degrees F (93 degrees C).
- D. Cabinet: Minimum 16 gauge, 0.0598 inch (1.52 mm) thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.
- E. Finish: Factory applied baked enamel of color as selected on visible surfaces of enclosure or cabinet.
- F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- H. Control: Factory wired, solid state, infinite speed control, located in cabinet.
- I. Filter: Easily removed, 1 inch (25 mm) thick glass fiber throw-away type, located to filter air before coil.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are suitable for installation.
- B. Verify that field measurements are as indicated on drawings.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.
- C. Do not damage equipment or finishes.
- D. 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.
- E. Cabinet Unit Heaters:
 - 1. Install as indicated.
 - 2. Coordinate to ensure correct recess size for recessed units.
- F. Units with Hydronic Coils:
 - 1. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.
 - 2. If not easily accessible, extend air vent to exterior surface of cabinet for ease of servicing.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Provide manufacturer's field representative to test, inspect, and instruct.

3.4 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.
- E. Install new filters.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training for additional requirements.

3.6 PROTECTION

- A. Provide finished cabinet units with protective covers during the balance of construction.

END OF SECTION 23 8200

SECTION 23 8216 - AIR COILS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Water coils.

1.2 RELATED REQUIREMENTS

- A. Section 23 0719 - HVAC Piping Insulation.
- B. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

- A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addenda (2011).
- B. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2020.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.
- C. Certificates: Certify that coil capacities, pressure drops, and selection procedures meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.
- B. Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Trane
- B. Daikin
- C. York
- D. Carrier Corporation
- E. Greenheck

2.2 WATER COILS

- A. Tubes: 5/8 inch (16 mm) OD seamless copper arranged in parallel or staggered pattern, expanded into fins, brazed joints.
- B. Fins: Aluminum minimum 0.006 inch (0.152 mm) thick.
- C. Casing: Die formed channel frame of 16 gauge, 0.0598 inch (1.52 mm) galvanized steel with mounting holes on 3 inch (75 mm) centers. Provide tube supports for coils longer than 36 inches (900 mm).
- D. Headers: Seamless copper tube with silver brazed joints.
- E. Testing: Air test under water to 300 psi (2070 kPa) for working pressure of 200 psi (1380 kPa) and 325 degrees F (163 degrees C).
- F. Configuration: Serpentine type with return bends on smaller sizes and return headers on larger sizes.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Install in ducts and casings in accordance with SMACNA (DCS).
 - 1. Support coil sections independent of piping on steel channel or double angle frames and secure to casings.
 - 2. Provide airtight seal between coil and duct or casing.
- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install coils level. Install cleanable tube coils with 1:50 pitch.
- E. Make connections to coils with unions and flanges.
- F. Hydronic Coils:

1. Hydronic Coils: Connect water supply to leaving air side of coil (counterflow arrangement).
2. Provide manual air vents at high points complete with stop valve.
3. Ensure water coils are drainable and provide drain connection at low points.

END OF SECTION 23 8216

SECTION 26 0000 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 APPLICABILITY

- A. This section applies to and forms a part of each of the sections of Divisions 26, 27, and 28.
- B. General and Supplementary Conditions, and Division 1 – General Requirements shall apply to all work specified in this section.

1.2 SCOPE OF WORK

- A. The work under this section of the specifications consists of providing all labor, supervision, equipment, and materials necessary for and incidental to the installation of the complete electrical systems required by these specifications and/or drawings of the contract.

1.3 DRAWINGS

- A. The drawings indicate the extent and general layout of the electrical systems and are intended to be as accurate as planning can determine at the scale shown for estimating purposes only. Field verification of dimensions, locations, and construction details is required. Review appropriate drawings, make field measurements and adjust work to suit the conditions encountered. Electrical drawings are only diagrammatic but shall be followed as closely as actual construction of other trade will permit.
- B. Do not scale off the electrical drawings.
- C. Notify the Architect/Engineer of any discrepancies in or omissions from the drawings and documents. Interpretations will be made only by written Addenda. If discrepancies are not reported, the contractor shall bid the greater quantity or better quality, and appropriate adjustment will be made after contract award.
- D. Discrepancies discovered during construction shall immediately be called to the attention of the Architect/Engineer for clarification.

1.4 PERMITS AND LICENSES

- A. Obtain and pay for all licenses and permits, and pay all fees and charges for the connection to outside services as required by the inspecting authorities having jurisdiction.

1.5 CODES AND ORDINANCES

- A. The entire installation shall be made in accordance with all ordinances, laws, regulations, and codes applicable to the work involved. If, in any instance, the plans and specifications conflict with such laws, the law shall take preference. This does not relieve the contractor from complying with any requirements of the drawings and specifications that may be in excess of the rules and not contrary to the same.

1.6 PROGRESS OF WORK

- A. Organize the work so that progress of electrical work will conform to the progress of other trades. Complete the entire installation as soon as building conditions permit.

1.7 COOPERATION WITH OTHER TRADES

- A. Cooperate with other trades and organize work so as to avoid conflict in space and time sequence. If interference develops, the matter shall be brought to the attention of the Architect/Engineer for decision.
- B. Prior to rough-in, verify voltage and current characteristics and control connections of electrical equipment furnished by others and wired under this division.

1.8 INSPECTION OF SITE

- A. Before submitting a proposal on the work contemplated in these specifications and accompanying drawings, each bidder shall examine the site and familiarize himself with the existing conditions and limitations. No extras will be allowed because of the contractor's misunderstanding as to the amount of work involved or his lack of knowledge of existing site conditions.

1.9 TESTS

- A. Test all equipment installed under these specifications and demonstrate its proper operation to the Architect/Engineer and Owner's representatives.
- B. Do not test or operate equipment for any purpose until it has been fully installed and serviced in accordance with the manufacturer's instructions.
- C. The entire installation shall be tested free from open and short circuits and improper grounds.

1.10 OPERATING INSTRUCTIONS

- A. At the completion of the project, the contractor shall furnish competent instruction to the Owner or his designated representatives, in operation and routine maintenance of the electrical equipment and systems.

1.11 RECORD DRAWING

- A. The contractor shall maintain one set of drawings at the job site to be used as a master copy. All changes and deviations shall be clearly marked and noted by colored pencil. These drawings shall be turned over to the Architect upon project completion.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION 26 0000

SECTION 26 0100 - BASIC MATERIALS AND METHODS

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 MATERIAL AND WORKMANSHIP

- A. All material shall be new, of the quality specified, and shall conform to NFPA, NEMA, UL and ANSI standards in every case where such a standard had been established for the particular type of material.
- B. Equipment shall be furnished with an U.L. label. Materials shall be standard products of manufacturer's regularly shall be standard products of manufacturer's regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design.
- C. Installation of materials shall be coordinated with other trades and installed at such time and manner as to not delay or interfere with the work of other trades.
- D. All workmanship shall be neat, first class and complete in both effectiveness and appearance and shall be executed by a person licensed and skilled in the trade.
- E. This contractor shall be held solely responsible for proper size and location of hangers, slots, chases, openings, etc., required for proper installation of his work and shall arrange with the proper contractors for the building in of inserts and leaving chases or openings.

1.3 STANDARDIZATION OF PRODUCT MANUFACTURER

- A. Except as noted, all magnetic starters, manual starters and motor control centers shall be manufactured by the same company, all finishes shall be the same color, and all equipment shall fit the space designated. Equipment manufactured by G.E., Square D, Westinghouse or Allen Bradley will be acceptable providing they comply with the specific condition of the specifications and accompanying drawings.
- B. Wiring devices, lighting fixtures, and other items covered under single specifications shall be of the same manufacturer and style whenever practical or where failure to do so is visibly noticeable.

1.4 MATERIAL HANDLING, STORAGE AND PROTECTION

- A. This contractor shall make provisions for delivery and safe storage of materials and arrangement for introduction into building of equipment too large to pass through finished or existing openings.

- B. During construction, it shall be the responsibility of this contractor to protect the surface of equipment and material furnished.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 CLEANING AND PAINTING

- A. Clear away all debris, surplus material, etc., resulting from work operations, leaving the job and the equipment furnished under this contract in a clean condition.
- B. Equipment furnished with finished paint coat shall be examined upon job completion for scratches and surface damage. Damaged surfaces shall be touched up to match factory finish.
- C. Light fixtures shall be dusted and cleaned prior to final acceptance.

3.2 CONCRETE EQUIPMENT

- A. Switchboards and emergency generator shall be mounted on 4" concrete pads furnished as noted on drawings. Size pads such that pad extend 2" beyond the perimeter of the equipment installed.
- B. Exterior light fixtures shall be on or in concrete bases provided by the electrical contractor and as detailed on drawings.
- C. Concrete shall conform to Division 03 of this specification.

3.3 CUTTING AND REPAIRING

- A. Cutting, fitting, and repairing which may be required for this work shall be done by craftsmen skilled in their respective trades. When cutting is required it shall be done in such a manner as to not weaken walls, partition, or floors. Concrete and masonry shall be cut with a diamond core drill or concrete saw. When patching is required, it shall be done and finished to match existing. All existing walls shall be cut and patched to install new boxes and conduit for the new construction work.

3.4 PENETRATIONS

- A. Sleeves shall be used to accommodate conduits, cables or pipes passing through concrete floors, walls and partitions. Sleeves shall be black iron pipe or galvanized sheet metal set in place and secured in position. Sleeves located above grade shall be caulked with an approved caulking compound to make water tight, fireproof, etc., as required by the particular application. Sleeves located below grade or through on- grade slabs shall be black iron pipe and shall be made watertight with oakum and / or lead wool and sealed with asphalt. For fireproofing, use item equal to 3M product 2000. One hour walls require HWB1003, ULCBJ 1000 and 5000.

- B. Conduit passing through poured concrete walls or floors may be imbedded directly into the concrete, however when subject to sheer forces, i.e. below grade applications, the conduit must be rigid steel.
- C. Cables and conductors, not in raceway, shall be placed in sleeves when passing through fire and smoke partitions.
- D. Sleeves penetrating floors shall extend a minimum of 4" above finished floor.
- E. Where acceptable to the Architect/ Engineer and other trades involved, conduit may be placed prior to concrete pour thereby eliminating the use of sleeves. The contractor shall, however, remain responsible to insure and make such installation watertight.
- F. Conduit or sleeves going through the roof shall be installed in pitch pockets complete with flashing as may be required by the type of building construction. Where feeding equipment located on roof, the electrical conduit may be run in the same pitch pocket as used to install piping, etc. to the equipment. It shall be the responsibility of the electrical contractor to coordinate sizes of curbs and pitch pockets so as to allow installation of conduit. If conduit cannot be installed in common opening with piping, etc. the electrical contractor shall provide a separate pitch pocket for his wiring.
- G. Where conduits, sleeves, wireways, and other electrical raceways pass through fire partitions, walls, or floors, install a fire-stop that provides an effective barrier against the spread of fire, smoke and gases. Fire-stop material shall be packed tight, completely fill clearances between raceway and openings as required maintaining the rating of the assembly penetrated.
- H. Where conduits, sleeves, wireways, and other electrical raceways pass through partitions, walls, floors or insulation separating spaces subject to temperature differences, effective means shall be taken to prevent air leaks, and condensation problems.
- I. Flexible or liquid tight flexible conduit may not be used through walls, floors, roof, etc. that are moisture, temperature, fire or smoke barriers. Conduits through these types of items must be either rigid steel or EMT.

3.5 MATERIAL INSTALLATION

- A. In general, all wiring and electrical items shall be concealed, with visual portions set true and plumb with building lines. Items shall be aligned in an orderly fashion consistent with the patterns and design of the background material.
- B. Where items are to be surface mounted, such items shall be grouped together. Provide a ¾" plywood backing, painted two coats grey paint.

3.6 TRENCHES, EXCAVATING, AND BACKFILLING

- A. The contractor shall do trenching and excavating required installing equipment, underground cable and conduit to the depth shown or required for proper operation. Excavation below the required level shall be backfilled with earth and thoroughly tamped. The contractor shall do all shoring and bracing necessary to perform his work and as required for safety. Contractor shall remove by pumping or other means any water which accumulates in the excavation. Temporary bridges shall be built by the contractor where required to maintain traffic.

- B. In any excavation across hard surfaced streets, drives, or walks, contractor shall cut and replace the surface material. Replacement material shall be identical to material removed unless shown otherwise.
- C. If any excavation is across gravel bed or any stabilized yard, contractor shall repair damaged surface. Replacement material shall be identical to existing unless otherwise approved by the Engineer.
- D. The contractor shall backfill all excavations made for his work. Utilities services shall be observed by the Engineer or proper inspection authority before backfilling. Backfilling shall be done by placing earth evenly and carefully around conduit in 6" maximum layers. Backfill material shall be free from rock and debris.
- E. Each layer shall be carefully, mechanically compacted until at least one foot of cover exists over the pipe or equipment. The remainder of the back fill shall be placed and compacted in one-foot maximum layers. Compaction shall be 90% of the maximum standard Proctor density in area that are to be sodded or seeded Proctor density in areas that are to be sodded or seeded and shall be 95% of maximum modified Proctor density under walks, drives or any structure.
- F. The contractor shall be responsible for and shall repair without charge all damage due to settlement of the earth, including but not limited to laws, drives, streets or parking lots, over the damaged area.
- G. The contractor shall be responsible for cleaning up areas adjacent to the excavation where the earth has been temporarily stored, sweeping or washing pavement, repairing the gravel surface, or reseeding the lawns as required to bring the entire excavated area as close to the original conditions as possible.
- H. All excavated materials not required for fill or backfill shall be disposed or removed from the site by this contractor.

3.7 EQUIPMENT AND MOTOR CONNECTION

- A. Prior to rough-in, the electrical connector shall consult applicable shop drawing to determine connections required. If required connections differ from connections shown on drawings, consult engineer for resolution.
- B. Control devices, (unless an integral part of the equipment to be wired) furnished under other divisions of this specification, shall be turned over to this contractor for installation. Consult with other contractors, as to the exact location of their equipment needing electrical connections and install and connect control equipment. Provide boxes, mounting brackets, painted plywood backing, etc. as required to mount these devices.
- C. Where automatic controls are involved, wire equipment in the system to run continuously. This shall include required interlocks and primary equipment wiring required for normal operation such as solenoids, gas valves, etc.

- D. All conduit to motors shall be run exposed, except in finished areas, and shall terminate in liquid tight flexible conduit fastened directly to motor boxes. Where motors are located in equipment enclosures or an integral part of an equipment package, liquid tight flexible conduit shall be used to isolate equipment enclosure from the building electrical system and to isolate the motor(s) from the equipment enclosures.
- E. Provide necessary wiring of control and safety devices for overhead doors as required by manufacturer for complete installation.
- F. Comply with elevator requirements when wiring elevator motor.

END OF SECTION 26 0100

SECTION 26 0400 - ELECTRIC SERVICE

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 the furnishing and installation of materials and labor required to provide the new electrical service to the new & remodeled building.
- B. Fees or charges submitted by the utility company for their portion of the service installation shall be paid for by this contractor. The serving utility is: Capital Electric Cooperative.
- C. Services to the buildings shall be as follows:
 - 1. Existing Service
 - a. Both existing services shall be removed.
- D. NEW SERVICES
 - 1. Provide new 277/480 volt, 3 phase, 4 wire electric normal power service.

PART 2 PRODUCTS

2.1 THE FOLLOWING ITEMS ARE FURNISHED BY THE UTILITY COMPANY:

- 1. Transformers.
- 2. Primary services.
- 3. Revisions to primary services.
- 4. Removal of existing transformers and primary wiring.
- B. The contractor shall furnish other necessary items which shall include, but not be limited to the following:
 - 1. Underground secondary service revisions.
 - 2. Service switchboards.
 - 3. Transformer pads with one transformer & two C/T cabinet.
 - 4. Connection/CT cabinet (two required).
 - 5. Pathway between transformer and connection/C/T cabinet. (as required)
 - 6. Trenching & backfilling.

PART 3 EXECUTION

- 3.1 CONTACT AND MAKE NECESSARY ARRANGEMENTS WITH THE UTILITY COMPANY TO COMPLY WITH THEIR POLICIES AND REGULATIONS RELATING TO THE SERVICE ENTRANCE.
- A. Service entrance conductors shall be run in conduit, size as indicated on Drawings.
 - B. New secondary services shall be underground from main distribution to the pad mounted transformers.
 - C. Verify transformer location & pad detail with utility company. If the electric utility does not have a detail for the transformer and the connection cabinet. EC shall coordinate these details to the satisfaction of the electric utility & engineer.

END OF SECTION 26 0400

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Underground feeder and branch-circuit cable.
- C. Service entrance cable.
- D. Metal-clad cable.
- E. Wiring connectors.
- F. Electrical tape.
- G. Wire pulling lubricant.
- H. Cable ties.
- I. Firestop sleeves.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013 (Reapproved 2024).
- 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; 2024.
 - F. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
 - G. NECA 120 - Standard for Installing Armored Cable (AC) and Type Metal-Clad (MC) Cable; 2018.
 - H. NECA 121 - Standard for Installing Nonmetallic-Sheathed Cable (Type NM-B) and Underground Feeder and Branch-Circuit Cable (Type UF); 2024.
 - I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; 2021.
 - J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
 - K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
 - L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
 - M. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Current Edition, Including All Revisions.
 - N. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
 - O. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
 - P. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
 - Q. UL 493 - Thermoplastic-Insulated Underground Feeder and Branch-Circuit Cables; Current Edition, Including All Revisions.
 - R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
 - S. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.
- 1.4 SUBMITTALS
- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
 - B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- 1.5 QUALITY ASSURANCE
- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductor Material:
 - 1. Provide copper conductors 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.
- H. 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.
 - 3) 20 A, 277 V circuits longer than 150 feet (46 m): 10 AWG, for voltage drop.
- I. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - 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.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. Cerro Wire LLC: www.cerrowire.com/#sle.
 - b. Encore Wire Corporation: www.encorewire.com/#sle.
 - c. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
 - d. Service Wire Co: www.servicewire.com/#sle.
 - e. Southwire Company: www.southwire.com/#sle.
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size 10 AWG and Smaller: Solid.
 - b. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2, except as indicated below.

2.4 UNDERGROUND FEEDER AND BRANCH-CIRCUIT CABLE

- A. Manufacturers:
 - 1. Cerro Wire LLC: www.cerrowire.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Service Wire Co: www.servicewire.com/#sle.
 - 4. Southwire Company: www.southwire.com/#sle.
- B. Description: NFPA 70, Type UF multiple-conductor cable listed and labeled as complying with UL 493, Type UF-B.
- C. Provide equipment grounding conductor unless otherwise indicated.
- D. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- E. Insulation Voltage Rating: 600 V.

2.5 METAL-CLAD CABLE

- A. Manufacturers:
 - 1. AFC Cable Systems Inc: www.afcweb.com/#sle.
 - 2. Encore Wire Corporation: www.encorewire.com/#sle.
 - 3. Service Wire Co: www.servicewire.com/#sle.
 - 4. Southwire Company: www.southwire.com/#sle.
- B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.
- C. Conductor Stranding:
 - 1. Size 10 AWG and Smaller: Solid.
 - 2. Size 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation: Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Grounding: Full-size integral equipment grounding conductor.
- G. Armor: Steel, interlocked tape.

2.6 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:
- 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.
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - c. NSI Industries LLC: www.nsiindustries.com/#sle.
- E. Mechanical Connectors: Provide bolted type or set-screw type.
 - 1. Manufacturers:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. nVent ILSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.

- F. Compression Connectors: Provide circumferential type or hex type crimp configuration.
 - 1. Manufacturers:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. nVent ILSCO: www.ilsco.com/#sle.
 - c. Thomas & Betts Corporation: www.tnb.com/#sle.

2.7 ACCESSORIES

- A. Electrical Tape:
 - 1. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com/#sle.
 - 2. 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. Manufacturers:
 - a. 3M: www.3m.com/#sle.
 - b. American Polywater Corporation: www.polywater.com/#sle.
 - c. Ideal Industries, Inc: www.idealindustries.com/#sle.
 - 2. Listed and labeled as complying with UL 267.
 - 3. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 4. Suitable for use at installation temperature.
 - 5. Products:
 - a. American Polywater Corporation; Polywater J Cable Pulling Lubricant: www.polywater.com/#sle.
 - b. American Polywater Corporation; Polywater LZ Cable Pulling Lubricant: www.polywater.com/#sle.
- C. Cable Ties: Material and tensile strength rating suitable for application.
 - 1. Manufacturers:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
- 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.
 - 1. Products:
 - a. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - b. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- E. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:

- a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
- b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 - 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 - 2. When circuit destination is indicated without specific routing, determine exact routing required.
 - 3. Arrange circuiting to minimize splices.
 - 4. Include circuit lengths required to install connected devices within 10 ft (3.0 m) of location indicated.
 - 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 - 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 - 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
 - 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Install underground feeder and branch-circuit cable (Type UF-B) in accordance with NECA 121.

- E. Install metal-clad cable (Type MC) in accordance with NECA 120.
- F. Installation in Raceway:
 - 1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 - 2. Pull all conductors and cables together into raceway at same time.
 - 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 - 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- G. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- H. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
- I. Terminate cables using suitable fittings.
 - 1. Metal-Clad Cable (Type MC):
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- J. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. 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 contaminants. 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.
- N. 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.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.

- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- Q. 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

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.2 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.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- 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.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. 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.

2.2 GROUNDING AND BONDING COMPONENTS

- A. General Requirements:
 - 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
 - 2. Provide products listed and labeled as complying with UL 467 where applicable.
- B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 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.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).
- 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.
 - 4. Manufacturers - Mechanical and Compression Connectors:
 - a. allG Fabrication; _____: www.allgfab.com/#sle.
 - b. Burndy LLC; _____: www.burndy.com/#sle.
 - c. Harger Lightning & Grounding; _____: www.harger.com/#sle.
 - d. nVent ERICO; _____: www.nvent.com/#sle.
 - e. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
 - 5. Manufacturers - Exothermic Welded Connections:
 - a. Burndy LLC; _____: www.burndy.com/#sle.
 - b. nVent ERICO; Cadweld: www.nvent.com/#sle.

- c. thermOweld, subsidiary of Continental Industries; division of Burndy LLC;
_____ : www.thermoweld.com/#sle.
- D. Ground Bars:
 - 1. Description: Copper rectangular ground bars with mounting brackets and insulators.
 - 2. Size: As indicated.
 - 3. Holes for Connections: As indicated or as required for connections to be made.
 - 4. Manufacturers:
 - a. allG Fabrication; _____ : www.allgfab.com/#sle.
 - b. Harger Lightning & Grounding; _____ : www.harger.com/#sle.
 - c. nVent ERICO; _____ : www.nvent.com/#sle.
 - d. thermOweld, subsidiary of Continental Industries; division of Burndy LLC;
_____ : www.thermoweld.com/#sle.
- 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.
 - 4. Where rod lengths of greater than 10 feet (3.0 m) are indicated or otherwise required, sectionalized ground rods may be used.
 - 5. Manufacturers:
 - a. allG Fabrication; _____ : www.allgfab.com/#sle.
 - b. Galvan Industries, Inc; _____ : www.galvanelectrical.com/#sle.
 - c. Harger Lightning & Grounding; _____ : www.harger.com/#sle.
 - d. nVent ERICO; _____ : www.nvent.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

- 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

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.
- B. Section 27 0529 - Hangers and Supports for Communications Systems.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- 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; 2023.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 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 load to be supported with minimum safety factor of _____. 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 and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent; Caddy: www.nvent.com/#sle.
 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 3. Conduit Clamps: Bolted type unless otherwise indicated.
 4. Products:
 - a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - b. Gripple, Inc; Fast Trak: www.gripple.com/#sle.
 - c. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent; Caddy: www.nvent.com/#sle.
- D. Metal Channel/Strut Framing Systems:
1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - c. Eaton Corporation: www.eaton.com/#sle.
 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 3. Comply with MFMA-4.
- E. 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. Busway Supports: 1/2-inch (13 mm) diameter.

- c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.
 - d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
 - f. Outlet Boxes: 1/4-inch (6 mm) diameter.
 - g. Luminaires: 1/4-inch (6 mm) diameter.
- F. Anchors and Fasteners:
- 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
 - 2. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

PART 3 EXECUTION

3.1 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

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Stainless steel rigid metal conduit (RMC).
- C. Aluminum rigid metal conduit (RMC).
- D. Galvanized steel intermediate metal conduit (IMC).
- E. Stainless steel intermediate metal conduit (IMC).
- F. PVC-coated galvanized steel rigid metal conduit (RMC).
- G. Flexible metal conduit (FMC).
- H. Liquidtight flexible metal conduit (LFMC).
- I. Galvanized steel electrical metallic tubing (EMT).
- J. Stainless steel electrical metallic tubing (EMT).
- K. Aluminum electrical metallic tubing (EMT).
- L. Rigid polyvinyl chloride (PVC) conduit.
- M. Electrical nonmetallic tubing (ENT).
- N. Liquidtight flexible nonmetallic conduit (LFNC).
- O. Reinforced thermosetting resin conduit (RTRC).
- P. High-density polyethylene (HDPE) conduit.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete encasement of conduits.
- B. Section 07 8400 - Firestopping.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0529 - Hangers and Supports for Electrical Systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.

1.3 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. ANSI C80.5 - American National Standard for Electrical Rigid Metal Conduit -- Aluminum (ERMC-A); 2020.
- D. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit; 2018.
- E. ASTM D2683 - Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing; 2020.
- F. ASTM D3261 - Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing; 2016.
- G. ASTM F1055 - Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing; 2016a (Reapproved 2022).
- H. ASTM F2160 - Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD); 2016.
- I. ASTM F2176 - Standard Specification for Mechanical Couplings Used on Polyethylene Conduit, Duct and Innerduct; 2017.
- J. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- K. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2020.
- L. NECA 102 - Standard for Installing Aluminum Rigid Metal Conduit; 2004.
- M. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2017.
- N. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2014.
- O. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit; 2018.
- P. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2020.
- Q. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2021.
- R. NEMA TC 7 - Solid-Wall Coilable and Straight Electrical Polyethylene Conduit; 2021.
- S. NEMA BI 50058 - Electrical Nonmetallic Tubing (ENT); 2014 (Reaffirmed 2019).
- T. NEMA TC 14 (SERIES) - Reinforced Thermosetting Resin Conduit and Fittings Series; 2015.
- U. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- V. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
 - W. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
 - X. UL 6A - Electrical Rigid Metal Conduit-Aluminum, Red Brass, and Stainless Steel; Current Edition, Including All Revisions.
 - Y. UL 360 - Liquid-Tight Flexible Metal Conduit; Current Edition, Including All Revisions.
 - Z. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
 - AA. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
 - BB. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
 - CC. UL 651A - High Density Polyethylene (HDPE) Conduit; Current Edition, Including All Revisions.
 - DD. UL 746C - Polymeric Materials – Use in Electrical Equipment Evaluations; Current Edition, Including All Revisions.
 - EE. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
 - FF. UL 797A - Electrical Metallic Tubing - Aluminum and Stainless Steel; Current Edition, Including All Revisions.
 - GG. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
 - HH. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.
 - II. UL 1653 - Electrical Nonmetallic Tubing; Current Edition, Including All Revisions.
 - JJ. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.
 - KK. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.
- 1.4 SUBMITTALS
- A. See Section 01 3000 - Administrative Requirements for submittals procedures.
 - B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

PART 2 PRODUCTS

2.1 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. Under Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), stainless steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 - 4. Where rigid polyvinyl chloride (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or schedule 80 rigid PVC conduit where emerging from underground.
 - 5. Where rigid polyvinyl (PVC) conduit larger than 2-inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit (RMC) elbows, stainless steel rigid metal conduit (RMC) elbows, galvanized steel intermediate metal conduit (IMC) elbows, stainless steel intermediate metal conduit (IMC) elbows, PVC-coated galvanized steel rigid metal conduit (RMC) elbows, or concrete-encased PVC elbows for bends.
 - 6. Where galvanized steel rigid metal conduit (RMC) or galvanized steel intermediate metal conduit (IMC) is installed in direct contact with earth where soil has resistivity of less than 2000 ohm-centimeters or is characterized as severely corrosive based on soils report or local experience, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 - 7. Where galvanized steel electrical metallic tubing (EMT) is installed in direct contact with earth, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.

8. Where aluminum rigid metal conduit (RMC) or aluminum electrical metallic tubing (EMT) is installed in direct contact with earth, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
 9. Where galvanized rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) emerges from concrete into soil, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches (100 mm) on either side of where conduit emerges.
- D. Embedded Within Concrete:
1. Within Slab on Grade: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC). Embed within structural slabs only where approved by Structural Engineer.
 2. Within Slab Above Ground: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC). Embed within structural slabs only where approved by Structural Engineer.
 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), galvanized steel electrical metallic tubing (EMT), rigid PVC conduit, or reinforced thermosetting resin conduit (RTRC).
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or galvanized steel electrical metallic tubing (EMT) where emerging from concrete.
 5. Where galvanized steel electrical metallic tubing (EMT) emerges from concrete into salt air, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection for minimum of 4 inches (100 mm) on either side of where conduit emerges.
 6. Where aluminum rigid metal conduit (RMC) and aluminum electrical metallic tubing (EMT) is installed in concrete, use corrosion protection tape, factory-applied corrosion protection coating, or field-applied corrosion protection compound acceptable to authorities having jurisdiction to provide supplementary corrosion protection.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet (6.1 m) in warehouse areas.
- K. Exposed, Interior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or stainless steel intermediate metal conduit (IMC).
 - 1. Locations subject to severe physical damage include, but are not limited to:
 - a. High traffic industrial and warehouse areas where exposed below 8 feet (2.4 m), except within electrical and communication rooms or closets.
 - b. Where exposed below 20 feet (6.1 m) in industrial manufacturing areas.
- L. Exposed, Exterior, Not Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- M. Exposed, Exterior, Subject to Severe Physical Damage: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), or stainless steel intermediate metal conduit (IMC).
 - 1. Exterior locations subject to severe physical damage include, but are not limited to:
 - a. Where exposed to vehicular traffic below 20 feet (6.1 m).

- N. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).
- O. Corrosive Locations Above Ground: Use stainless steel rigid metal conduit (RMC), stainless steel intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit (RMC), stainless steel electrical metallic tubing (EMT), or reinforced thermosetting resin conduit (RTRC).
 - 1. Corrosive locations include, but are not limited to:
 - a. Cooling towers.
 - b. Electroplating operations.
 - c. Wastewater treatment facilities.
 - d. Marine environments.
- P. Hazardous/Classified Locations: Use galvanized steel rigid metal conduit (RMC), stainless steel rigid metal conduit (RMC), galvanized steel intermediate metal conduit (IMC), stainless steel intermediate metal conduit (IMC), or PVC-coated galvanized steel rigid metal conduit (RMC).
- Q. Flexible Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit (FMC).
 - 1. Maximum Length: 6 feet (1.8 m).
- R. Flexible Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit (FMC).
 - 2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).
 - 3. Maximum Length: 6 feet (1.8 m) unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.
- S. Fished in Existing Walls, Where Necessary: Use flexible metal conduit (FMC), galvanized steel electrical metallic tubing (EMT), or stainless steel electrical metallic tubing (EMT).

2.2 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. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4-inch (21 mm) trade size.
 - 2. Branch Circuit Homeruns: 3/4-inch (21 mm) trade size.
 - 3. Control Circuits: 1/2-inch (16 mm) trade size.
 - 4. Flexible Connections to Luminaires: 3/8-inch (12 mm) trade size.
 - 5. Underground, Interior: 3/4-inch (21 mm) trade size.
 - 6. Underground, Exterior: 1-inch (27 mm) trade size.

- E. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Rymco USA: www.rymcousa.com/#sle.
 - 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- C. Factory-Painted, Color-Coded Galvanized Steel RMC: Apply according to indicated color code.
 - 1. See Section 26 0553 for color code.
- D. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings Inc: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 STAINLESS STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC stainless steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6A.
- B. Fittings:
 - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
 - 2. Material: Use stainless steel with corrosion resistance equivalent to conduit.
 - 3. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.5 ALUMINUM RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 - 3. Rymco USA: www.rymcousa.com/#sle.

4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type RMC aluminum rigid metal conduit complying with ANSI C80.5 and listed and labeled as complying with UL 6A.
- C. Fittings:
1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6A.
 3. Material: Use aluminum.
 4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.6 GALVANIZED STEEL INTERMEDIATE METAL CONDUIT (IMC)

- A. Manufacturers:
1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 2. Nucor Tubular Products: www.nucortubular.com/#sle.
 3. Rymco USA: www.rymcousa.com/#sle.
 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- C. Fittings:
1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 2. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.
 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 4. Material: Use steel or malleable iron.
 5. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.7 STAINLESS STEEL INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

- B. Fittings:
 - 1. Nonhazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 1242.

2.8 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Manufacturers:
 - 1. ABB; Ocal: www.electrification.us.abb.com/#sle.
 - 2. Calbond, a division of Atkore International www.calbond.com/#sle
 - 3. Robroy Industries: www.robroy.com/#sle.
- B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- C. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch (1.02 mm).
- D. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch (0.05 mm).
- E. PVC-Coated Boxes and Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.
 - 3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.
 - 4. Material: Use steel or malleable iron.
 - 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch (1.02 mm).
 - 6. Interior Coating: Urethane, minimum thickness of 2 mil, 0.002 inch (0.05 mm).
- F. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil, 0.015 inch (0.38 mm).

2.9 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.
- 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.

2.10 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Electri-Flex Company: www.electriflex.com/#sle.
 - 3. International Metal Hose: www.metalhose.com/#sle.

- B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- C. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.

2.11 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 - 2. Nucor Tubular Products: www.nucortubular/#sle.
 - 3. Rymco USA: www.rymcousa.com/#sle.
 - 4. Western Tube, a division of Zekelman Industries: www.westerntube.com/#sle.
 - 5. Wheatland Tube, a division of Zekelman Industries: www.wheatland.com/#sle.
- B. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- C. Factory-Painted, Color-Coded Galvanized Steel EMT: Apply according to indicated color code.
 - 1. See Section 26 0553 for color code.
- D. Fittings:
 - 1. Manufacturers:
 - a. ABB; T&B: www.electrification.us.abb.com/#sle.
 - b. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.us/#sle.
 - c. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 - d. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 3. Material: Use steel or malleable iron.
 - 4. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 - 5. Embedded Within Concrete, Where Permitted: Use fittings listed as concrete-tight. Fittings that require taping to be concrete-tight are acceptable.

2.12 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. Connectors and Couplings: Use compression/gland or set-screw type.

2.13 ALUMINUM ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 1. American Conduit, a division of Hydro: www.americanconduit.com/#sle.
- B. Description: NFPA 70, Type EMT aluminum electrical metallic tubing listed and labeled as complying with UL 797A.
- C. Fittings:
 1. Manufacturers:
 - a. Arlington Industries: www.aifittings.com/#sle.
 - b. Bridgeport Fittings, LLC: www.bptfittings.com/#sle.
 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; listed for use with aluminum EMT.
 3. Material: Use aluminum.
 4. Connectors and Couplings: Use compression/gland or set-screw type.
 - a. Do not use indenter type connectors and couplings.

2.14 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Manufacturers:
 1. ABB; Carlon: www.carlon.com/#sle.
 2. Allied Tube & Conduit, a division of Atkore International: www.alliedeg.com/#sle.
 3. Cantex Inc: www.cantexinc.com/#sle.
 4. Heritage Plastics, a division of Atkore International: www.heritageplastics.com/#sle.
 5. JM Eagle: www.jmeagle.com/#sle.
- B. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- C. Fittings:
 1. Manufacturer: Same as manufacturer of conduit to be connected.
 2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.15 ELECTRICAL NONMETALLIC TUBING (ENT)

- A. Manufacturers:
 1. ABB; Carlon: www.electrification.us.abb.com/#sle.
 2. Cantex Inc: www.cantexinc.com/#sle.
- B. Description: NFPA 70, Type ENT electrical nonmetallic tubing complying with NEMA BI 50058 and listed and labeled as complying with UL 1653.

- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of ENT to be connected.
 - 2. Use solvent-welded type fittings.
 - 3. Solvent-Welded Fittings: Rigid PVC fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; suitable for use with ENT.

2.16 LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT (LFNC)

- A. Manufacturers:
 - 1. AFC Cable Systems, a division of Atkore International: www.afcweb.com/#sle.
 - 2. Electri-Flex Company: www.electriflex.com/#sle.
 - 3. IPEX, a division of Aliaxis: www.ipexna.com/#sle.
- B. Description: NFPA 70, Type LFNC liquidtight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
- C. Fittings:
 - 1. Manufacturer: Same as manufacturer of conduit to be connected.
 - 2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for type of conduit to be connected.

2.17 REINFORCED THERMOSETTING RESIN CONDUIT (RTRC)

- A. Description: NFPA 70, Type RTRC reinforced thermosetting resin conduit complying with NEMA TC 14 (SERIES).
- B. Supports: As recommended by manufacturer.
- C. Fittings: Same type and manufacturer as conduit to be connected.

2.18 HIGH-DENSITY POLYETHYLENE (HDPE) CONDUIT

- A. Manufacturers:
 - 1. ABB; Carlon: www.electrification.us.abb.com/#sle.
 - 2. Blue Diamond Industries, LLC: www.bdiky.com/#sle.
 - 3. Eastern Wire + Conduit, a division of Atkore International: www.easternwire.com/#sle.
- B. Description: NFPA 70, Type HDPE high-density polyethylene solid-wall conduit complying with ASTM F2160 and NEMA TC 7; list and label as complying with UL 651A; Schedule 40 unless otherwise indicated.
- C. Joining Methods: Approved by HDPE conduit manufacturer.
- D. Mechanical Fittings: Comply with ASTM F2176; list and label as complying with UL 651A.
- E. Butt Heat Fusion Fittings: Comply with ASTM D3261.
- F. Socket Fusion Fittings: Comply with ASTM D2683.
- G. Electrofusion Fittings: Comply with ASTM F1055.

2.19 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch (0.51 mm).
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Epoxy Adhesive for RTRC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- E. Adhesive for HDPE and RTRC Conduit:
 - 1. Specifically designed for bonding dissimilar materials in lieu of transition fittings, including but not limited to polyethylene, fiberglass, PVC, aluminum, and steel; UL 746C recognized.
 - 2. Approved by adhesive manufacturer for use with materials to be joined.
- F. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf (5.6 kN).
- G. Foam Conduit Sealant:
 - 1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 - 2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.
 - 3. Rated to hold minimum of 10 ft (3.0 m) water head pressure.
 - 4. Products:
 - a. American Polywater Corporation; Polywater AFT Foam Duct Sealant: www.polywater.com/#sle.
 - b. American Polywater Corporation; Polywater FST Foam Duct Sealant: www.polywater.com/#sle.
- H. Conduit Mechanical Seals:
 - 1. Listed as complying with UL 514B.
 - 2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.
 - 3. Suitable for sealing around conductors/cables to be installed.
 - 4. Products:
 - a. American Polywater Corporation; PHRD SG Mechanical Seals: www.polywater-haufftechnik.com/#sle.
- I. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.
- J. Sealing Systems for Concrete Penetrations:
 - 1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.
 - 2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.
 - 3. Products:
 - a. American Polywater Corporation; PZVR Cement-Coated Concrete Wall Sleeves: www.polywater-haufftechnik.com/#sle.

- b. American Polywater Corporation; PHSD Mechanical Seals: www.polywater-haufftechnik.com/#sle.
 - c. American Polywater Corporation; PHSI 150 Varia Double Wall Inserts: www.polywater-haufftechnik.com/#sle.
 - d. American Polywater Corporation; PGKD Modular Seals: www.polywater-haufftechnik.com/#sle.
- K. 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.
 - 1. Products:
 - a. Alta Products, LLC; Sigrist Pipe Chase Housing, Curbs, and Exit Seals: www.altaproductsllc.com/#sle.
 - b. Menzies Metal Products; Electrical Roof Stack and Cap: www.menzies-metal.com/#sle.
 - c. Menzies Metal Products; Electrical Retro Box: www.menzies-metal.com/#sle.
- L. 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/#sle.
- M. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.
 - 1. Products:
 - a. HoldRite, a brand of Reliance Worldwide Corporation; HydroFlame Pro Series/HydroFlame Custom Built: www.holdrite.com/#sle.
- N. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.
 - 1. Products:
 - a. Advance Products & Systems, LLC; Duct Bank Spacers: www.apsonline.com/#sle.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in accordance with NECA 1.

- C. Galvanized Steel Rigid Metal Conduit (RMC): Install in accordance with NECA 101.
- D. Aluminum Rigid Metal Conduit (RMC): Install in accordance with NECA 102.
- E. Intermediate Metal Conduit (IMC): Install in accordance with NECA 101.
- F. PVC-Coated Galvanized Steel Rigid Metal Conduit (RMC): Install using only tools approved by manufacturer.
- G. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.
- H. Electrical Nonmetallic Tubing (ENT): Install in accordance with NECA 111.
- I. Liquidtight Flexible Nonmetallic Conduit (LFNC): Install in accordance with NECA 111.
- J. Conduit Routing:
 - 1. When conduit destination is indicated without specific routing, determine exact routing required.
 - 2. Conceal conduits unless specifically indicated to be exposed.
 - 3. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 4. Unless otherwise approved, do not route exposed conduits:
 - a. Across roofs.
 - b. Across top of parapet walls.
 - c. Across building exterior surfaces.
 - 5. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 7. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.
 - 8. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
 - 9. Route conduits above water and drain piping where possible.
 - 10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 11. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
 - 12. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
 - 13. Group parallel conduits in same area on common rack.
- K. 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.
4. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.
6. Use conduit clamp to support single conduit from beam clamp or threaded rod.
7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.
8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.
9. Use of spring steel conduit clips for support of conduits is not permitted.
10. Use of wire for support of conduits is not permitted.

L. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.
8. Secure joints and connections to provide mechanical strength and electrical continuity.

M. 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. Provide suitable sealing system where conduits penetrate exterior wall below grade.
6. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
7. 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.

8. Install firestopping to preserve fire resistance rating of partitions and other elements; see Section 07 8400.
- N. Underground Installation:
1. Provide trenching and backfilling; see Section 31 2316.13.
 2. Provide underground warning tape along entire conduit length for service entrance where not concrete-encased; see Section 26 0553.
- O. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):
1. Maximum Conduit Size: 1-inch (27 mm) trade size unless otherwise approved.
 2. Secure conduits to prevent floating or movement during pouring of concrete.
- P. Concrete Encasement: Where conduits not otherwise embedded within concrete are indicated to be concrete-encased, provide minimum concrete cover of 3 inches (76 mm) on all sides unless otherwise indicated; see Section 03 3000.
- Q. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where calculated in accordance with NFPA 70 for reinforced thermosetting resin conduit (RTRC) conduit installed above ground to compensate for thermal expansion and contraction.
 4. Where conduits are subject to earth movement by settlement or frost.
- R. 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.
 - c. Where conduits penetrate coolers or freezers.
 3. Where conduits cross boundaries of hazardous/classified locations, provide identified/listed sealing fittings or conduit mechanical seals as approved by authorities having jurisdiction; locate as indicated or in accordance with NFPA 70.
- S. Provide grounding and bonding; see Section 26 0526.
- T. Identify conduits; see Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION 26 0533.13

SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 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).
- C. Boxes and enclosures for integrated power, data, and audio/video.
- D. Boxes for hazardous (classified) locations.
- E. Floor boxes.
- F. Underground boxes/enclosures.
- G. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 3100 - Access Doors and Panels: Panels for maintaining access to concealed boxes.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Floor box service fittings.
 - 3. Poke-through assemblies.
 - 4. Access floor boxes.
 - 5. Additional requirements for locating boxes for wiring devices.
- F. Section 27 1000 - Structured Cabling: Additional requirements for communications systems outlet boxes.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.

- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- 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. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013 (Reaffirmed 2020).
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specifications for Underground Enclosure Integrity; 2023.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, floor boxes, and underground boxes/enclosures.
 - 1. Underground Boxes/Enclosures: Include reports for load testing in accordance with SCTE 77 certified by a professional engineer or an independent testing agency upon request.
- C. Project Record Documents: Record actual locations for outlet and device boxes, pull boxes, cabinets and enclosures, floor boxes, and underground boxes/enclosures.
- 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. Keys for Lockable Enclosures: Two of each different key.

PART 2 PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
3. Provide products listed, classified, and labeled as suitable for the purpose intended.
4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

B. Outlet and Device Boxes Up to 100 cubic inches (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 cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
4. Use cast aluminum boxes where aluminum rigid metal conduit is used.
5. Use nonmetallic boxes where exposed rigid PVC conduit is used.
6. Use suitable concrete type boxes where flush-mounted in concrete.
7. Use suitable masonry type boxes where flush-mounted in masonry walls.
8. Use raised covers suitable for the type of wall construction and device configuration where required.
9. Use shallow boxes where required by the type of wall construction.
10. Do not use "through-wall" boxes designed for access from both sides of wall.
11. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
12. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
13. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.
14. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
15. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
16. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Communications Systems Outlets: 4 inch square by 2-1/8 inch (100 by 54 mm) trade size.
17. Wall Plates: Comply with Section 26 2726.
18. Manufacturers:

- a. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. E-Lids LLC; _____: www.e-lids.com/#sle.
 - c. Hubbell Incorporated; Bell Products; _____: www.hubbell-rtb.com/#sle.
 - d. Hubbell Incorporated; RACO Products; _____: www.hubbell-rtb.com/#sle.
 - e. O-Z/Gedney, a brand of Emerson Electric Co; _____: www.emerson.com/#sle.
 - f. Thomas & Betts Corporation; _____: www.tnb.com/#sle.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 1. Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA EN 10250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm):
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 4. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - b. Hoffman, a brand of Pentair Technical Products; _____: www.hoffmanonline.com/#sle.
 - c. Hubbell Incorporated; Wiegmann Products; _____: www.hubbell-wiegmann.com/#sle.
- D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
 1. Manufacturers:
 - a. Appleton, a brand of Emerson Electric Co; _____: www.emerson.com/#sle.
 - b. Cooper Crouse-Hinds, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
 - c. Hubbell Incorporated; Killark Products; _____: www.hubbell-killark.com/#sle.
- E. Floor Boxes:
 1. Description: Floor boxes compatible with floor box service fittings provided in accordance with Section 26 2726; with partitions to separate multiple services; furnished with all components, adapters, and trims required for complete installation.
 2. Manufacturer: Same as manufacturer of floor box service fittings.
- F. Underground Boxes/Enclosures:
 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size: As indicated on drawings.
 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).
 4. Applications:

- a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use polymer concrete enclosures, with minimum SCTE 77 Tier 8 load rating.
 - b. Do not use polymer concrete enclosures in areas subject to deliberate vehicular traffic.
- 5. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.
 - a. Manufacturers:
 - 1) Hubbell Incorporated; Quazite Products; _____ : www.hubbellpowersystems.com/#sle.
 - 2) MacLean Highline; _____ : www.macleanhighline.com/#sle.
 - 3) Oldcastle Precast, Inc; _____ : www.oldcastleprecast.com/#sle.
 - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.
 - c. Product(s):
 - 1) MacLean Highline PHA Series: Straight wall, all-polymer concrete splice box/pull box; available Tier 8, Tier 15, and Tier 22 load ratings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.

3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 - b. Communications Systems Outlets: Comply with Section 27 1000.
 4. Locate boxes so that wall plates do not span different building finishes.
 5. Locate boxes so that wall plates do not cross masonry joints.
 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.
 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
 11. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- I. Box Supports:
1. Secure and support boxes in accordance with NFPA 70 and Section 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.
 3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (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.
- L. Install boxes as required to preserve insulation integrity.

- M. Metallic Floor Boxes: Install box level at the proper elevation to be flush with finished floor.
- N. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
 - 2. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- P. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- Q. Close unused box openings.
- R. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- S. Provide grounding and bonding in accordance with Section 26 0526.
- T. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION 26 0533.16

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Voltage markers.
- D. Warning signs and labels.

1.2 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 0536 - Cable Trays for Electrical Systems: Additional identification requirements for cable tray systems.
- C. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.

1.3 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

2.1 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.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
- d. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
- e. Enclosed Contactors:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify coil voltage.
- f. Transfer Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify 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. 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.
 - f. Panelboards.
 - g. Switchboards.
 - h. Disconnects

5. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.

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.

C. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

D. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Manufacturers:
 - a. Brimar Industries, Inc: www.brimar.com/#sle.
 - b. Kolbi Pipe Marker Co; _____: www.kolbipipemarkers.com/#sle.
 - c. Seton Identification Products; _____: www.seton.com/#sle.
2. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
3. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
4. Stainless Steel Nameplates: Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
5. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
6. 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. Manufacturers:
 - a. Brady Corporation; _____: www.bradyid.com/#sle.
 - b. Brother International Corporation: www.brother-usa.com/#sle.
 - c. Panduit Corp: www.panduit.com/#sle.
2. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
3. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

2.3 VOLTAGE MARKERS

- A. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- B. Minimum Size:
 - 1. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches (29 by 110 mm).
 - 2. Markers for Junction Boxes: 1/2 by 2 1/4 inches (13 by 57 mm).
- C. Legend:
 - 1. Markers for Voltage Identification: Highest voltage present.
- D. Color: Black text on orange background unless otherwise indicated.

2.4 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 - 1. Materials:
 - 2. 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

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.

6. Interior Components: Legible from the point of access.
 7. Boxes: Outside face of cover.
 8. Conductors and Cables: Legible from the point of access.
 9. 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. 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

1.1 SECTION INCLUDES

- A. Short-circuit study.
- B. Protective device coordination study.
- C. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- D. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.
- B. Section 26 2413 - Switchboards.
- C. Section 26 2416 - Panelboards.

1.3 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 00001 - Motors and Generators; 2024.
- H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

- 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.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
 - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.
 - 3. Notify Architect of any conflicts with or deviations from 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.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Study reports, stamped or sealed and signed by study preparer.
- C. Field quality control reports.

1.6 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.
 - 2) Generator as source.
- B. General Study Requirements:
 - 1. Comply with NFPA 70.
 - 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
 - 1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.

- a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - 2) Utility Company: As indicated on drawings.
 - 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 00001 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).
 - 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
2. Existing Installations:
- a. Provide the services of field testing agency or equipment manufacturer's representative to perform field data collection.
 - b. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
- 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 provide adequate protection for equipment and conductors while achieving full selective coordination.

- F. Arc Flash and Shock Risk Assessment:
1. Comply with NFPA 70E.
 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 - a. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
 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.
 - c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years experience in preparation of studies of similar type and complexity using specified computer software.
- B. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.
 1. Products:
 - a. EasyPower LLC: www.easypower.com/#sle.
 - b. ETAP/Operation Technology, Inc: www.etap.com/#sle.
 - c. SKM Systems Analysis, Inc: www.skm.com/#sle.

PART 2 PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 1. Materials: Comply with Section 26 0553.
 2. Minimum Size: 4 by 6 inches (100 by 150 mm).
 3. 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 text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.

- b. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.
 - 6) Restricted approach boundary.
 - 7) Equipment identification.
 - 8) Study preparer, report reference, and date calculations were performed.

PART 3 EXECUTION

3.1 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.
- E. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.2 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

END OF SECTION 26 0573

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.
- B. Time switches.
- C. In-wall time switches.
- D. Outdoor photo controls.
- E. Lighting contactors.

1.2 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
 - 2. Daylighting Controls: Provide lighting plan indicating location, model number, and orientation of each photo sensor and associated system component.
- D. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.3 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

1.4 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. See schedule on drawings for listed manufacturers and models.

2.2 LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. ABB; _____: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation; _____: www.eaton.com/#sle.
 - 3. Rockwell Automation Inc; _____: www.rockwellautomation.com/#sle.
 - 4. Schneider Electric; _____: www.se.com/#sle.
 - 5. Siemens Industry, Inc; _____: www.new.siemens.com/#sle.
- B. Description: Magnetic lighting contactors complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; noncombination type unless otherwise indicated; ratings, configurations and features as indicated on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Install lighting control devices in accordance with manufacturer's instructions.
- C. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- D. Install lighting control devices plumb and level, and held securely in place.
- E. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each lighting control device for damage and defects.
- C. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- D. Test time switches to verify proper operation.
- E. Test outdoor photo controls to verify proper operation, including time delays where applicable.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Architect.
- C. Adjust position of directional occupancy sensors and outdoor motion sensors to achieve optimal coverage as required.
- D. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Architect. Record settings in written report to be included with submittals.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

- A. See Section 01 9113 - General Commissioning Requirements for commissioning requirements.

3.8 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 proper operation of lighting control devices to Architect, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.

END OF SECTION 26 0923

SECTION 26 2200 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General purpose transformers.
- B. K-factor transformers rated for nonlinear loads.
- C. Buck-boost transformers.
- D. Shielded transformers.
- E. Small power centers.

1.2 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 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2416 - Panelboards.
- G. Section 26 2713 - Electricity Metering: Instrument transformers for electrical metering.

1.3 REFERENCE STANDARDS

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers; 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers; 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2015.
- F. NEMA ST 20 - Dry Type Transformers for General Applications; 2021.

- G. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- H. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
 - 1. K-factor Rated Transformers: Include K-factor ratings.
 - 2. Buck-boost Transformers: Include voltage selection tables and wiring diagrams for autotransformer configurations.
 - 3. Shielded Transformers: Include shielding method and noise attenuation performance.
 - 4. Small Power Centers: Include panelboard bus ampacity, integrated short circuit ampere rating, and circuit breaker sizes and ampere ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.7 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 - 1. Greater than 10 kVA: 104 degrees F (40 degrees C) maximum.
 - 2. Less than 10 kVA: 77 degrees F (25 degrees C) maximum.

1.8 WARRANTY

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet (1,000 m).
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F (40 degrees C).
 - b. Less than 10 kVA: Not exceeding 77 degrees F (25 degrees C).
- C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- E. Basic Impulse Level: 10 kV.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- G. Isolate core and coil from enclosure using vibration-absorbing mounts.

- H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20
- I. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.
 - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- J. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor clean, dry locations: Type 2.
 - b. Outdoor locations: Type 3R.
 - 2. Construction: Steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.

2.4 K-FACTOR TRANSFORMERS RATED FOR NONLINEAR LOADS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 1561, and designed to supply nonlinear loads to the degree designated by the UL defined K-factor; ratings as indicated on the drawings.
- B. K-factor Rating: K-4, or higher.
- C. Insulation System and Allowable Average Winding Temperature Rise: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- D. Coil Conductors: Continuous aluminum windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.
- E. Winding Taps: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
- F. Neutral Bus: Sized to accommodate twice the rated secondary current.
- G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20
- I. Mounting Provisions:
 - 1. Up to 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 2. Larger than 75 kVA: Suitable for floor mounting.
- J. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Construction: Steel, ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.

2.5 BUCK-BOOST TRANSFORMERS

- A. Description: Self-cooled, four winding, buck-boost transformers listed and labeled as complying with UL 506 or UL 1561, and suitable for field connection as an autotransformer; ratings as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 0.25 kVA: Class 105 degree C insulation system with 55 degrees C rise.
 - 2. 0.25 kVA and Larger: Class 180 degree C insulation system with 115 degree C rise.
- C. Coil Conductors: Continuous windings.
- D. Lugs: Suitable for terminating conductors sized for full rated load ampacity of transformer when operating in buck-boost configuration indicated.
- E. Mounting Provisions: Suitable for wall mounting.

- F. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA EN 10250: Type 3R.
 - 2. Construction: Steel, totally enclosed, non-ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.

2.6 SHIELDED TRANSFORMERS

- A. Description: Self-cooled, two winding, shielded isolation transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- C. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- D. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20
- G. Winding Shield: Electrostatic, with separate insulated grounding connection.
- H. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.
 - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- I. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Construction: Steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.

2.7 SMALL POWER CENTERS

- A. Description: Factory assembled unit with integral primary circuit breaker, transformer, and distribution section with secondary main and branch circuit breakers; ratings and panel arrangements as indicated on the drawings.
- B. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- C. Coil Conductors: Continuous windings.
- D. Winding Taps: Two 5 percent full capacity primary taps below rated voltage.
- E. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- F. Sound Levels: Standard sound levels complying with NEMA ST 20.
- G. Mounting Provisions: Suitable for wall mounting.
- H. Unit Enclosure:
 - 1. Environment Type per NEMA EN 10250: Type 3R.
 - 2. Construction: Steel.
 - 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
 - 4. Provide lifting eyes or brackets.
 - 5. Provide lockable hinged door for compartment housing circuit breakers.
- I. Secondary Distribution Panel:
 - 1. Bus: Copper.
 - 2. Branch Circuit Breakers: Bolt-on.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.
- C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).

- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet (600 mm) minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 - 1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
 - 2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
 - 3. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch (80 mm) high concrete pad constructed in accordance with Section 03 3000.
 - 4. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.

3.4 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.

- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2200

SECTION 26 2413 - SWITCHBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.
- B. Overcurrent protective devices for switchboards.

1.2 RELATED REQUIREMENTS

- A. Section 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.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 2713 - Electricity Metering: For interface with equipment specified in this section.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- 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. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

- J. UL 891 - Switchboards; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 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.
 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.
 2. Identify mounting conditions required for equipment seismic qualification.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Switchboards:
 - 1. ABB: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric: www.se.com/#sle.
 - 4. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.2 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.
 - 1. Line Conductor Terminations:

- a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
- 2. Load Conductor Terminations:
 - a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Lug Type:
 - 1) Provide mechanical lugs unless otherwise indicated.
- I. Enclosures:
 - 1. Environment Type per NEMA EN 10250: 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. Owner Metering: Comply with Section 26 2713.
- L. Instrument Transformers:
 - 1. Comply with IEEE C57.13.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.3 OVERCURRENT PROTECTIVE DEVICES

- A. 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.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - 2) Provide electronic trip circuit breakers where indicated.
 - b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 1) Provide the following field-adjustable trip response settings:

- a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - b) Long time delay.
 - c) Short time pickup and delay.
 - d) Instantaneous pickup.
 - e) Ground fault pickup and delay where ground fault protection is indicated.
- 3. Insulated Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, trip-free circuit breakers with two-step stored energy closing mechanism; standard 80 percent rated unless otherwise indicated; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
 - b. Operation:
 - 1) Provide manually operated circuit breakers unless otherwise indicated.
 - c. Trip Units: Solid state, microprocessor-based, true rms sensing.
 - 1) Provide the following field-adjustable trip response settings:
 - a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - b) Long time delay.
 - c) Short time pickup and delay.
 - d) Instantaneous pickup.
 - e) Ground fault pickup and delay where ground fault protection is indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive switchboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch (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.

3.3 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of switchboard covers and doors.

3.4 CLEANING

- A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

3.5 PROTECTION

- A. Protect installed switchboards from subsequent construction operations.

END OF SECTION 26 2413

SECTION 26 2416 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Load centers.
- C. Overcurrent protective devices for panelboards.

1.2 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 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- E. Section 26 2200 - Low-Voltage Transformers: Small power centers with integral primary breaker, transformer, and panelboard.
- F. Section 26 2713 - Electricity Metering: For interface with equipment specified in this section.
- G. Section 26 2813 - Fuses: Fuses for fusible switches and spare fuse cabinets.
- H. Section 26 4300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2015.
- D. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- E. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 1000V or Less; 2023.
- F. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 67 - Panelboards; Current Edition, Including All Revisions.
- K. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- L. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 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.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.
- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature:
- C. 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.
 - 2. Listed series ratings are acceptable, except where not permitted by motor contribution according to NFPA 70.
 - 3. Label equipment utilizing series ratings as required by NFPA 70.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.

- H. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

2.3 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:
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 - c. Series Rated Systems: Provide circuit breakers listed in combination with upstream devices to provide interrupting rating not less than the short circuit current rating indicated.
 - 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 4. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
 - 6. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 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. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- K. Provide filler plates to cover unused spaces in panelboards.

3.3 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. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than _____ amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2416

SECTION 26 2713 - ELECTRICITY METERING

PART 1 GENERAL

1.1 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 0533.16 - Boxes for Electrical Systems: Cabinets and enclosures for metering system components.
- D. Section 26 2813 - Fuses.

1.2 REFERENCE STANDARDS

- A. ANSI C12.1 - Electric Meters - Code for Electricity Metering; 2022.
- B. IEC 62053-21 - Electricity Metering Equipment - Particular Requirements - Part 21: Static Meters for AC Active Energy (Classes 0,5, 1 and 2); 2020.
- C. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2016.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- E. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- F. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate work to provide equipment suitable for interface with electricity metering systems to be provided.
 - 2. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for electricity metering systems and associated components and accessories. Include ratings, configurations, standard wiring diagrams, dimensions, service condition requirements, and installed features.
- C. Shop Drawings: Include system interconnection schematic diagrams showing all factory and field connections. Include requirements for interface with other systems.

- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Electricity Meters:
 - 1. ABB: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric: www.se.com/#sle.
 - 4. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.2 EQUIPMENT FOR OWNER ELECTRICITY METERING

- A. Provide microprocessor-based digital electricity metering systems including all instrument transformers, wiring, and connections necessary for measurements specified.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide electricity metering systems and associated components compatible with the equipment and associated circuits to be metered.
- D. Service Conditions: Provide electricity meters suitable for operation under the service conditions at the installed location.
- E. Enclosures:
 - 1. Where not furnished by manufacturer, provide required cabinets and enclosures in accordance with Section 26 0533.16.
 - 2. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 3. Finish: Manufacturer's standard unless otherwise indicated.
- F. Instrument Transformers:
 - 1. Comply with IEEE C57.13, where applicable.
 - 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 - 3. Current Transformers: Compatible with connected meters; replace meters damaged by connection of incompatible current transformers. Provide shorting terminal blocks for connection of secondaries where applicable.
 - 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.3 MULTI-CIRCUIT ELECTRICITY METERS

- A. Multi-Circuit Electricity Meter - Basis of Design: Veris Industries; E3x Series Panelboard Monitoring System; 5-year warranty; utilizes voltage mode CTs that do not require shorting terminal blocks.

1. Metering Capacity: As indicated or as required for circuits to be monitored (configurations available for monitoring up to 84 branch circuits, two 3-phase main devices, and two neutrals with one meter).
2. Accuracy:
 - a. Real/Active Power/Energy (for models that measure this parameter): Revenue grade; plus/minus 1.0 percent (including branch CTs); complying with ANSI C12.1 and IEC 62053-21, Class 1.
 - b. Voltage (for models that measure this parameter): Plus/minus 0.5 percent.
 - c. Current: Plus/minus 0.5 percent.
3. Measured Parameters at Main Device:
 - a. Current; per phase and average of all phases.
 - b. Maximum current; per phase and maximum average of all phases.
 - c. Current demand; per phase and average of all phases.
 - d. Maximum current demand; per phase and maximum average of all phases.
 - e. Models available with measurements for:
 - 1) Current phase angle.
 - 2) Real/active energy (kWh); per phase and total of all phases.
 - 3) Snapshot of total energy as of the completion of the most recent demand interval; per phase and total of all phases.
 - 4) Real/active power (kW); per phase and total of all phases; available signed to indicate whether energy is being imported or exported.
 - 5) Apparent power (kVA); per phase and total of all phases.
 - 6) Power factor; per phase and total, based on three-phase breaker rotation, signed, to indicate leading or lagging current.
 - 7) Voltage, line-to-line and line-to neutral; per phase and average of all phases.
 - 8) Voltage phase angle.
 - 9) Frequency; phase A.
4. Measured Parameters at Branch Circuits:
 - a. Current; per branch and average of all phases for multi-phase logical circuits.
 - b. Maximum current; per branch and maximum average of all phases for multi-phase logical circuits.
 - c. Current demand; per branch and average of all phases for multi-phase logical circuits.
 - d. Maximum current demand; per branch and maximum average of all phases for multi-phase logical circuits.
 - e. Models available with measurements for:
 - 1) Current phase angle.
 - 2) Real/active power (kW); per branch and total of all phases for multi-phase logical circuits; available signed to indicate whether energy is being imported or exported.
 - 3) Real/active power (kW) demand; per branch and total of all phases for multi-phase logical circuits.
 - 4) Real/active power (kW) demand maximum; per branch and total of all phases for multi-phase logical circuits.
 - 5) Real/active energy (kWh); per branch and total of all phases for multi-phase logical circuits.
 - 6) Snapshot of total energy as of the completion of the most recent demand interval; per branch and total of all phases for multi-phase logical circuits.

- 7) Apparent power (kVA); per branch and total of all phases for multi-phase logical circuits.
 - 8) Power factor; per branch and average of all phases for multi-phase logical circuits, signed to indicate leading or lagging current.
- 5. Alarm capability, with configurable setpoints.
 - a. Current over/under range.
 - b. Models available with voltage over/under range.
- 6. Communications: Compatible with connected systems. Provide all accessories necessary for proper interface.
 - a. Models Available with Serial Communications:
 - 1) RS-485, 2-wire or 4-wire; support for Modbus RTU protocol.
 - 2) RS-485, 2-wire; support for Modbus RTU and BACnet MS/TP protocols.
 - b. Models Available with Ethernet Communications:
 - 1) Without RJ-45 10/100 Mbit; requires Modbus TCP Gateway; support for Modbus TCP protocol.
 - 2) With RJ-45 10/100 Mbit; support for Modbus TCP, BACnet IP, and SNMP protocols.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of metering systems and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive meters.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment components in accordance with Section 26 0529.
- D. Provide grounding and bonding in accordance with Section 26 0526.
- E. Provide fuses complying with Section 26 2813 as required.

3.3 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. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

- D. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.
- E. Correct deficiencies and replace damaged or defective metering system components.

3.4 ADJUSTING

- A. Program system parameters according to requirements of Owner.

3.5 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 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 system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.7 PROTECTION

- A. Protect installed system components from subsequent construction operations.

END OF SECTION 26 2713

SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Wall plates and covers.
- E. Floor box service fittings.
- F. Poke-through assemblies.

1.2 RELATED REQUIREMENTS

- A. Section 09 6900 - Access Flooring.
- B. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- C. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0533.23 - Surface Raceways for Electrical Systems: Surface raceway systems, including multioutlet assemblies.
- F. Section 26 0539 - Underfloor Raceways for Electrical Systems.
- G. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- H. Section 26 0583 - Wiring Connections: Cords and plugs for equipment.
- I. Section 26 0923 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.
- J. Section 26 2723 - Indoor Service Poles.
- K. Section 26 2913 - Enclosed Controllers: Manual motor starters and horsepower rated motor-starting switches without overload protection.
- L. Section 27 1000 - Structured Cabling: Voice and data jacks.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h (Validated 2022).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2017g (Validated 2023).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- 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 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.
- M. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.
- N. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.
- O. UL 1917 - Solid-State Fan Speed Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 4. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
 - 5. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

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

- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
 - 1. Wall Dimmers: Include derating information for ganged multiple devices.
- C. 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 Wall Plates: One of each style, size, and finish.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 WIRING DEVICES - GENERAL REQUIREMENTS

- A. Provide wiring devices suitable for intended use with ratings adequate for load served.
- B. Wiring Device Applications:
 - 1. Receptacles Installed Outdoors or in Damp or Wet Locations: Use weather-resistant GFCI receptacles with weatherproof covers.
 - 2. Receptacles Installed in Dwelling Units: Use tamper-resistant receptacles.
 - 3. Provide GFCI protection for:
 - a. Receptacles installed within 6 feet (1.8 m) of sinks.
 - b. Receptacles installed in kitchens.
- C. Wiring Device Finishes:
 - 1. Provide wiring device finishes as described below, unless otherwise indicated.
 - 2. Wiring Devices, Unless Otherwise Indicated: White with white nylon wall plate.
 - 3. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
 - 4. Wiring Devices Installed in Wet or Damp Locations: White with weatherproof cover.
 - 5. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.

2.2 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
 - 3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.3 WALL DIMMERS

- A. Manufacturers:
 1. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
 2. Lutron Electronics Company, Inc; Maestro Series: www.lutron.com/#sle.
 3. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
- B. 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.

2.4 RECEPTACLES

- A. Manufacturers:
 1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 2. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
 3. Lutron Electronics Company, Inc; Designer Style: www.lutron.com/#sle.
 4. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
 3. Hospital Grade Receptacles: Listed as complying with UL 498 Supplement SD, with green dot hospital grade mark on device face.
- C. Convenience Receptacles:
 1. Standard Convenience Receptacles: Hospital grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 2. Weather Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
 3. Tamper Resistant Convenience Receptacles: Commercial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
2. Standard GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
 - a. Products:
 - 1) Hubbell Incorporated; Model _____: www.hubbell.com/#sle.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
3. Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
4. Tamper Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type.
5. Tamper Resistant and Weather Resistant GFCI Receptacles: Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

E. USB Charging Devices:

1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, commercial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; rectangular decorator style.
 - a. Products:
 - 1) Hubbell Incorporated; Model _____: www.hubbell.com/#sle.

2.5 WALL PLATES AND COVERS

A. Manufacturers:

1. Hubbell Incorporated; _____: www.hubbell-wiring.com/#sle.
2. Intermatic, Inc; _____: www.intermatic.com/#sle.
3. Leviton Manufacturing Company, Inc; _____: www.leviton.com/#sle.
4. Lutron Electronics Company, Inc; _____: www.lutron.com/#sle.
5. Pass & Seymour, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
2. Size: Standard; _____.
3. Screws: Metal with slotted heads finished to match wall plate finish.

2.6 FLOOR BOX SERVICE FITTINGS

A. Manufacturers:

1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
2. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.

- B. Description: Service fittings compatible with floor boxes provided under Section 26 0533.16 with components, adapters, and trims required for complete installation.

2.7 POKE-THROUGH ASSEMBLIES

- A. Manufacturers:
 - 1. Hubbell Incorporated; _____: www.hubbell.com/#sle.
 - 2. Wiremold, a brand of Legrand North America, Inc; _____: www.legrand.us/#sle.
- B. Description: Assembly comprising floor service fitting, poke-through component, fire stops and smoke barriers, and junction box for conduit termination; fire rating listed to match fire rating of floor and suitable for floor thickness where installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- L. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- M. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- N. 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.
- O. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- P. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each wiring device for damage and defects.
- C. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- D. Test each receptacle to verify operation and proper polarity.
- E. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- F. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.4 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.5 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 26 2726

SECTION 26 2813 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.
- B. Spare fuse cabinet.

1.2 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 0573 - Power System Studies: Additional criteria for the selection of protective devices specified in this section.
- C. Section 26 2413 - Switchboards: Fusible switches.
- D. Section 26 2416 - Panelboards: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

1.4 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.
 - 1. Spare Fuse Cabinet: Include dimensions.
- C. 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 Fuses: One set(s) of three for each type and size installed.
 - 3. Fuse Pullers: One set(s) compatible with each type and size installed.
 - 4. Spare Fuse Cabinet Keys: Two.

1.5 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation; _____: www.cooperindustries.com/#sle.
- B. Littelfuse, Inc; _____: www.littelfuse.com/#sle.
- C. Mersen; _____: ep-us.mersen.com/#sle.

2.2 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

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that mounting surfaces are ready to receive spare fuse cabinet.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.

- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION 26 2813

SECTION 26 2816.13 - ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.4 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. ABB: www.electrification.us.abb.com/#sle.

- B. Eaton Corporation: www.eaton.com/#sle.
- C. Schneider Electric: www.se.com/#sle.
- D. Siemens Industry, Inc: www.new.siemens.com/#sle.

2.2 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
- D. Short Circuit Current Rating:
- E. Conductor Terminations: Suitable for use with the conductors to be installed.
- F. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- G. Enclosures: Comply with NEMA EN 10250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
- H. Provide externally operable handle with means for locking in the OFF position.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 - 1. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

PART 3 EXECUTION

3.1 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 circuit breakers plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.

3.2 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.3 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 2816.13

SECTION 26 3213 - ENGINE GENERATORS - DIESEL

PART 1 GENERAL

1.1 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.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 23 1113 - Facility Fuel-Oil Piping:
 - 1. Diesel fuel piping.
- C. Section 23 5100 - Breechings, Chimneys, and Stacks: Engine exhaust piping.
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- E. Section 26 0529 - Hangers and Supports for Electrical Systems.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- G. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.
- H. Section 26 3600 - Transfer Switches.

1.3 REFERENCE STANDARDS

- A. ASTM D975 - Standard Specification for Diesel Fuel; 2024a.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
- D. NEMA MG 00001 - Motors and Generators; 2024.
- E. NFPA 30 - Flammable and Combustible Liquids Code; 2024, with Errata (2025).
- F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2024, with Amendment.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. NFPA 99 - Health Care Facilities Code; 2024, with Errata.

- I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
- J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
- K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
- L. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - a. Transfer Switches: See Section 26 3600.
 - 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.

1.5 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.
 - 1. Include generator set sound level test data.
 - 2. Include characteristic trip curves for overcurrent protective devices upon request.
 - 3. Include alternator thermal damage curve upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
 - 1. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.
- F. Manufacturer's factory emissions certification.
- G. Provide NFPA 110 required documentation from manufacturer where requested by authorities having jurisdiction, including but not limited to:

1. Certified prototype tests.
2. Torsional vibration compatibility certification.
3. NFPA 110 compliance certification.
4. Certified rated load test at rated power factor.

1.6 QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70 (National Electrical Code).
 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
 3. NFPA 99 (Health Care Facilities Code).
 4. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
 5. NFPA 30 (Flammable and Combustible Liquids Code).
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Packaged Engine Generator Set:
 1. Caterpillar Inc: www.cat.com/#sle.
 2. Cummins Power Generation Inc: www.cumminspower.com/#sle.

3. Rolls-Royce Power Systems; MTU: www.mtu-solutions.com/#sle.

2.2 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: Diesel (compression ignition).
 - 2. Power Rating: 500 kW, standby.
 - 3. Voltage: As indicated on drawings.
- 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.
- 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.

2.3 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 - Diesel (Compression Ignition):
 - 1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.
 - 2. Fuel Storage: Sub-base fuel tank.
 - 3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve. Provide fuel cooler where recommended by manufacturer.
 - 4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.
 - 5. Sub-Base Fuel Tank:
 - a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.
 - b. Tank Capacity: Size for minimum of 48 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.
 - c. Features:
 - 1) Direct reading fuel level gauge.
 - 2) Normal atmospheric vent.
 - 3) Emergency pressure relief vent.
 - 4) Fuel fill opening with lockable cap.
 - 5) Dedicated electrical conduit stub-up area.
- 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. Listed 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.

2.4 ALTERNATOR (GENERATOR)

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 00001; 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 00001, Class H; suitable for alternator temperature rise.
- E. Enclosure: NEMA MG 00001, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.

2.5 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 (warning).
 - 6) Low oil pressure (shutdown).
 - 7) Overspeed (shutdown).
 - 8) Low fuel level (warning).
 - 9) Low coolant level (warning/shutdown).
 - 10) Generator control not in automatic mode (warning).
 - 11) High battery voltage (warning).
 - 12) Low cranking voltage (warning).
 - 13) Low battery voltage (warning).
 - 14) 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 (warning).
 - 6) Low oil pressure (shutdown).
 - 7) Overspeed (shutdown).
 - 8) Low fuel level (warning).
 - 9) Low coolant level (warning/shutdown).
 - 10) Generator control not in automatic mode (warning).
 - 11) High battery voltage (warning).
 - 12) Low cranking voltage (warning).
 - 13) Low battery voltage (warning).
 - 14) Battery charger failure (warning).
 - b. Provide audible alarm with silence function.
 - c. Provide lamp test function that illuminates all indicator lamps.

2.6 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

3.1 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 diesel fuel piping and venting in accordance with Section 23 1113, where not factory installed.
- I. 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.
- J. Do not insulate piping for engine components restricted by manufacturer.
- K. Provide grounding and bonding in accordance with Section 26 0526.
- L. Identify system wiring and components in accordance with Section 26 0553.

3.2 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.3 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 system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.4 PROTECTION

- A. Protect installed engine generator system from subsequent construction operations.

END OF SECTION 26 3213

SECTION 26 3600 - TRANSFER SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

1.2 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.
- E. Section 26 3213 - Engine Generators - Diesel: For interface with transfer switches.
 - 1. Includes code requirements applicable to work of this section.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NEMA IA 10042-1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2025.
- D. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 110 - Standard for Emergency and Standby Power Systems; 2025.
- G. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.4 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.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

1.5 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
 - 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for system Level specified in Section 26 3213.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Transfer Switches:
 - 1. ABB: www.electrification.us.abb.com/#sle.
 - 2. Eaton Corporation: www.eaton.com/#sle.
 - 3. Schneider Electric; ASCO Power Technologies: www.ascopower.com/#sle.

2.2 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. Applications:
- D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
- E. Automatic Transfer Switch:
 - 1. Transfer Switch Type: Automatic transfer switch.
 - 2. Transition Configuration: As indicated on the drawings.
 - 3. Voltage: As indicated on the drawings.
 - 4. Ampere Rating: As indicated on the drawings.
 - 5. Neutral Configuration: Switched neutral.
 - 6. Load Served: As indicated on the drawings.
 - 7. Primary Source: As indicated on the drawings.
 - 8. Alternate Source: As indicated on the drawings.

- F. Comply with NEMA IA 10042-1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).
- G. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
- H. 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.
- I. Switching Methods:
 - 1. Open Transition:
 - a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
 - 2. Neutral Switching: Either simultaneously switched neutral (break-before-make) or overlapping neutral (make-before-break) methods are acceptable.
 - 3. Obtain control power for transfer operation from line side of source to which the load is to be transferred.
- J. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
- K. Enclosures:
 - 1. Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 2. Finish: Manufacturer's standard unless otherwise indicated.
- L. 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.
- M. Automatic Transfer Switches:
 - 1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
 - 2. Control Functions:
 - a. Automatic mode.
 - b. Test Mode: Simulates failure of primary/normal source.
 - c. Voltage and Frequency Sensing:
 - 1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
 - 2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - 3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - d. Outputs:
 - 1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
 - 2) Auxiliary contacts; one set(s) for each switch position.

- e. Adjustable Time Delays:
 - 1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
 - 2) Transfer to alternate/emergency source time delay.
 - 3) Retransfer to primary/normal source time delay.
 - 4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
- f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.
- g. Synchronization/In-Phase Monitor (Closed Transition Transfer Switches): Monitors voltage and phase angle difference between sources for initiating synchronized transfer.
- h. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
- 3. Status Indications:
 - a. Connected to alternate/emergency source.
 - b. Connected to primary/normal source.
 - c. Alternate/emergency source available.
- 4. Alarm Indications for Closed Transition Transfer Switches:
 - a. Failure to synchronize.
 - b. Extended source interconnection/transfer switch locked out.
- 5. Automatic Sequence of Operations:
 - a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
 - b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
 - c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
 - d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive transfer switches.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances 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.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Prepare and start system in accordance with manufacturer's instructions.
- C. Automatic Transfer Switches:
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.
- D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

3.6 PROTECTION

- A. Protect installed transfer switches from subsequent construction operations.

3.7 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.

END OF SECTION 26 3600

SECTION 26 3633 - CONNECTION CABINETS FOR PORTABLE GENERATORS AND LOAD BANKS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Permanently installed connection cabinets/docking stations with provisions for temporary power connections to portable equipment.

1.2 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.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.
- E. UL 1773 - Termination Boxes; Current Edition, Including All Revisions.

1.4 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.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing factory and field connections.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Schneider Electric; ASCO Power Technologies: www.ascopower.com/#sle.
- B. Trystar.

2.2 CONNECTION CABINETS/DOCKING STATIONS

- A. Description: Cabinets with provisions for temporary facility connection to portable generators and/or load banks.
- B. General Requirements:
 - 1. Listed as complying with UL 1008 or UL 1773.
 - 2. Temporary Connectors:
 - a. Camlocks: Single-pole, series 16; _____.
 - b. Lugs: Single-pole, mechanical type.
 - 3. Input Camlock Connections for Generator: For each row, provide five camlock connectors (one for each phase, one for neutral, and one for ground).
 - 4. Output Camlock Connections for Load Bank: For each row, provide four camlock connectors (one for each phase and one for ground).
 - 5. Camlock Connector Color Code:
 - a. 240 V and Below:
 - 1) Phase 1: Black.
 - 2) Phase 2: Red.
 - 3) Phase 3, Where Required: Blue.
 - b. 277 V to 480 V:
 - 1) Phase 1: Brown.
 - 2) Phase 2: Orange.
 - 3) Phase 3: Yellow.
 - c. Neutral: White.
 - d. Ground: Green.
 - 6. Equipment Ground: Bonded to enclosure.
 - 7. Bus Bar:
 - a. Material: Tin-plated copper, unless otherwise indicated.
 - b. Provide permanent connection to facility with mechanical set screw lugs.
 - 8. Neutral Configuration:
 - a. Input for Generator: 100 percent rated.
 - b. Output for Load Bank: No neutral.
 - 9. Temporary Cable Provisions: Provide access wiring entry/exit for conductors, with no sharp edges that may come in contact with conductor insulation.
- C. Enclosure:
 - 1. Material: Painted steel.
 - 2. NEMA EN 10250 Rating: Type 3R.
 - 3. Front Door: Lockable; capable of securing connection cables when locked.

- 4. Temporary Cable Access Panel: Hinged plate for bottom entry, mechanically interlocked with front door.
- 5. Finish Color: Manufacturer's standard.
- D. Short Circuit Current Rating: Where not specified, provide connection cabinet with listed short circuit current rating not less than available fault current at installed location as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1 for general workmanship.
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances and required maintenance access; provide adequate space for temporary cable connections.
- D. Provide required support and attachment; see Section 26 0529.
- E. Install connection cabinets plumb and level.
- F. Unless otherwise indicated, mount floor-mounted connection cabinets on properly sized concrete pad 3 inches (80 mm) in height.
- G. Provide grounding and bonding; see Section 26 0526.
- H. Provide identification; see Section 26 0553.
 - 1. Identify system wiring and components.
 - 2. Connection Cabinets for Portable Generators:
 - a. Use identification nameplate to identify phase rotation.
 - b. Use warning label or identification nameplate to identify system bonding requirements in accordance with NFPA 70.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Test system operation.
- C. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- D. Provide additional inspection and testing as required for completion of permanent engine generator testing as specified in Section 26 3213.

3.3 PROTECTION

- A. Protect installed connection cabinets from subsequent construction operations.

END OF SECTION 26 3633

SECTION 26 4300 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 2300 - Low-Voltage Switchgear.
- C. Section 26 2413 - Switchboards.
- D. Section 26 2416 - Panelboards.
- E. Section 26 2726 - Wiring Devices - Lutron: Receptacles with integral surge protection.
- F. Section 27 1000 - Structured Cabling: Protectors for communications service entrance.

1.3 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.4 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. NEMA EN 10250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2024.
- C. NETA ATS - Standard for Acceptance Testing Specifications for Electrical Power Equipment And Systems; 2025.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.6 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
- C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.
- D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- F. Project Record Documents: Record actual connections and locations of surge protective devices.

1.7 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.9 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

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

- B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Field-Installed, Externally Mounted Surge Protective Devices:
 - 1. ABB: www.electrification.us.abb.com/#sle.
 - 2. Intermatic, Inc: www.intermatic.com/#sle.
 - 3. nVent ERICO: www.nvent.com/#sle.
 - 4. Schneider Electric: www.se.com/#sle.
 - 5. Surge Suppression, LLC (SSI): www.surgesuppression.com/#sle.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. 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. Protected Modes:
 - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. Equivalent to basis of design.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA EN 10250: Unless otherwise indicated, as specified for the following installation locations:
 - 1. Indoor clean, dry locations: Type 1.
 - 2. Outdoor locations: Type 3R.
- H. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
 - 1. Switchgear: See Section 26 2300.
 - 2. Switchboards: See Section 26 2413.
 - 3. Panelboards: See Section 26 2416.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. 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.

3.3 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.

3.4 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 26 4300

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.

1.2 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 0923 - Lighting Control Devices.
- E. Section 26 2726 - Wiring Devices: Manual wall switches and wall dimmers.
- F. Section 26 5600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

- A. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2025.
- D. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- H. UL 1598C - Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits; Current Edition, Including All Revisions.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, 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

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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. 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.
- I. Install lamps in each luminaire.

3.3 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect or authority having jurisdiction.
- C. Air-Handling Luminaires with Air Control Blades or Heat Removal Dampers: Adjust as indicated or as required for proper airflow as directed by Architect.
- D. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect or authority having jurisdiction.

3.4 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

3.6 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 5100

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires.

1.2 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 0533.16 - Boxes for Electrical Systems.
- D. Section 26 0923 - Lighting Control Devices.
- E. Section 26 2726 - Wiring Devices: Receptacles for installation in poles.
- F. Section 26 5100 - Interior Lighting.

1.3 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.
- B. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; 2002 (Corrigendum 2012).
- C. IES LM-63 - Approved Method: IES Standard File Format for the Electronic Transfer of Photometric Data and Related Information; 2019.
- D. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products; 2024.
- E. IES LM-80 - Approved Method: Measuring Maintenance of Light Output Characteristics of Solid-State Light Sources; 2021.
- F. IES RP-8 - Recommended Practice: Lighting Roadway and Parking Facilities; 2022.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- H. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2000 (Reaffirmed 2006).
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 1598 - Luminaires; Current Edition, Including All Revisions.

- K. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Architect of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.

1.6 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 WARRANTY

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

- B. Provide 3-year manufacturer warranty for LED replacement lamps.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 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.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect.

3.4 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect. Secure locking fittings in place.

3.5 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.

3.7 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION 26 5600

SECTION 27 0529 - HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other communications work.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 27 1000 - Structured Cabling.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
- 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; 2023.
- 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).

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.

2. Coordinate work to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
5. Notify Architect of 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 cured; see Section 03 3000.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

1.6 QUALITY ASSURANCE

- A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 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 with minimum safety factor of _____. 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. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. nVent; Caddy: www.nvent.com/#sle.
 2. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 3. Conduit Clamps: Bolted type unless otherwise indicated.
 4. Products:
 - a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - b. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
- C. Cable Supports: Suitable for cables to be supported, including but not limited to J-hooks, bridle rings, drive rings, and flexible harnesses/slings.
 1. Applications:
 - a. Do not exceed 5 feet (1.5 m) between cable supports.
 - b. Maximum Number of Cables per Cable Support:
 - 1) J-Hooks: 50, regardless of capacity.
 - c. Allowable Cable Types:
 - 1) J-Hooks: Category 3, Category 5e, and Category 6.
 - 2) Bridle Rings with Saddle: Category 3, Category 5e, and Category 6.
 2. Comply with TIA-569.
- D. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
- E. 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.
- F. 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. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch (6 mm) diameter.
 - c. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch (10 mm) diameter.
 - d. Trapeze Support for Multiple Conduits: 3/8-inch (10 mm) diameter.
- G. Anchors and Fasteners:
 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.

- d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- 2. Manufacturers - Powder-Actuated Fastening Systems:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.
 - c. ITW Ramset, a division of Illinois Tool Works, Inc: www.ramset.com/#sle.
 - d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- 3. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
- 4. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- 5. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 6. Hollow Masonry: Use toggle bolts.
- 7. Hollow Stud Walls: Use toggle bolts.
- 8. Steel: Use beam clamps, machine bolts, or welded threaded studs.
- 9. Sheet Metal: Use sheet metal screws.
- 10. Wood: Use wood screws.
- 11. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install 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. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- I. Secure fasteners in accordance with manufacturer's recommended torque settings.
- J. Remove temporary supports.
- K. Identify independent communications component support wires above accessible ceilings, where permitted, with color distinguishable from other support wires in accordance with NFPA 70.

3.3 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 27 0529

SECTION 27 0536 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Metal cable tray systems:
 - 1. Metal ladder cable tray.
 - 2. Metal wire mesh/basket cable tray.

1.2 RELATED REQUIREMENTS

- A. Section 27 0529 - Hangers and Supports for Communications Systems.

1.3 REFERENCE STANDARDS

- A. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
- B. BICSI ITSIMM - Information Technology Systems Installation Methods Manual (ITSIMM), 8th Edition; 2022.
- C. BICSI N3 - Planning and Installation Methods for the Bonding and Grounding of Telecommunication and ICT Systems and Infrastructure; 2020.
- D. BICSI TDMM - Telecommunications Distribution Methods Manual, 15th Edition; 2024.
- E. NECA/BICSI 607 - Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings; 2011.
- F. NEMA BI-50016 - Cable Tray Installation Guidelines; 2024.
- G. NEMA BI 50015 - Metal Cable Tray Systems; 2024.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

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

PART 2 PRODUCTS

2.1 CABLE TRAY SYSTEM - GENERAL REQUIREMENTS

- A. Provide new cable tray system consisting of required components, fittings, supports, and accessories, as necessary for complete system.
- B. Provide products listed, classified, and labeled as suitable for 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 service conditions at installed location.
- E. Unless otherwise indicated, specified span/load ratings are based on safety factor of 1.5 and working load only (i.e., no additional concentrated static load), with ratings for metal cable tray systems in accordance with NEMA BI 50015.
- 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 BI 50015 including applicable allowable tolerances.

2.2 METAL CABLE TRAY SYSTEMS

- A. Manufacturers:
 - 1. ABB, Inc: www.new.abb.com/#sle.
 - 2. Cablofil, a brand of Legrand North America, Inc: www.legrand.us/cablofil/#sle.
 - 3. Cope, a brand of Atkore International Inc: www.copecabletray.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Comply with NEMA BI 50015.
- C. Material/Finishes:
 - 1. Zinc Electroplated Steel: Comply with ASTM B633.
- D. Metal Wire Mesh/Basket Cable Tray:
 - 1. Material: Zinc-electroplated steel or mill-galvanized before fabrication (pre-galvanized) steel.
 - 2. Tray Depth: As indicated on drawings.
 - 3. Span/Load Rating: As indicated on drawings.
 - 4. Mesh Spacing: 2 by 4 inches (51 by 102 mm).
 - 5. Tray Width: As indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage cable tray system has been completed.

- B. Verify field measurements.
- C. Verify dimensions and span/load ratings of cable tray system components.
- D. Verify that mounting surfaces are ready to receive cable tray and associated supports.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Unless otherwise indicated, arrange cable tray to be parallel or perpendicular to building lines.
- C. Arrange cable tray to provide required clearances and maintain cable access.
- D. Install cable tray plumb and level, with sections aligned and with horizontal runs at specified elevation.
- E. Metal Wire Mesh/Basket Cable Tray: Field fabricate fittings in accordance with manufacturer's instructions, using only manufacturer-approved connectors classified for bonding.
 - 1. Inside Radius of Fittings: 12 inches (305 mm).
- F. Cable Tray Movement Provisions:
 - 1. Provide 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 BI-50016.
 - 2. Use expansion guides in lieu of hold-down clamps where prescribed in NEMA BI-50016.
 - 3. Set gaps for expansion fittings in accordance with NEMA BI-50016.
- G. Cable Provisions:
 - 1. Use fixed barrier strips to maintain separation of cables as indicated and as required by NFPA 70.
 - 2. Use drop-out fittings or bushings where cables exit cable tray as required to maintain minimum cable bending radius.
 - 3. Use 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 BI-50016, BICSI ITSIMM, and manufacturer's requirements, but not exceeding specified span unless otherwise approved by Engineer. Provide required support and attachment 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:

1. Install cable tray grounding in accordance with the following. Where requirements differ, comply with the most stringent.
 - a. BICSI ITSIMM (technology systems).
 - b. BICSI N3 (cabling infrastructure).
 - c. BICSI TDMM (telecommunications distribution methods).
 - d. NECA/BICSI 607 (telecommunications bonding and grounding).
 2. Metal Cable Tray Systems: Use suitable bonding jumpers or classified cable tray connectors to provide electrical continuity. Do not use classified cable tray connectors where cable tray sections have been modified, such as being bent, cut, or reshaped.
- K. Penetrations: Install firestopping to preserve fire resistance rating of building elements.
- L. Identification Requirements:
- M. Install cable tray covers where indicated and as follows:
1. For first 6 ft (1.8 m) of cable tray extending vertically from floor penetration.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Inspect cable tray system for damage and defects.
- C. Correct deficiencies and replace damaged or defective cable tray system components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Remove dirt and debris from cable tray.
- B. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.6 PROTECTION

- A. Protect cable tray system from subsequent construction operations.

END OF SECTION 27 0536

SECTION 27 1000 - STRUCTURED CABLING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Communications system design requirements.
- B. Copper cable and terminations.
- C. Fiber optic cable and interconnecting devices.
- D. Communications outlets.
- E. Communications grounding and bonding.
- F. Communications identification.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products.
- E. Section 26 2726 - Wiring Devices.

1.3 REFERENCE STANDARDS

- A. BICSI N1 - Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure, 1st Edition; 2019.
- B. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; 2005e.
- C. FM (AG) - FM Approval Guide; Current Edition.
- D. ICEA S-83-596 - Indoor Optical Fiber Cable; 2021.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices; 1988a (Reaffirmed 2012).
- G. TIA-492AAAD - Detail Specification for 850-nm Laser- Optimized, 50-μm Core Diameter/125-μm Cladding Diameter Class 1a Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber; 2009.

- H. TIA-526-14 - Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; IEC 61280-4.1 Edition 3.1, Fiber Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant- Multimode Attenuation Measurement; 2023d.
- I. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2024.
- J. TIA-568.2 - Balanced Twisted-Pair Telecommunications Cabling and Components Standards; 2018d, with Addenda (2020).
- K. TIA-568.3 - Optical Fiber Cabling and Components Standard; 2022e.
- L. TIA-569 - Telecommunications Pathways and Spaces; 2019e, with Addendum (2022).
- M. TIA-598 - Optical Fiber Cable Color Coding; 2014d, with Addendum (2018).
- N. TIA-606 - Administration Standard for Telecommunications Infrastructure; 2021d.
- O. TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; 2019d, with Addendum (2021).
- P. UL 444 - Communications Cables; Current Edition, Including All Revisions.
- Q. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- R. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.
- S. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate requirements for service entrance and entrance facilities with Communications Service Provider.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
 - 3. Coordinate arrangement of communications 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.

1.5 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.
- C. Sustainable Design Documentation: Submit manufacturer's product data on cable and cable insulation showing compliance with specified lead content requirements.
- D. Evidence of qualifications for installer.
- E. Field Test Reports.

1.6 QUALITY ASSURANCE

- A. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- B. Installer Qualifications: A company having at least 3 years experience in the installation and testing of the type of system specified, and:
 - 1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
 - 2. Supervisors and installers factory certified by manufacturers of products to be installed.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

1.8 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a 2 year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.1 SYSTEM DESIGN

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
 - 1. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
 - 2. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F (0 to 60 degrees C) at relative humidity of 0 to 95 percent, noncondensing.
 - 3. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.
- B. Main Distribution Frame (MDF): Centrally located support structure for terminating horizontal cables that extend to telecommunications outlets, functioning as point of presence to external service provider.
 - 1. Locate main distribution frame as indicated on the drawings.
- C. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.2 COPPER CABLE AND TERMINATIONS

- A. Manufacturers:
 - 1. CommScope: www.commscope.com/#sle.
 - 2. General Cable Technologies Corporation: www.generalcable.com/#sle.
- B. Copper Horizontal Cable:
 - 1. Description: 100 ohm, balanced twisted pair cable complying with TIA-568.2 and listed and labeled as complying with UL 444.
 - 2. Cable Type - Voice and Data: TIA-568.2 Category 6 UTP (unshielded twisted pair); 23 AWG.
 - 3. Cable Capacity: 4-pair.
 - 4. Cable Applications: Use listed NFPA 70 Type CMP plenum cable unless otherwise indicated.
 - 5. Cable Jacket Color - Voice and Data Cable: See Drawings for cable color requirements.
 - 6. Product(s):
 - a. CommScope; SYSTIMAX Twisted Pair Cables; GigaSPEED XL Category 6 U/UTP Cable: www.commscope.com/#sle.
 - b. CommScope; Uniprise Twisted Pair Cables; CS34 Series Category 6 U/UTP Cable: www.commscope.com/#sle.
 - c. General Cable Technologies Corporation; GenSPEED Cables: www.generalcable.com/#sle.
- C. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool; use screw connections only where specifically indicated.
- D. Jacks and Connectors: Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
 - 1. Performance: 500 mating cycles.
 - 2. Voice and Data Jacks: 8-position modular jack, color-coded for both T568A and T568B wiring configurations.
 - 3. Product(s):
 - a. CommScope; SYSTIMAX RJ45 Jacks; MGS400 Series Category 6 U/UTP Modular Jacks: www.commscope.com/#sle.

2.3 FIBER OPTIC CABLE AND INTERCONNECTING DEVICES

- A. Manufacturers:
 - 1. CommScope; _____: www.commscope.com/#sle.
 - 2. General Cable Technologies Corporation; _____: www.generalcable.com/#sle.
 - 3. Siemon Company; _____: www.siemon.com/#sle.
- B. Fiber Optic Backbone Cable:
 - 1. Description: Tight buffered, non-conductive fiber optic cable complying with TIA-568.3, TIA-598, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
 - 2. Cable Type: Multimode, laser-optimized 50/125 um (OM4) complying with TIA-492AAAD.
 - 3. Cable Capacity: Quantity of fibers as indicated on drawings.

4. Cable Applications:
 - a. Plenum Applications: Use listed NFPA 70 Type OFNP plenum cable.
 5. Cable Jacket Color:
 - a. Laser-Optimized Multimode Fiber (OM3/OM4): Aqua.
- C. Fiber Optic Interconnecting Devices:
1. Connector Type: Type LC.
 2. Connector Performance: 500 mating cycles, when tested in accordance with TIA-455-21.
 3. Maximum Attenuation/Insertion Loss: 0.3 dB.

2.4 COMMUNICATIONS OUTLETS

- A. Manufacturers:
1. CommScope: www.commscope.com/#sle.
 2. Siemon Company: www.siemon.com/#sle.
- B. Outlet Boxes: Comply with Section 26 0533.16.
1. Provide depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius.
 2. Minimum Size, Unless Otherwise Indicated:
 - a. Data or Combination Voice/Data Outlets: 4 inch square by 2-1/8 inch deep (100 by 54 mm) trade size.
- C. Wall Plates:
1. Comply with system design standards and UL 514C.
 2. Accepts modular jacks/inserts.
 3. Capacity:
 - a. Data or Combination Voice/Data Outlets: 8 ports.
 4. Wall Plate Material/Finish - Flush-Mounted Outlets: Match wiring device and wall plate finishes specified in Section 26 2726.

2.5 GROUNDING AND BONDING COMPONENTS

- A. Comply with TIA-607.
- B. Comply with Section 26 0526.

2.6 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.
- B. Comply with Section 26 0553.

2.7 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test cables according to TIA-568 (SET).

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Comply with latest editions and addenda of TIA-568 (SET) (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), BICSI N1, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.
- C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.

3.2 INSTALLATION OF PATHWAYS

- A. Install pathways with the following minimum clearances:
 - 1. 48 inches (1220 mm) from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
 - 2. 12 inches (300 mm) from power conduits and cables and panelboards.
 - 3. 5 inches (125 mm) from fluorescent and high frequency lighting fixtures.
 - 4. 6 inches (150 mm) from flues, hot water pipes, and steam pipes.
- B. Outlet Boxes:
 - 1. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of telecommunications outlets provided under this section.
 - a. Mounting Heights: Unless otherwise indicated, as follows:
 - 1) Telephone and Data Outlets: 18 inches (450 mm) above finished floor.
 - 2) Telephone Outlets for Side-Reach Wall-Mounted Telephones: 54 inches (1.4 m) above finished floor to top of telephone.
 - 3) Telephone Outlets for Forward-Reach Wall-Mounted Telephones: 48 inches (1.2 m) above finished floor to top of telephone.

3.3 INSTALLATION OF EQUIPMENT AND CABLING

- A. Cabling:
 - 1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
 - 2. Do not over-cinch or crush cables.
 - 3. Do not exceed manufacturer's recommended cable pull tension.
 - 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
 - 1. At Distribution Frames: 120 inches (3000 mm).
 - 2. At Outlets - Copper: 12 inches (305 mm).
 - 3. At Outlets - Optical Fiber: 39 inches (1000 mm).

- C. Copper Cabling:
 - 1. Category 5e and Above: Maintain cable geometry; do not untwist more than 1/2 inch (12 mm) from point of termination.
 - 2. For 4-pair cables in conduit, do not exceed 25 pounds (110 N) pull tension.
 - 3. Use T568B wiring configuration.
- D. Fiber Optic Cabling:
 - 1. Prepare for pulling by cutting outer jacket for 10 inches (250 mm) from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.
 - 2. Support vertical cable at intervals as recommended by manufacturer.
- E. Identification:
 - 1. Use wire and cable markers to identify cables at each end.
 - 2. Use manufacturer-furnished label inserts, identification labels, or engraved wallplate to identify each jack at communications outlets with unique identifier.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Comply with inspection and testing requirements of specified installation standards.
- C. Visual Inspection:
 - 1. Inspect cable jackets for certification markings.
 - 2. Inspect cable terminations for color coded labels of proper type.
 - 3. Inspect outlet plates and patch panels for complete labels.
- D. Testing - Copper Cabling and Associated Equipment:
 - 1. Test backbone cables after termination but before cross-connection.
 - 2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
 - 3. Test operation of shorting bars in connection blocks.
 - 4. Category 5e and Above Links: Perform tests for wire map, length, attenuation, NEXT, and propagation delay.
- E. Testing - Fiber Optic Cabling:
 - 1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.
 - 2. Multimode Backbone: Perform tests in accordance with TIA-526-14.
- F. Final Testing: After all work is complete, including installation of telecommunications outlets, and telephone dial tone service is active, test each voice jack for dial tone.

END OF SECTION 27 1000

SECTION 27 5116 - PUBLIC ADDRESS SYSTEMS

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

1.2 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.3 SYSTEM DESCRIPTION

- A. Public address system for voice. System to be provided by owner and installed by EC. EC shall provide all
- B. Input components:

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Splice cable only in accessible junction boxes or at terminal block units.
- C. Make cable shields continuous at splices and connect speaker circuit shield to equipment ground only at amplifier.
- D. Install input circuits in separate cables and raceways from output circuits.
- E. Leave 18 inches (300 mm) excess cable at each termination at microphone, volume pad, speaker, and other system outlet.
- F. Provide protection for exposed cables where subject to damage.
- G. Use armored cable for outside speaker circuits.
- H. Support cables above accessible ceilings to keep them from resting on ceiling tiles. Use spring metal clips or plastic cable ties to support cables from structure for ceiling suspension system. Include bridle rings or drive rings.
- I. Use suitable cable fittings and connectors.

- J. Connect reproducers to amplifier with matching transformers.
- K. Install equipment racks in location shown; arrange to provide adequate ventilation and access.
- L. Ground and bond equipment and circuits in accordance with Section 26 0526.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Measure and record sound power levels at designated locations.

3.3 ADJUSTING

- A. Adjust transformer taps for appropriate sound level.
- B. Adjust devices and wall plates to be flush and level.

END OF SECTION 27 5116

SECTION 27 5223 - NURSE CALL/CODE BLUE SYSTEMS

PART 1 GENERAL

1.1 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 MANUFACTURERS - SYSTEM SHALL BE PROVIDED BY OWNER AND INSTALLED BY EC. EC SHALL PROVIDE RACEWAY AND BOXES.

2.2 NURSE CALL/CODE BLUE SYSTEM

- A. System Features:
 - 1. Two-way communication between master station and patient, emergency, staff, and duty stations.
 - 2. Digital page system.
 - 3. Audible and visual annunciation of calls to master station.
- B. System Capacity:
- C. System Configuration:
- D. Calling Sequence of Operation:
- E. Annunciation Sequence of Operation:
- F. Call Status Annunciation:
- G. Intercom Sequence of Operation:

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 ADJUSTING

- A. Adjust controls to achieve proper operation.

B. Set medical status of each patient and staff station as directed.

END OF SECTION 27 5223

SECTION 28 1000 - ACCESS CONTROL

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware: Electrically operated door hardware, for interface with access control system.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.2 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- B. UL 294 - Access Control System Units; Current Edition, Including All Revisions.

PART 2 PRODUCTS

2.1 MANUFACTURERS - SYSTEM SHALL BE PROVIDED BY OWNER AND INSTALLED BY EC. EC SHALL PROVIDE RACEWAY AND BOXES.

2.2 ACCESS CONTROL SYSTEM REQUIREMENTS

- A. Provide new access control system consisting of required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, 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.
 - 1. Access Control Units and Readers: Listed and labeled as complying with UL 294.

2.3 ACCESS CONTROL UNITS AND SOFTWARE

- A. Provide access control units and software compatible with readers to be connected.
- B. Unless otherwise indicated, provide software and licenses required for fully operational system.

2.4 ACCESS CONTROL POINT PERIPHERALS

- A. Provide devices compatible with control units and software.
- B. Provide devices suitable for operation under the service conditions at the installed location.
- C. Door Locking Devices (Electric Strikes and Magnetic Locks): Comply with Section 08 7100.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install access control system in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Provide grounding and bonding in accordance with Section 26 0526.
- D. Identify system wiring and components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Prepare and start system in accordance with manufacturer's instructions.
- C. Program system parameters according to requirements of Owner.
- D. Test for proper interface with other systems.
- E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

3.4 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 PROTECTION

- A. Protect installed system components from subsequent construction operations.

END OF SECTION 28 1000

SECTION 28 2000 - VIDEO SURVEILLANCE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Video surveillance system requirements.

1.2 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.

1.3 REFERENCE STANDARDS

- A. 47 CFR 15 - Radio Frequency Devices; current edition.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2023.
- C. NECA 303 - Standard for Installing Closed-Circuit Television (CCTV) Systems; 2025.

PART 2 PRODUCTS

2.1 MANUFACTURERS - CAMERA SYSTEM SHALL BE PROVIDED BY OWNER AND INSTALED BY EC. EC SHALL PROVIDE CABLING, RACEWAY, AND BOXES.

2.2 VIDEO SURVEILLANCE SYSTEM

- A. Provide new video surveillance system consisting of all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. System Description: IP system with connection to network (IP) cameras.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B, consumer application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of system components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive system components.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to system where applicable.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install video surveillance system in accordance with NECA 1 (general workmanship) and NECA 303.
- B. Install products in accordance with manufacturer's instructions.
- C. Provide required support and attachment in accordance with Section 26 0529.
- D. Provide grounding and bonding in accordance with Section 26 0526.
- E. Identify system wiring and components in accordance with Section 26 0553.

END OF SECTION 28 2000

SECTION 28 4600 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Circuits from protected premises to supervising station, including conduit.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

- A. NFPA 72 - National Fire Alarm and Signaling Code; Most Recent Edition Cited by Referring Code or Reference Standard.

1.4 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. Drawings must be prepared using AutoCAD Release ____.
- 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 the manufacturer of the control unit that the system design complies with Contract Documents.
 11. Certification by Contractor that the system design complies with Contract Documents.
- E. Inspection and Test Reports:
1. Submit inspection and test plan prior to closeout demonstration.
 2. Submit documentation of satisfactory inspections and tests.
- F. Operating and Maintenance Data: See Section 01 7800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
1. Complete set of specified design documents, as approved by authority having jurisdiction.
 2. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
- G. Closeout Documents:
1. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
- H. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
1. Installer Personnel: At least 2 years of experience installing fire alarm systems.

1.6 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Alarm Control Units and Accessories:
1. Honeywell Security & Fire Solutions/Notifier; _____: www.notifier.com/#sle.
 2. Potter Electric Signal Company; _____: www.pottersignal.com/#sle.
 3. Siemens Building Technologies, Inc; _____: www.usa.siemens.com/#sle.
 4. Simplex, a brand of Johnson Controls; _____: www.simplex-fire.com/#sle.

- B. Initiating Devices and Notification Appliances:
 - 1. Honeywell Security & Fire Solutions/Notifier; _____: www.notifier.com/#sle.
 - 2. Siemens Building Technologies, Inc; _____: www.sbt.siemens.com/#sle.
 - 3. Simplex, a brand of Johnson Controls; _____: www.simplex-fire.com/#sle.
 - 4. Same manufacturer as control units.
- C. Substitutions: See Section 01 6000 - Product Requirements.

2.2 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. The requirements of the State Fire Marshal.
 - c. Applicable local codes.
 - d. Contract Documents (drawings and specifications).
 - e. NFPA 101.
 - f. 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. Voice Notification: Provide emergency voice/alarm communications with multichannel capability; digital.
- B. Circuits:
 - 1. Initiating Device Circuits (IDC): Class B, Style A.
 - 2. Signaling Line Circuits (SLC) Within Single Building: Class B, Style 0.5.
 - 3. Signaling Line Circuits (SLC) Between Buildings: Class A, Style 2.
 - 4. Notification Appliance Circuits (NAC): Class B, Style W.
- C. Spare Capacity:
 - 1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 - 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 - 3. Speaker Amplifiers: Minimum 25 percent spare capacity.
 - 4. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- D. Power Sources:
 - 1. Primary: Dedicated branch circuits of the facility power distribution system.
 - 2. Secondary: Storage batteries.
 - 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72.
 - 4. Each Computer System: Provide uninterruptible power supply (UPS).

2.3 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:

1. Sprinkler water control valves.
 2. Elevator shut-down control circuits.
- B. Alarm: Provide alarm initiation in accordance with NFPA 72 for the following:
1. Sprinkler water flow.
 2. Kitchen hood suppression activation; also disconnect fuel source from cooking equipment.
 3. Elevator lobby, elevator hoistway, and elevator machine room smoke detectors.
 4. Duct smoke detectors.
- C. Elevators:
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:
1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- E. Doors:
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.

2.4 COMPONENTS

- A. General:
1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Master Control Unit: _____.
- D. Remote Annunciators: _____.
- E. 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.
- F. Initiating Devices:
1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.

- b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
- 2. Manual Pull Stations: _____.
 - a. Provide 1 extra.
- 3. Key Operated Pull Stations: _____.
 - a. Provide 1 extra.
- 4. Smoke Detectors: _____.
 - a. Provide 1 extra.
- 5. Duct Smoke Detectors: _____.
 - a. Provide 1 extra.
- 6. Heat Detectors: _____.
 - a. Provide 1 extra.
- G. Notification Appliances:
 - 1. Speakers: _____.
 - a. Provide 1 extra.
- H. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.

PART 3 EXECUTION

3.1 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. Install instruction cards and labels.

3.2 INSPECTION AND TESTING FOR COMPLETION

- A. Notify Owner 7 days prior to beginning completion inspections and tests.
- B. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- C. Provide the services of the installer's supervisor or person with equivalent qualifications to supervise inspection and testing, correction, and adjustments.
- D. Prepare for testing by ensuring that all work is complete and correct; perform preliminary tests as required.
- E. Provide all tools, software, and supplies required to accomplish inspection and testing.
- F. Perform inspection and testing in accordance with NFPA 72 and requirements of local authorities; document each inspection and test.

- G. Diagnostic Period: After successful completion of inspections and tests, Operate system in normal mode for at least 14 days without any system or equipment malfunctions.
 - 1. Record all system operations and malfunctions.
 - 2. If a malfunction occurs, start diagnostic period over after correction of malfunction.

3.3 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
- B. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.

3.4 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.
 - 1. Be prepared to conduct any of the required tests.

3.5 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
 - 1. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 - 2. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
- C. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- D. Comply with Owner's requirements for access to facility and security.

END OF SECTION 28 4600