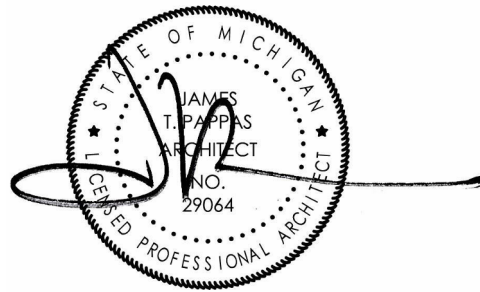


PVM WESTLAND
9% PROJECT – IL BUILDING
WESTLAND, MICHIGAN



FUSCO, SHAFFER & PAPPAS, INC.
ARCHITECTS AND PLANNERS

SPECIFICATIONS

PVM WESTLAND
9% Project – IL Building
Westland, Michigan

Owner
PRESBYTERIAN VILLAGES OF MICHIGAN
Southfield, Michigan

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Issued:
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PVM WESTLAND 9% PROJECT – IL BUILDING WESTLAND, MICHIGAN

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SECTION 011000.00 – SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Project Information.
2. Work covered by Contract documents.
3. Access to site.
4. Work restrictions.
5. Specification and drawing conventions.

- B. Related Requirements:

1. Section 011000.01 "General Conditions", for a copy of the AIA General Conditions for the Contract.

1.3 PROJECT INFORMATION

- A. Project Identification: **PVM Westland – 9% Project- IL Building**

1. Project Location: **32001 Cherry Hill Road, Westland, MI 48186**

Owner: **Presbyterian Villages of Michigan**

- B. Architect: **Fusco Shaffer & Pappas, Inc.**

- C. Construction Manager: **G. Fisher Construction**

1. The terms "Construction Manager" and "Contractor" are synonymous.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. Project includes all Civil, Landscape, Architectural, Structural, Mechanical, Plumbing, Electrical, Food Service and Interior Design work to provide a complete

and functional building with all applicable permits and licenses obtained. Building will require inspection and approval from and meet all requirements of the City of Westland. See the drawings and specifications for a delineation of required work.

2. The building is existing and is of wood and masonry frame construction with wood walls and wood sheathing floors. Exterior walls are a combination of brick and wood siding on a wood stud frame. Roofs are shingles.
3. See Drawings for Code Review.

B. Type of Contract:

1. Project will be constructed under coordinated, concurrent multiple contracts. Contracts for this Project include the following:
 - a. As agreed to by Owner and Construction Manager - AIA Document A102 -2017 or Later Standard Form of Agreement between Owner and Contractor where the basis of payment is the Cost of Work Plus a Fee with a Guaranteed Maximum Price.

1.5 ACCESS TO SITE

- A. General: Contractor shall have full use of Project Site for construction operations during construction period.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Nonsmoking Building: Smoking is not permitted on the property.
- C. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000.00

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END OF SECTION 011000.00

SECTION 011000.01 – GENERAL CONDITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. AIA Document A201-2007, General Conditions for the Contract for Construction as appended to this Document.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000.01

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END OF SECTION 011000.01

SECTION 011000.03 SUPPLEMENTAL GENERAL CONDITIONS

PART 1 – GENERAL

The general provisions of the contract, including General Conditions and Division 1, General Requirements, apply to work specified in this section. Wherever the General Conditions are referred to in the specifications, such reference shall be understood to include these Supplemental General Conditions.

1. General Contractor and Subcontractor's Insurance (Refer to General Conditions).

The General Contractor shall not commence work under this contract until he has obtained the insurance required under this paragraph, nor shall the General Contractor permit any Subcontractor to commence work on his subcontract until the insurance required of the Subcontractor has been so obtained.

- a) Workmen's Compensation Insurance: The General Contractor and Subcontractors shall procure and shall maintain during the life of this contract, Workmen's Compensation Insurance for all of his employees to be engaged in work on the project under this contract and in case any such work is sublet, the General Contractor shall require the Subcontractor similarly to provide Workmen's Compensation for all of the latter's employees to be engaged in such work.
- b) General Contractor's and Subcontractors Public Liability and Property Damage Insurance: The General Contractor and Subcontractors shall procure and shall maintain during the life of this contract, General Contractor and Subcontractor Public Liability Insurance in an amount not less than \$1,000,000 for injuries, including accidental death arising out of any one occurrence; and General Contractor's and Subcontractors property damage insurance shall be in an amount not less than \$1,000,000 each occurrence and \$2,000,000 aggregate.

See paragraph c) for "Owner's and Contractor's Protective Public Liability and Property Damage Insurance.

- c) General Contractor's and Subcontractors Motor Vehicle Bodily Injury and Property Damage Insurance: The General Contractor and Subcontractors shall procure and shall maintain during the life of this contract, Motor Vehicle Bodily Injury Insurance (Comprehensive Form) in an amount not less than \$100,000 for injuries, including accidental death arising out of any one occurrence; and property damage in an amount not less than \$2,000,000 for each occurrence.

The General Contractor and Subcontractors shall procure and shall maintain, during the life of this contract, Hired and Non-Ownership Motor Vehicle Bodily

Injury and Property Damage Insurance in an amount not less than \$1,000,000 for injuries, including accidental death arising out of any one occurrence; and property damage in an amount not less than \$2,000,000 for each occurrence.

- d) Proof of Carriage of Insurance: The General Contractor and Subcontractors shall provide the Owner at the time contracts are returned by him for execution, certificates and policies listed below. A guarantee that fifteen (15) days notice to the Owner prior to cancellation of, or change in, any such insurance shall be endorsed on each policy and certificate of insurance.

Four (4) copies of Certificate of Coverage of General Contractor's and Subcontractors Workmen's Compensation Insurance.

Four (4) copies of Certificate of Coverage of General Contractor's and Subcontractors Public Liability and Property Damage Insurance.

Four (4) copies of certificate of Coverage of General Contractor's and Subcontractors Motor Vehicle Bodily Injury and Property Damage Insurance covering Owner, Hired and Non-Owned vehicles.

PART 2 – SPECIAL CONIDITIONS

Substitutions in the specified work shall be covered by the following statement in the Special Conditions: "Material and Workmanship." Unless otherwise specifically provided in this contract, reference to any equipment, material, article, or patented process, by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The contractor may, at his option, use any equipment, material, article or process, which, in the judgment of the Owner, is equal to that named. The Contractor shall furnish to the Owner for approval the name of the manufacturer, the model number, and other identifying data and information respecting the performance, capacity, nature, and rating of the machinery and mechanical and other equipment, which the Contractor contemplates incorporating in the work. When required by its contract or when called for by the Owner, the Contractor shall furnish the Owner for approval, full information concerning the material or articles, which the contractor contemplates incorporating into the work. When directed, samples shall be submitted for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles installed or used without required approval shall be at the risk of subsequent rejection.

END OF SECTION 011000.03

SECTION 011000.05 GENERAL REQUIREMENTS

PART 1 - GENERAL

A. GENERAL

1. The AIA General Conditions, the MSHDA General Conditions of The Contract, Supplementary General Conditions, Special Conditions and these General Requirements shall be considered as an inclusive part of each division of these specifications. All subcontractors as well as the General Contractor shall be governed by all applicable sections of these documents with reference to their respective areas of work. It shall be the responsibility of the General Contractor to apprise all subcontractors and suppliers of these requirements.
2. Where the specifications refer to products of one or more manufacturers, such references designate the type, quality, size, grade, style, etc. of materials or equipment to be furnished and are not intended to restrict competitive bidding. Written approval of the Architect must be secured for use of any alternate material or product.
3. The drawings and these specifications are intended to be complementary, what is called for by either shall be as binding as if called for by both. Any discrepancies found between the drawings and the specifications shall be brought to the attention of the Architect for the interpretation of the intent of the contract documents.
4. It shall be the responsibility of the General Contractor and all subcontractors to have examined and reviewed the site and the complete set of working drawings and specifications and to provide all labor and material for their respective area of work for a complete and finished installation in compliance with the intent of the drawings and specifications whether indicated or not, shall be in compliance with all codes and ordinances that are applicable to the project. Costs for permits, bonds, fees, etc., shall be the responsibility of each subcontractor.

Submittal of proposal implies that the Bidder is fully conversant with all requirements of all said Divisions and Documents. No claims for additional compensation will be entertained or paid to any Contractor or Subcontractor on account of his failure to be fully informed of all requirements of all documents.

5. The General Contractor shall keep a competent superintendent on the site at all times during the entire progress of the work.

6. Subcontractors shall cooperate with each other and with the General Contractor to provide materials and labor that are necessary in each other's work at the proper times so that the construction schedule is not affected. These interfacing shall be the responsibility of the subcontractors whose work is affected as such.
7. Every subcontractor is to remove his own debris from jobsite and to keep areas of this work in broom swept condition as directed by the job superintendent.
8. In no instance shall any contractor or subcontractor substitute any material or process stipulated or scheduled in these Specifications or the Drawings without prior written approval of Architect. In preparation of Bid Proposals, should any subcontractor desire to change or substitute any material or construction process utilized in Contract Drawings and Specifications, he may request same upon written notification to Architect and by identifying in his Bid Proposal any such proposed changes, alterations or omissions.

Where the specifications refer to products of one or more manufacturers, such references designate the type, quality, size, grade, style, etc., of materials or equipment to be furnished and are not intended to restrict competitive bidding. Written approval of the Architect must be secured for use of any alternate material or product.

9. Shop drawings - six sets of shop drawings, bound in sequence shall be submitted for each separate portion of the work. Shop drawings shall be submitted to the General Contractor who shall review, stamp and sign approved each submittal prior to submittal to the Architect. Data submitted shall show proposed equipment only and shall not be catalogs showing a manufacturer's complete line. A minimum of three samples shall be submitted unless additional samples are requested. All shop drawings and samples shall be identified with the job name and shall be accompanied by a letter of transmittal containing a complete list of the submitted material. Shop drawings found to be inaccurate or otherwise in error shall be returned to the subcontractor for correction before submitting them to the Architect.

Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

- a. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required.

Architect will advise Contractor when a submittal being processed must be delayed for coordination.

- b. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
- c. Resubmittal Review: Allow 7 days for review of each resubmittal.
- d. Allow an additional 15 days review time for intensive submittals which demand sequential or multiple consultant reviews, such as Structural Steel, Door & Hardware and Lighting submittals.

B. LAYING OUT WORK

1. The General Contractor shall locate and provide all general reference points and take ordinary precautions to prevent their destruction. Each subcontractor shall be responsible for laying out his own work and shall be responsible for all lines, elevations measurements, grading and other as may be required by his work. He shall be held responsible for verifying all figures and details shown on the drawings, which relate to his work, prior to laying out the work. He will be held responsible for any error resulting from this failure to take such precautions.
2. The General Contractor shall be responsible for establishing field benchmarks for the purpose of establishing required elevations. The stakes shall be sufficiently far enough away from the work so as not to be disturbed.

C. TEMPORARY FIELD OFFICE

The General Contractor shall provide and maintain a watertight field office for his own use and that of the Architect, the Owner and the MSHDA representative for the duration of the project. The office shall be properly heated, lighted and equipped with tables, filing space for drawings and a telephone.

D. FIELD DRAWINGS AND RECORD DRAWINGS

A complete set of working drawings shall be maintained by the General Contractor on the site and shall be updated regularly. All changes and/or modifications made in the field must be recorded by the General Contractor and each subcontractor on their own field set as soon as the change is made, and immediately thereafter, recorded on the General Contractor's field set. This shall comprise an accurate set of marked-up drawings of the project, insofar as the actual construction or installation differs from the Contract Drawings. These "record" drawings are required at the time of Substantial Completion, and shall be turned over to the Architect at that time for the purpose of recording changes on the original working drawings.

E. STORAGE SHEDS

Prime subcontractors shall furnish storage facilities large enough to hold all materials that might be subject to damage or vandalism, that are required on the site at any one time. The facilities shall be adequately constructed so as to prevent damage from the elements and so they can be adequately secured. Location on the site shall be as per the General Contractor's instructions. Each subcontractor shall bear the responsibility for the security of his own materials and equipment.

F. SAFE PREMISES

1. It shall be the responsibility of each subcontractor to maintain all areas adjacent to the construction site in a manner not to hinder or endanger normal traffic flow, or endanger or damage adjacent property.
2. Streets and sidewalks adjacent to the site shall be kept clean and open for pedestrian and vehicular traffic. Warning lights, guards and barricades shall be utilized and maintained as required to ensure these conditions by the subcontractor whose work is partially or totally in the above stated area. General Contractor shall provide for all temporary walk areas required for access to the building area and as necessary to carry out the work.
3. If necessary, due to soil conditions, the responsible subcontractor shall provide cribbing and shoring for excavations which might endanger workmen, equipment, or adjacent property.
4. The responsible subcontractor is to provide scaffolding necessary for all his work. All scaffolding must be built in accordance with the requirements of federal, state and local regulations.
5. Temporary stairs, ladders and ramps shall be provided by the subcontractor for his work in order to safely enable access to all parts of the work by the Architect, the MSHDA representative, the Owner and any authorized inspecting personnel. All such equipment shall meet all federal, state and local safety requirements.

G. TEMPORARY LIGHT AND POWER

The electrical subcontractor shall provide all temporary electric service and lighting required during the entire construction period and pay for all costs for installing, maintaining and removing temporary service. Include all necessary temporary wiring, panelboards, outlets, switches, lamps, fuses, controls and accessories. Provide a sufficient number of electric outlets located so that 50-foot-long extension cords will reach all work requiring light or power. All temporary 120 V, 15 and 20 amp receptacle outlets shall be G.F.I. protected. All temporary service equipment shall be removed by the Electrical

subcontractor when so instructed by the General Contractor. The General Contractor shall be responsible for payment of the electric bill.

H. TEMPORARY WATER

The General Contractor shall pay for all water required during the entire construction period. The site utilities subcontractor shall pay tap fees and shall lay a temporary water line from the source, fit with a hose bibb, and shall provide and maintain all valves, connections and hoses.

The General Contractor shall furnish drinking water from an approved source for all persons on the work. Each subcontractor shall be responsible to provide containers for his own men.

If the use period for the temporary water installation includes freezing weather, the site utilities subcontractor shall provide insulation for all exposed temporary service piping to prevent freezing.

I. TEMPORARY HEAT

Each subcontractor shall provide temporary heat as necessary to protect all of his work and materials from damaging dampness and freezing. Temperatures shall be maintained as per ASTM requirements. Precautions shall be taken against possible spread of fire and the possible damaging effects to building and equipment from smoke and soot.

J. TEMPORARY TOILETS

The General Contractor shall provide and maintain in a sanitary manner, temporary toilets as necessary for the use of the workmen.

K. PROJECT SIGN

The General Contractor shall furnish and install a project sign and locate on site where directed by the Architect. The sign shall be 8 x 8 feet in size of 3/4" exterior grade plywood and supported and braced as needed. Paint all surfaces of sign with 2 coats of exterior house paint. Design and lettering shall be as detailed by the Architect.

L. TESTS AND INSPECTIONS

Unless otherwise noted, the General Contractor shall cause to be performed all inspections and tests required in each Section of the Specifications and those listed in Tables 1704.3, 1704.4 and 1704.5.1 of the Michigan Building Code. Notify each inspecting or testing authority or agency 24 hours in advance of each test or inspection required. Keep records of

each test or inspection. Include in such records the time of the test or inspection, weather conditions, names of inspector or testing authority, results of the test and all other pertinent area. In addition to any other distribution, submit a copy of each report and test result as it is made to the Architect and the MSHDA representative for their review.

M. LEAD BASED PAINT RENOVATION, REPAIR AND PAINTING PROCEDURE REQUIREMENTS

1. Under the Residential Lead-based Hazard Reduction Act Of 1992, Congress required the EPA to develop regulations to address renovation, repair and painting (RRP) activities in single and multifamily housing built before 1978. The purpose of the new rule is to reduce children's exposure to dust containing lead paint created during the course of these activities. This rule is effective as of April 22,2010.
2. If any testing associated with any Renovation, Repair And Painting (RRP) activities is done, the results of that testing must be disclosed and available to any interested party.
3. Responsibility to comply with the new rule rests with contractor. Contractors and workers must be trained and certified by the EPA to conduct the new lead paint safe work practices while performing RRP activities in housing constructed prior to 1978.
4. Contractors shall be responsible for contacting occupants of dwelling units in writing prior to commencing work.
5. Exemptions: These rules may be waived under the following conditions:
 - a. The dwelling unit or facility was built after January 1, 1978.
 - b. The repairs are minor, with the interior work disturbing less than six sq. ft. or exteriors disturbing less than 20 sq. ft.
 - c. If the components of the dwelling unit test lead free by a Certified Risk Assessor, Lead Inspector, or Certified Renovator.

N. VERMIN EXTERMINATION

The General Contractor shall be responsible to contract for the extermination of all insects, rodents and other pests within each dwelling unit and common areas of the building prior to turning such building over to the Owner.

O. GENERAL CONTRACTOR AND SUBCONTRACTOR INSURANCE

The General Contractor and each subcontractor are required to purchase and maintain the following types of insurance:

1. Workman's Compensation
2. Public Liability Insurance with the following minimum coverage.
 - a. General Liability-\$1,000,000 per occurrence.
 - b. Bodily Injury-Minimum of \$1,000,000 per occurrence.
 - c. Property Damage-Minimum of \$1,000,000.
 - d. Include Contractual Liability coverage with same limits.
 - e. The Owner of the property shall be named as an additional insured.
3. Appropriate insurance certificates must be submitted prior to any payment requests.

P. GUARANTEE PERIOD

The General Contractor shall and hereby does guarantee and warrant that all work for this development, under this Contract, shall be free from defects or faulty labor and/or materials for a period of one (1) year from date of Substantial Completion of the project, except when longer periods are herein specified, which develop within any guarantee periods.

Q. USE OF FACILITIES

If the General Contractor or any of the Subcontractors or separate Contractors chooses to use any system, equipment, facilities or services which have been installed into the building as a permanent part thereof by any other Subcontractors or separate Contractor, such Contractor shall assume full responsibility for damage to said system, equipment, facilities or services, and shall make such arrangements with the installing Subcontractor as are necessary so that in no case shall the extent of the guarantee period mentioned above be jeopardized as a result of such use.

END OF SECTION 011000.05

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END OF SECTION 011000.05

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

- A. General: Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
 - 1. Construction Waste:
 - a. Masonry and CMU.
 - b. Lumber.
 - c. Metals.
 - d. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Wood crates.
 - 5) Plastic pails.

1.5 QUALITY ASSURANCE

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

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan.
- B. Waste Identification: Indicate anticipated types and quantities of construction waste generated by the Work.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
 - 1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3.3 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 CLOSEOUT SUBMITTALS

- A. Certificate of Insurance: For continuing coverage.
- B. Field Report: For pest control inspection.

1.3 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
 - 2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 3. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - 4. Submit test/adjust/balance records.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1.5 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

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

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

3.2 REPAIR OF THE WORK

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

END OF SECTION 017700

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END OF SECTION 017700

SECTION 018113 - SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This project is designed to achieve all mandatory requirements and no fewer than 35 optional points under the Enterprise Green Communities Criteria, including all current revisions.
 - 1. Certain Criteria are dependent on material selections. Compliance with the Criteria shall be a basis of evaluating substitution requests.
 - 2. Additional Criteria needed to obtain Enterprise Green Communities Certification are dependent on Architect's design and other aspects of the project that are not part of the Work of Contract.
- B. The project will achieve Enterprise Green Communities Certification [see 1.2.A].
- C. Contractor is responsible for all requirements of the Criteria that are contained throughout these Specifications, including successful compliance with and passage of visual inspections and performance tests by verifying party.
- D. Contractor is not responsible for the application for Enterprise Green Communities Certification, nor for determination of methods of achieving the Criteria unless otherwise specifically indicated.
- E. Related Sections
 - a. Division 01 Section "Construction Waste Management and Disposal" for detailed Criteria requirements to be incorporated into construction process.
 - b. Division 01 Section "Closeout Procedures" for requirements to be incorporated into Building Maintenance Manual.
 - c. Division 01 Section "Indoor Air Quality Requirements" for detailed Criteria requirements to be incorporated into construction process.
 - d. Divisions 03 through the end of this Specifications book.

1.2 ACTION SUBMITTALS

- A. Enterprise Green Communities Certification submittals:
 - 1. Step 2 Submittals: To be submitted within 60 days after the construction end date.
 - a. Final Certification Form – Basic project information to ensure proper listing in database.
 - b. Compliance Report – A revised version of the Intended Methods form from Step 1 requiring project teams to document any changes in their strategy to

- meet the Criteria.
 - c. Cost Development Form – Documents the incremental costs that project teams incurred when meeting the Enterprise Green Communities standard.
 - d. Photos – Teams upload before, during, and after photos from the development.
 - e. Utility Release Form(s) – A series of forms that authorize Enterprise to conduct energy data monitoring after the completion of the development.
- B. Low-Emitting Materials: Provide product data as described in Division 01 Section “Indoor Air Quality Requirements.”
- C. Recycled Content Materials: Provide product data indicating percentages of post-industrial and post-consumer recycled content. Include statement of material cost for each recycled content material.
- D. Regional Materials: Provide product data indicating location of extraction, processing, and manufacture.
Include statement of material cost for each regional material.
- E. FSC Certified Wood Products: Provide Chain of Custody certificates certifying that products specified to be made from certified wood comply with forest certification requirements. Include statement of material cost for each qualified material.
Alternative compliance paths as follows:
- a. For Salvaged Wood: Documentation indicating percentage of wood product that is salvaged and the location of origin.
 - b. For Engineered Wood Products: Documentation indicating no added urea-formaldehyde.
- F. Status Reports: Provide construction status reports and coordinate pre-drywall and final inspections with verifiers charged with inspecting and testing installed green building measures.

1.3 PROJECT MEETINGS

- A. Agenda: Provide status of Criteria-related work on the agenda of all required regularly scheduled job-site meetings.

1.4 CONTRACTOR GREEN COMMUNITIES COORDINATOR

- A. Designate one team member with Enterprise Green Communities experience as the General Contractor Coordinator for this project.

1. This Coordinator shall be present for all relevant General Contractor meetings.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Where specifications state that products shall meet certain Criteria, these products shall be counted toward the minimum total materials required to meet the related Criteria.

2.2 RECYCLED-CONTENT MATERIALS

- A. Recycled Content: Minimum 25% post-consumer or 50% post-industrial recycled content for each qualifying material.
- B. Qualified Building Components: Provide minimum 90% of the building component by weight or volume for one to four of the following:
 1. Framing: Wood, concrete, steel, aluminum.
 2. Siding or Masonry: Wood, metal, vinyl, masonry.
 3. Non-Structural Flooring: Linoleum, cork, bamboo, reclaimed wood, sealed concrete, carpet.
 4. Concrete: Cement, aggregate, urbanite.
 5. Roofing: Wood shingles, asphalt shingles, tile, metal.
 6. Insulation: Fiberglass batt, cellulose, rigid panel.
 7. Sheathing: Plywood, oriented strand board (OSB).

2.3 REGIONAL MATERIALS

- A. Regional Materials: Qualifying building materials extracted, processed, and manufactured within 500 miles of project site.
- B. Qualified Building Components: Provide minimum 50% of the building component based on cost of the project's total material value for one to five of the following:
 1. Concrete: Cement and aggregate
 2. Brick

2.4 CERTIFIED, SALVAGED, AND ENGINEERED WOOD PRODUCTS

- A. Qualified Building Materials: Minimum 25%, by cost or value, of the project's total wood products used as structural components. The following qualify:
 1. FSC Certified Wood: Certified in accordance with the Forest Stewardship Council

(FSC) guidelines

2. Engineered Wood: No added urea-formaldehyde binders

PART 3 – EXECUTION (No Comments)

END OF SECTION 018113

SECTION 018119 – INDOOR AIR QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Implement the following procedures in an effort to improve indoor air quality during Owner's occupancy.
- B. Construction Indoor Air Quality (IAQ) Management.
 - 1. Provide low-emitting products as required by EGC Criteria and as specified.

1.2 REFERENCES

- A. Related Section
 - 1. Section 018113 Sustainable Design Requirements.
- B. Enterprise Green Communities Criteria – Reference Enterprise Green Communities 2020 Design Manual
 - 1. Low/No VOC Paints and Primers
 - 2. Low/No VOC Adhesives and Sealants
 - 3. Composite Wood Products that Emit Low or No Formaldehyde
 - 4. Environmentally Preferable Flooring

1.3 INFORMATIONAL SUBMITTALS

- A. Low-Emitting Materials: For each low-emitting product, provide the following product data:
 - 1. Carpet: Proof of Green Label Plus certification.
 - 2. Carpet Cushion: Proof of Green Label certification.
 - 3. Hard Surface Flooring (except ceramic tile or reclaimed or unfinished hardwood floors): Proof of Floor Score certification.
 - 4. Adhesives, Sealants, Paints, and Primers: VOC content as measured in grams per liter (g/L).
 - 5. Composite Wood Products: Manufacturer declaration that product complies with CARB 93120.

PART 2 – PRODUCTS

2.1 LOW-EMITTING MATERIALS

- A. Adhesives: Comply with VOC Content limits of South Coast Air Quality

Management District (SCAQMD) Rule 1168 "Adhesive and Sealant Applications," Bay Area Air Quality Management District (BAAQMD) Regulation 8 Rule 51, or more stringent levels, as follows (in grams/Liter):

1. Indoor Carpet & Pad Adhesives: 50
 2. Outdoor Carpet Adhesives: 150
 3. Wood Flooring Adhesives: 100
 4. Rubber Floor Adhesives: 60
 5. Subfloor Adhesives: 50
 6. Ceramic Tile Adhesives: 65
 7. VCT and Asphalt Tile (& Linoleum) Adhesives: 50
 8. Dry Wall and Panel Adhesives: 50
 9. Cove Base Adhesives: 50
 10. Multipurpose Construction Adhesives: 70
 11. Structural Glazing Adhesives: 100
 12. Single-Ply Roof Membrane Adhesives: 250
 13. Non-Membrane Roof Installation/Repair: 300
 14. Perimeter Bonded Sheet Vinyl Flooring Installation: 660
 15. PVC Welding: 510
 16. CPVC Welding: 490
 17. ABS Welding: 325
 18. Plastic Cement Welding: 250
 19. Adhesive Primer for Plastic: 550
 20. Contact Adhesive: 80
 21. Special Purpose Contact Adhesive: 250
 22. Structural Wood Member Adhesive: 140
 23. Metal to Metal Substrate: 30
 24. Plastic Foam Substrate: 50
 25. Porous Substrate Except Wood: 50
 26. Wood Substrate: 30
 27. Fiberglass Substrate: 80
 28. All Other Welding and Installation Adhesives: 250
- B. Paints and coatings applied within building waterproofing envelope: Comply with VOC Content limits (as noted in Criterion 6.1) of Green Seal Standard GS-11 "Paints," First Edition; Standard GC-03 "Anti-Corrosive Paints," and MPI GPS-2-08, as follows:
1. Flat: 50
 2. Non-flat: 50
 3. Anti-Corrosive and Anti-Rust: 250
 4. Floor Coatings: 100
- C. Hard Surface Flooring (vinyl, linoleum, hardwood, cork, bamboo): Comply with testing and product requirements of the Resilient Floor Covering Institute's Floor Score Program.

D. Permanently installed composite wood products: Comply with one of the following:

1. CARB 93120 certification
2. Products not in compliance with CARB 93120: Seal all exposed edges and sides with low-VOC sealants that comply with Criterion 6.2.

PART 3 – EXECUTION

3.1 GENERAL

A. Incorporate procedures and processes during construction and prior to occupancy as described herein.

END OF SECTION 018119

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END OF SECTION 018119

SECTION 020000 - DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL

The work of this Section consists of all demolition and cleaning, and related items, as shown on the drawings and as specified herein, and includes, but is not limited to, the following:

- A. All demolition work required for the existing buildings and existing site as called for on the drawings and/or as required to accommodate the renovation work. See Architectural, Mechanical and electrical sheets for demolition information.
 - 1. All demolition as called for on drawings and/or as required to complete the project.
 - 2. Demolition activities shall include the abatement of lead based paint and asbestos containing materials. The lead based paint abatement activities are to be done in accordance with Federal {(Part 35) Regulations and Worker Safety Requirements under Part 603 of Public Act 154. The asbestos abatement must be done based upon an asbestos inspection meeting the requirements of NESHAP, by an appropriately licensed and insured abatement contractor.
 - 3. Cleaning of the site and building interiors to a broom finish.
 - 4. Demolition required by trades.
 - 5. Refer to the drawings – civil, landscape, architectural, mechanical and electrical for the scope of demolition work.
 - 6. Perform cutting of openings in floors for new installations.
 - 7. Patch and repair all holes left in walls, floors and ceilings as result of demolition operations.
 - 8. The above tasks shall be performed where deemed necessary regardless of their mention or non-mention on the drawings as directed by the Architect.
 - 9. Carry out all demolition work in close coordination and cooperation with structural trades for proper sequencing of the work to assure the complete safety and structural integrity of the building and its elements at all times. Provide temporary columns, jacks, beams, etc., where required for support of existing elements of construction to remain in safe, competent manner, in

conformance with all laws, codes ordinances, rules and regulations bearing on the work.

10. Cutting of holes through slabs and walls for new piping, wiring and general installations.
11. Cut all grooves, chases, openings, holes, etc., required for all trades and for the passage of piping, ductwork, conduit, etc., through existing construction except holes to be used for expansion or similar type anchoring devices which shall be cut by the trade requiring same.
12. Remove from site and legally dispose of all removed materials, trash, debris, etc., removed by demolition work, except any items specifically indicated on the drawings or specified herein to be reused on the project. Carefully remove items designated on drawings to be reused on the project, and provide safe storage of same in storage area(s) within the buildings, fully protected from damage.

1.3 RELATED WORK UNDER OTHER SECTIONS

- A. The following items of related work are specified and included in other sections of the Specifications:
 1. Patching of existing concrete.
 2. Cutting and capping of existing mechanical and electrical work as required in preparation for indicated demolition and removal of mechanical and electrical items.

1.4 EXAMINATION OF PREMISES

- A. The contractor will be held to have examined the premises before submitting his proposal for the work and to have satisfied himself as to the existing conditions under which he will be obligated to operate or that will in any way affect the work under this Contract, and also the amount of existing materials and debris to be removed, the amount of cleaning to be done and the amount of specific surface preparation to be done. No allowances will be made in this connection for error or negligence of the Contractor.

1.5 MANNER OF CONDUCTING THE WORK

- A. The work shall be conducted with prime consideration given to the following:
 1. Compliance with all applicable laws, codes, ordinances, and regulations, including O.S.H.A.
 2. Protection of the public and workmen.
 3. Protection from the weather.

4. No bearing walls or structural members shall be removed without contacting the Architect in writing and receiving his written consent.
 5. Carry out all demolition work in close coordination and cooperation with structural trades for proper sequencing of the work to assure the complete safety and structural integrity of the building and its elements at all times. Provide temporary columns, jacks, beams, etc., where required for support of existing elements of construction to remain in safe, competent manner, in conformance with all laws, codes ordinances, rules, and regulations bearing on the work.
 6. Elimination of noise, shocks and vibration.
 7. Elimination of dirt and dust.
 8. Orderly access to, and storage of materials.
 9. Protection of the existing building from damage of all types from all sources.
 10. Discipline and order of construction personnel.
 11. Neat and accurate cutting and trimming of elements to be only partially removed, subject to Owner's approval.
- B. Demolition of all portions of the structure to be removed shall be done with utmost care, using tools and methods subject to Owner's approval. All possible care shall be taken to avoid damaging, shock or vibration to portions of existing structure to remain.
- C. Debris shall not be allowed to accumulate and shall be sprinkled during handling and loading to reduce dust. All debris shall be removed from the premises daily.
- D. Post "NO SMOKING" signs in all interior spaces where demolition work is to be carried on. Strictly enforce the "NO SMOKING" restriction among all personnel employed on the work.
- E. Construct temporary dust proof enclosures to contain dust to areas of demolition. Coordinate locations with General Contractor.

1.6 CLEANING

- A. Upon completion of demolition work, remove all loose dust, and debris and broom clean all exposed surfaces throughout.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION- NOT USED

END OF SECTION 020000

SECTION 033000 – CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL

- A. Items included but not limited to the following:
 - 1. Footings and foundations
 - 2. Furnishing and installation of reinforcing steel material and welded wire fabric.
 - 3. Furnishing and installation of all necessary accessories.
 - 4. Site concrete
 - 5. Sub-base
 - 6. Formwork
 - 7. Mechanical and electrical bases (refer also to specific Divisions of these specifications).
 - 8. Dumpster enclosure wall system.
 - 9. Testing

1.3 SITE CONCRETE

- A. Materials - Concrete shall conform to Section 2.1, Cast-in-place concrete.
- B. Execution
 - 1. Concrete work shall be as indicated on the drawings.
 - 2. All concrete walks shall be of size indicated on the drawings. Concrete walks shall have tooled joints spaced equal to the walk width but not more than five feet with expansion joints located at each fourth joint. Concrete shall have a light broom finish across the width.
 - 3. Patios, porches, waiting areas and steps shall be as indicated on the drawings. All exterior concrete to have light broom finish.

4. Exterior walks and slabs shall be installed over a minimum of 4" of compacted bank run sand or gravel. Subbase below granular fill shall be well compacted before fill is placed.
 5. Set curb forms with top at finished grade. Provide grade stakes not more than 20 feet apart for all curb construction. Check tops of forms for grade before placing concrete and reinforcing.
 6. Construct concrete curbs in sections 20 feet long. Install 1/4" premolded filler plates between each section. Such plates shall be of size and shape conforming to cross-section of the concrete. Minimum length of closure piece to be 4 inches.
 7. Rub face of concrete curb where necessary.
 8. Coordinate locations and dimensions of mechanical and electrical bases with respective subcontractors and the General Contractor.
 9. Refer to the Civil drawings for detectable warning information.
- C. All other requirements for site concrete not covered above shall be as per Section 2.1, CAST-IN-PLACE CONCRETE.

PART 2 - PRODUCTS

2.1 MATERIALS - CAST-IN-PLACE CONCRETE

- A. Concrete work shall conform to all requirements of ACI 301 Specifications for Structural Concrete for Buildings, except as modified by the Supplemental Requirements below. The Contractor shall keep a copy of the "Field Reference Manual" (ACI-SP-15) containing these specifications and related reference material in the project field office at all times. (Can be obtained from American Concrete Institute, P.O. Box 19150, Detroit, MI 48219-0150).
- B. The following items are additions, changes, or omissions to those specifications and govern over them. Items are numbered according to related chapters and paragraph number of ACI-301.

MATERIALS FOR CONCRETE

- 2.1 Type I, II or III (ASTM C150) cements may be used.

PROPORTIONING

- 3.2 All concrete for interior work and footings shall have a minimum compressive strength of 3000 PSI at 28 days.

Concrete for exterior work shall have a minimum compressive strength of 4000 PSI at 28 days and shall contain entrained air per table 3.4.1.

- 3.4.1 Concrete exposed to the weather shall contain entrained air as per table 3.4.1. The maximum water cement ratio shall be 5-1/2 gallons of water per sack of cement, for concrete exposed to the weather.

- 3.7.1 No admixture containing calcium chloride shall be used without written permission from the Architect.

- 3.8 The proportioning of concrete mixes shall be in accordance with Method 1 or Method 2. A minimum cement content of 5 sacks per yard is to be used.

FORMWORK

- 4.1.3 Earth cuts may be used as forms for vertical surfaces providing the sides of the cuts are stable enough to contain the concrete without contamination.

REINFORCEMENT

- 5.2.1 Reinforcing steel except for ties and stirrups shall be new billet stock conforming to ASTM A-615 Grade 60. Reinforcing steel for ties and stirrups shall conform to ASTM A-615 Grade 60.

Concrete slabs on grade shall have fiber mesh reinforcement or 6"x6" W1.4 x W1.4 welded wire mesh. Place mesh reinforcement in the top 1/3 of the slab, with mesh lapped and wired together at its joints.

JOINTS AND EMBEDDED ITEMS

- 5.1.2 Longitudinal keys may be omitted at the construction joints between walls and slabs or footings providing the surface of the concrete is thoroughly cleaned and all laitance removed.

Install 5/8" diameter by 12" long stainless steel threaded anchor bolts spaced 32" on center for attachment of sill plates at exterior walls.

- 6.4 Bolts, nuts, and washers as per "Specifications for low-carbon steel externally and internally threaded standard fasteners" (ASTM A-307).

Structural Steel - Structural steel inserts per ASTM A-36.

Various other inserts - the Dayton Sure Grip and Shore Co. Products, 721 Richard Street, Miamisburg, Ohio 45342; Heckman Building Products, Inc., 4018 West Lake Street, Chicago, IL 60624.

If any of these inserts are to be exposed to the elements after completion of the construction, they are to be galvanized as per ASTM A-153.

PLACING

- 8.1 Placing of concrete shall not be started until the Owner or his representative reviews the reinforcing, embedded items and openings. Adequate notice shall be given for this review. This does not relieve the Contractor of his responsibilities.

FINISHING OF FORMED SURFACES

- 10.2.2 All interior exposed concrete surfaces shall receive smooth form finish. All exposed exterior concrete surface shall receive a medium broom finish.
- 10.3 Required rubbed finish shall be as per 11.3.2 Grout cleaned finish.

SLABS

- 11.7 Unless otherwise noted, floors are to receive a trowel finish.

TESTING - BY THE GENERAL CONTRACTOR

- 16.2 An independent testing laboratory approved by the Architect shall provide for the services of Sections 16.3 and 16.4 for all concrete. The General Contractor shall pay for these services.
- 16.3 Three (3) test specimens shall be made for each test. One specimen shall be tested at 7 days, and two at 28 days. The General Contractor shall provide field storage facilities for storing test cylinders as per ASTM C31-69 prior to being taken to the laboratory. The testing laboratory is responsible for proper handling, and delivery to the laboratory of the cylinders. The testing

laboratory shall prepare all test specimens. One set of test specimens shall be made for each one hundred (100) cubic yards or fraction thereof of a given concrete mix placed in any one day.

- 16.6 Two (2) copies of all concrete tests shall be submitted to the Contractor. One copy shall be sent directly to the Architect, the Owner and the MSHDA representative by the testing laboratory.

TESTING - BY THE SUBCONTRACTORS

- 16.2 The subcontractors shall provide and pay for the service under Sections 16.5 and 16.7.
- 16.7 The subcontractor shall, at the time a contract is awarded to him, submit the design mixes to the Owner two weeks or more before the work is begun; no work will be placed prior to written approval of mixes.

TESTING OF CONCRETE IN PLACE

- 17.3 Core tests as in 17.3.2 of ACI-301 and/or Windsor Probe system are allowed methods of testing concrete in place.

2.2 PRECAST CONCRETE

- A. Precast concrete dumpster enclosure walls and steel support beams to be Series 1 Redi-Wall system by American Eagle Precast, 17301 Conant, Detroit, MI 48212. Phone: 313.893.6700. sales@aeprecast.com
- B. Panels to be 4" thick precast concrete with steel reinforcing and simulated brick face. Color to be selected from Manufacturers standard color palette, sizes as shown on plans. Provide steel upright I beam supports at all corners. Gate to be galvanized pipe, see details and Division 05 50 00.

2.3 OTHER MATERIALS

- A. This pertains to material other than those cast into the concrete.
- B. Fill Under Slabs on Grade and Site Concrete - Material shall be bank run sand or gravel or crushed stone. Thickness shall be a minimum of 4". Submit samples for approval by the General Contractor.
- C. Expansion Joint Filler - Material as required shall be 1/2" thick pre-molded asphalt impregnated fiber-board, width as required, unless otherwise shown on plan.

- D. Rigid Perimeter Insulation – 2" thick by 48" wide horizontally, 24" wide vertically by length of standard sizes to facilitate work, extruded polystyrene material, R-10. See drawings for areas to receive perimeter insulation. Insulation shall be manufactured specifically for below grade use.
- E. Vapor Barrier – Interior slabs on grade shall have a minimum of 10 mil. polyethylene membrane placed between the porous fill and the slab.
- F. Splashblocks-for each downspout outlet shall be precast concrete, 33"x11"x3 thick.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perimeter Insulation – Place below slab-on-grade, tight to foundation walls, 48" horizontally and 24" vertically.
- B. Vapor Barrier – the membrane under the slab on grade shall be lapped a minimum of 12" in all directions. Anchor the polyethylene vapor barrier securely in place during placing of fill and concrete.
- C. Patching formed concrete: Remove projections and offsets, cut out defects to sound concrete edges to be cut straight and back-beveled. Dampen cuts and scrub with a neat Portland cement slurry just prior to patching. Fill voids and patches with flush smooth finished concrete mortar mix (less coarse aggregate), cure and dry.
- D. Cold Weather Requirements
 - 1. Cold weather requirements per ACI standard 306-66 and as required herein.
 - 2. Adequate equipment, housings and covering shall be provided for heating concrete materials and concrete during freezing and near freezing temperatures. No frozen materials or materials containing ice shall be used.
 - 3. All concrete materials, reinforcement, forms, fillers and the ground on which concrete is to be placed shall be free of frost, snow and ice. Provide adequate means of maintaining temperature of 45 degrees F. to 85 degrees F. for at least 4 days after concrete placement. Protective covering shall remain in place for at least 24 hours after artificial heat is discontinued.

4. Methods and the extent of protection shall meet with the approval of the Owner.
5. Any concrete damaged by frost, freezing or pouring on frozen ground shall be replaced at no cost to the Owner.
6. Cold weather requirements will be enforced whenever surrounding air temperatures fall below 40 degrees F.

C. Hot Weather Requirements

1. Hot weather requirements shall be per ACI standard 305-72 and as required herein.
2. Temperature of concrete shall not exceed 90 degrees F.
3. The design water/cement ratio shall not be exceeded.
4. Retarding admixtures and curing procedures shall be as recommended by the Structural Engineer.

END OF SECTION 033000

PVM Westland
9% Project – IL Building

Fusco, Shaffer & Pappas, Inc.
PVM21.072

June 26, 2026

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END OF SECTION 033000

SECTION 057300 - ORNAMENTAL ALUMINUM RAILING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Stair and ramp guardrails
- B. Balcony railings and guardrails

1.2 RELATED SECTIONS

- A. Section 061000 – Rough Carpentry: Placement of blocking in wall construction.

1.3 DESIGN / PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer, fabricate, and install handrails, guardrails, and railing systems to withstand, when tested per ASTM E 935, loadings required by applicable building and safety codes but not less than the following:

1. Design Loads: Design to the following requirements. Concentrated and uniform loading need not be applied simultaneously.
2. Uniform load: 50 pounds per foot (74.3 kg/m) applied at the top in any direction.
3. Concentrated load: 200 pounds (90.6 kg) applied at the top in any direction.

1.4 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Preparation instructions and recommendations.
2. Details of material and construction.

B. Selection Samples: For each finish product specified, two complete sets of color charts representing manufacturer's full range of available colors and patterns.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Superior Aluminum Products, Inc.; 555 E. Main St., P. O. Box 430, Russia, OH 45363. Phone: 937-526-4065. Fax: 937-526-3904. Email: info@superioraluminum.com. Web: www.superioraluminum.com.

1. Product: Guard Rail Series 9P Aluminum Picket Railing.
2. Requests for substitutions will be considered in accordance with provisions of Section 01 6000 - Product Requirements.

2.2 ORNAMENTAL ALUMINUM RAILING

A. Guard Rail Series 9P Aluminum Picket Railing: Series 9P railings run between posts which shall contain machined openings for level applications and mechanical swivel brackets for locations at angles exceeding 10 degrees. Brackets shall not be used to attach railings to posts on level applications utilizing standard components. Pickets shall be 3/4-inch (1.91 cm) square on 4-1/2 inch (11.43 cm) maximum centers, and shall run between the top and bottom rail. Picket fasteners are concealed by a screw cover in matching finish.

1. Series 9P Design

a. Rail Style A: Single top and bottom rail, two-line railing system.

- 1) Top Rail Size: Standard 2 inch (5.08 cm) wide by 1-5/8 inch (4.13 cm) high top rail.
- 2) Bottom Rail Size: Standard 1-5/8 inch (4.13 cm) wide by 1-1/2 inch (3.81 cm) high bottom rail.

B. Square Posts:

- 1) 2-1/2 inch (6.35 cm)
- 2) Height: 36 inch (91.44 cm)
- 3) Base: Size to fit the posts specified

C. Heavy-Duty Surface Mount Base

2.6 FINISH

A. Standard Architectural Coating (AAMA 2603): As selected from manufacturer's standard colors

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared. Fully review the supporting structure and substrate to verify a structurally sound base for anchoring railing system.

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. Use wood blocks and padding to prevent damage to railing members and fittings during erection.

C. 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.
- B. Install components plumb and inline, accurately fitted, free of distortion or defects and securely anchored to building structure and/or substrate.
- C. Provide grounds, clips, backing materials, adhesives, brackets, anchors, and accessories necessary for a complete installation.
- D. Connect railing components in accordance with manufacturer's instructions applicable to the specified system.
- E. Tighten all fasteners so that completed railing is rigid and free of play at joints and component attachments.

3.5 CLEANING

- A. Remove dust or other foreign matter from component surfaces; clean finishes in accordance with AAMA 609 and AAMA 610-02.

3.6 PROTECTION

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

END OF SECTION 057300

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END OF SECTION 057300

SECTION 061000 - CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL

- A. The extent of the carpentry work is shown on the drawings.
- B. Items Included but not limited to the following:

- Stud framing and wall construction
- Blocking, shimming, grounds and furring as required
- Roof Trusses
- Millwork and finish trim
- Rough hardware such as nails, screws, bolts, etc.
- Cabinets and casework, installation only.
- Countertops
- Window stools
- Closet rods and shelving
- Install finish hardware and doors

1.3 QUALITY ASSURANCE:

- A. Lumber Standard: Lumber shall conform to American Lumber Standards, bear grade and trademark of Manufacturer's Association under which produced and mill identification.
- B. Factory-mark each piece of lumber and plywood with grade, type, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.

1.4 SUBMITTALS:

- A. Shop Drawings - Provide 6 copies of shop drawings of all millwork indicating conformation to design intent, species of lumber, size and methods of fastening and fabrication to the Architect for approval.

1.5 PRODUCT HANDLING:

- A. Delivery and Storage: Keep materials dry during delivery and storage. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks.

1.6 JOB CONDITIONS

- A. Installer must examine the substrates and supporting structures and the conditions under which the carpentry work is to be installed, and notify the Contractor in writing of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
- B. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow proper attachment of other work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rough Lumber
 - 1. Studs, posts and miscellaneous light framing shall be #2 or better Spruce-Pine-Fir,(S.P.F.). Wall framing shall typically be of 2 x 4 or 2 x 6 (nominal size) wood studs and plates, stud spacing and sizes shall be as indicated on the drawings.
 - 2. All sill plates in contact with concrete shall be preservative treated. Sill plates at exterior walls shall rest on 1/2 inch thick glass fiber or polyfoam sealer blanket of full width of plate. Sill plates shall be anchored to foundation walls with ½ inch diameter hot dipped galvanized anchor bolts spaced at 4 feet center to center maximum.
 - 3. Subflooring shall be 3/4" thick 48/24 tongue-and-groove underlayment grade Southern Yellowpine plywood, interior grade with exterior glue or 3/4" tongue-and-groove oriented strand board (OSB). Subflooring shall have its long sheet dimensions perpendicular to the span direction of floor trusses, with ends of sheets staggered except at perimeter of the building. Subflooring shall be both glued and nailed to floor trusses.
 - 4. Sheathing at exterior walls and at gable ends shall be 7/16" thick C-D fir plywood with exterior glue or 7/16" thick oriented strand board (OSB). All exterior walls shall be wrapped with one layer of housewrap material before installation of exterior finish

- materials. Housewrap shall be fastened to sheathing with manufacturer recommended large head nails or nails with large plastic washer heads. Staples are not acceptable.
5. Roof sheathing shall be 1/2 inch thick O.S.B. with exterior glue. Roof sheathing shall have unsupported edges blocked with “H” clips (one per unsupported space less than 48” and two for broader spaces).
 6. Headers, rafters, sills, plates, etc. shall be Southern Pine or Douglas Fir, No. 2 or better with a minimum allowable bending stress of $F_b = 1000$ psi, (1150 psi repetitive), shear stress $F_v = 90$ psi, modulus of elasticity $E = 1,6000,000$ psi according to the specific span dimensions contained in the National Forest Products Association span tables.
 7. Roof Trusses: provide wooden trusses where shown on the drawings, with spacing indicated on the drawings. Trusses shall be manufactured by a company experienced in the fabrication of wood trusses. Shop drawings of trusses shall be submitted by the manufacturer and shall bear the seal of an engineer registered in the state of Michigan. Truss drawings shall include each type of truss and its suitability for the span and spacing. Roof trusses to have heel height as indicated on the drawings. Provide truss location drawings when submitting roof truss drawings for review.
 8. Nailers, interior blocking, grounds, bucks: utility or better grade of same species.
 9. Exterior nailers and blocking: Utility grade spruce, pine, fir or equivalent grade of Southern Pine, surfaced four sides. Pressure treated resisting rot and fungus in areas in contact with concrete.
 10. Plywood
 - a. Plywood for interior rough carpentry shall be C-D Interior APA in thickness shown on drawings, species to be selected accordingly.
 - b. Exterior plywood soffit material shall be 1/2” thick beaded plywood, paint grade with exterior glue.
 11. Flashing around door and window openings shall be DuPont Tyvek “FlexWrap” system wrapping rough framing and sheathing at head, jambs and sill; bonds and corners. “FlexWrap” tape shall be an elastic, highly adhesive self-sealing butyl material with a polyolefin film. Installation shall be in strict accordance with manufacturer’s printed instructions.
 11. Preservative treatment of wood shall be a process of Koppers Company (Wolman Preservative Dept.), Osmose Wood Preserving Company or Protection Products Manufacturing Company. Lumber shall be impregnated with preservative salts in a closed cylinder by vacuum pressure process in accordance with treatment specifications of the processor. Each piece of treated lumber shall bear a brand denoting conformance to standards of the processor. All fasteners used with preservative treated lumber shall be stainless steel or hot dipped galvanized.

12. Adhesives

- a. All adhesives, adhesive bonding primers, adhesive primers or any other primer shall have a VOC content of not more than 250g/L less water and less exempt compounds.
- b. All adhesives, adhesive bonding primers, adhesive primers, sealants, sealant primers and any other primers shall have a VOC content of not more than the following less water and less exempt compounds, measured in grams per liter:

1)	Subfloor adhesives	50
2)	Drywall and panel adhesives	50
3)	Multipurpose construction adhesives	70

B. Rough Hardware

1. Provide and install all items of rough hardware necessary for a complete installation of work shown on drawings and/or specified herein. Rough hardware shall include nails, bolts, hangers, hurricane clips and anchors for attaching carpentry materials to other carpentry materials, to concrete or masonry except as those fastenings are regularly furnished with equipment and materials specified under another section. Hardware in contact with preservative treated lumber shall be stainless steel or hot dipped galvanized.

C. Finish Lumber

1. Finish trim as called for on the drawings or as required shall be finger jointed pine or poplar. Trim and moldings shall match existing profiles. Maximum moisture content of all finish lumber not to exceed 11%.
2. Exposed plastic laminate surfacing shall be in color as manufactured by Formica Corp., Wilsonart or Nevamar. Laminate to have matte finish, color as selected by Architect.
3. Closet shelves and laundry shelves shall be ventilated epoxy or plastic-coated steel rod shelving, type 6609 with integral hanging rod for clothes, type 6605 for linen clothes. Clothes closet shelves shall be 12" deep, depth of linen closet shelves shall be 16". Support shelving at maximum of 42" on center. Use manufacturer's 'Corner Rounder' pieces for inside corner installations in living unit closets. Manufacturer: Schulte Corp. Cincinnati, Ohio, Closet Maid or Clairon.
4. Exposed plastic laminate surfacing shall be in selected colors as manufactured by Formica Corp., Wilsonart or Nevamar. Laminate to have matte finish, color as selected by Architect.

5. Window stools shall be 3/4" thick "cultured marble" material in color selected by the Architect.
6. Hardwood handrail shall be paint grade poplar, solid stock in round shaped configuration.
7. Handrail brackets for railings shall be type 059 heavy duty handrail bracket as manufactured by Ives Hardware. Color as selected by the Architect. Provide with toggle bolts and wood screws.
8. Casework in building shall satisfy "Custom Grade" requirements of AWI "Specifications", except as otherwise shown. Countertops shall have high density particleboard core self-edged in 1/16" plastic laminate with laminated splash 4" high at back and sidewalls.
9. Formaldehyde emission levels for casework and countertops shall not exceed 0.30 parts per million; all backs, edges and undersides of materials shall be sealed with a low VOC (max. 250 g/L) sealer.
10. Formaldehyde free plywood may be used. Countertops shall have cutouts for sinks where required. Casework shall be shop assembled as far as practicable and delivered ready for erection. See Division 11, Section 11A, Cabinet Work.
11. Access panel covers for non-rated walls shall be ABS plastic, friction fit type. Model 34056 by Oatey. See Division 9 for rated access covers.

2.2 TEMPORARY WORK

- A. Provide temporary enclosures at entrances with suitable doors having temporary hardware including locks. Furnish keys to the Owner.
- B. Provide necessary protections for finish work as directed and maintain such protections until final acceptance of building unless otherwise directed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Secure rough framing plates to concrete with hot dipped galvanized expansion bolts spaced apart no further than 48 inches o.c. unless other spacing of bolts is shown. Ramset anchors will be acceptable for interior non-bearing partitions.
- B. Install all furring and all permanent or temporary grounds shown or required to complete the project, including furring and grounds for work of other sections of the specifications.

- C. Wall framing members shall occur at spacing indicated on the drawings. Studs at jambs of unit entrance doors and other locked doors in framed partitions shall be laterally braced by horizontal members on each side of openings, located at strike zone level of latch.
- D. Provide cross blocking in partitions to receive anchorage of grab bars, such assembly to withstand a hanging load of at least 300 pounds.
- E. Provide wood blocking of nominal 2-inch thickness for plumbing fixtures, cabinets, window blinds, light fixtures, towel bars, toilet paper holders, shower rods, paper towel dispensers, soap dishes, grab bars, etc. Blocking shall be utility grade Douglas Fir or spruce, pine, fir.
- F. All members shall be accurately cut and fitted into the respective locations plumb, square, level and true to line, permanently secured in proper position with lag screws, bolts or other fastenings and fittings as detailed, as necessary for structural stability or as herein specified to render the same, substantial and rigid. All bearings shall be accurately square cut.
- G. Cabinets shall be erected and securely anchored in place in plumb and level positions, using finishing moldings and filler pieces as necessary to fit the cabinets to the walls and ceilings.
- H. Finish woodwork of every nature shall be smoothly dressed prior to erection; finish shall be free from open joints, hammer and machine marks, and other structural defects and surface blemishes. Finish moldings shall be used on all rough ends of all woodwork. Moldings shall be of same material as woodwork.
- I. Wherever practicable, the means of fastening the various parts and members together shall be concealed, and where surface nailing is unavoidable, the nails shall be neatly set for putty stopping. Nailing through the finish surface of plastic laminated items is not acceptable.
- J. Cleanup - This contractor shall supply labor on items related to this work including the unloading of material and the disposing of, off site, all packaging materials and debris.

END OF SECTION 061000

SECTION 067300 - COMPOSITE DECKING – TREX ENHANCE® BASIC & NATURALS

Part 1 GENERAL

1.1 SECTION INCLUDES

A. Composite Decking – Basis of design: Trex Enhance Basics and Naturals

1.2 RELATED SECTIONS

A. Section 06-1100 – Wood Framing

1.3 REFERENCES

A. ASTM D-7032: Standard Specification for Establishing Performance Ratings for Wood-Plastic Composite Deck Boards

and Guardrail Systems (Guards or Handrails), ASTM International.

B. ASTM D-7031: Standard Guide for Evaluating Mechanical and Physical Properties of Wood-Plastic Composite

Products, ASTM International

C. ASTM E-84: Test Method for Surface Burning Characteristics of Building Materials, ASTM International.

D. ASTM D 570: Water Absorption of Plastics

E. ASTM D 1761: Mechanical Fasteners in Wood

F. ASTM D1413: Test method for Wood Preservatives by Laboratory Soil-block Cultures

G. ASTM C177: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties

by Means of the Guarded-Hot-Plate Apparatus

1.4 DESIGN/PERFORMANCE REQUIREMENTS

A. Structural Performance:

a. Deck: Uniform Load – An allowable span of 16 in. on-center and 100 lbf/sq.ft.

b. Tread of Stairs: Concentrated Load: An allowable span of 9 in. on-center, and 750 lbf-, and 1/8" max.

deflection, with a concentrated load of 300 lbf on area of 4 sq. in.

B. Fire-Test Response Characteristics per ASTM E-84.

a. Flame Spread Index– Class C.

1.5 SUBMITTALS

A. Product Data Indicate sizes, profiles, surface style, and performance characteristics.

B. Samples: For each product specified, one sample representing actual product color, size, and finish.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store Trex products on a flat and level surface. Support bundles on supplied dunnage.

B. Keep material covered using the provided bundle cover until time of installation.

C. See www.Trex.com for detailed storage recommendations:

Care and Cleaning Guide for Trex Transcend, Select, and Enhance Decking SECTION 074633

END OF SECTION 067300

SECTION 073100 – ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL

- A. The extent of roofing work is shown on the drawings.
- B. Work included under this section includes, but is not limited, to the following:
 - 1. Fiberglass shingles
 - 2. Roofing felt
 - 3. Ice barrier material
 - 4. Flashing and sheet metal
 - 5. Gutters and Downspouts
 - 6. PVC Roof Membrane
- C. Subcontract the roofing and associated work to a single firm specializing in the type of roofing required, so that there will be undivided responsibility for the performance of the work.

D. SUBMITTALS:

Manufacturer's Data, Roofing: Submit samples of shingles and prefinished sheet metal accessories to the Architect for selection of colors from the manufacturer's standard range.

1.3 JOB CONDITIONS

- A. Proceed with roofing work only after substrate construction and penetrating work have been completed.
- B. The Installer must examine the substrate and the conditions under which roofing work is to be performed, and notify the Contractor in writing of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

PART 2 - PRODUCTS

2.1 MATERIALS – SHINGLED ROOF

- A. Shingles. Fiberglass shingles shall be 12" x 36", Class "A" self-sealing 30-year warranty dimensional shingles as manufactured by CertainTeed or Iko. Shingles shall bear a label indicating compliance with ASTM D225 or D3462.
- B. Roofing felt. Roofing felt shall be 15-pound asphalt impregnated unperforated building paper, installed over the entire roof.
- C. Ice Barrier. A layer of Bituthene Ice & Water Shield waterproofing barrier as manufactured by W.R. Grace & Co. of Cambridge, MA shall be installed at eaves three 36" rolls wide, in all valleys, at each parapet wall projection, at each step in the roof and in any other locations indicated on the drawings.
- D. Fasteners. Fasteners for roofing materials shall be manufacturer recommended large head galvanized roofer's nails. Type and size of nails shall be as recommended by shingle manufacturer for specific installation.
- E. Flashing and sheet metal
 - 1. Metallic flashing and sheet metal work shall be in accordance with the Architectural Sheet Metal Manual, latest edition, published by the Sheet Metal and Air Conditioning Contractor's National Association, Inc.
 - 2. Sheet metal shall be of aluminum in alloy 3003-H14 having a thickness of at least .024 inch. Sheet metal work in exposed locations shall receive a manufacturer applied vinyl coated baked enamel finish, color as selected by the Architect. Sheet metal that remains concealed may be mill finish.
- F. Ridge vent shall be continuous aluminum "roofover" type for shingle application with prefinished baked enamel finish, color as selected by the Architect.
- G. Edge Vent – Install "The Edge Vent" by AirVent, (www.airvent.com) at perimeter eaves where existing ventilation is not existing or inadequate (See roof plans). Provides 9 sq. in/l.f. of net free area.
- H. Roof louvers, as needed, shall be model RV150, 14" x 14" louver with 150 Sq. in. free area as manufactured by Ampcor Metal Products. Provide with aluminum mesh insect screen and integral flashing. Units shall be factory prefinished in color to blend with the shingles.

- I. Undereave Vents by AirVent (www.airvent.com) 16" x 4" (28 sq.in NFA) 16" x 6" (42 sq.in NFA) or 16" x 8" (56 sq. in NFA) heavy duty aluminum as noted on the Roof Plan.
- J. Roof to wall vent – "Roof-to-Wall Vent" by Cor-A-Vent Corp. of Mishawaka, Indiana.
- K. Provide 2" x 1" prefinished aluminum drip edge at all roof rakes, roof eaves and above all fascia pieces. Finish to match prefinished flashings.
- L. Gutters and downspouts shall be factory prefinished aluminum, 5" profile. Gutters to be minimum .032" thickness, downspouts to be minimum .027" thickness 3" x 4". Install with aluminum nails through field installed aluminum grommets into wood fascia behind gutters. Provide necessary straps, bends, elbows, etc., for downspouts.
- M. Splashblocks for each downspout outlet shall be precast concrete, 33" x 11" x 3" thick.
- N. Aluminum soffit to be PAC-750 Aluminum Soffit Panel by Pac-Clad or approved equal. Provide Full vent, half vent or solid as noted on roof plan. 12" wide x ½" high x .032" thick. Colors to be selected by Architect from Manufacturers full range.

2.2 MATERIALS – PVC ROOF

- A. Manufacturer: Duro-Last Roofing, Inc., located at: 525 Morley Drive, Saginaw, MI 48601. Telephone: 800-248-0280. All roofing system components to be provided or approved by Duro-Last Roofing, Inc.
- B. Roofing Membrane: Duro-Last® PVC thermoplastic membrane conforming to ASTM D 4434, type III, fabric-reinforced, PVC, NSF/ANSI 347 Gold or Platinum Certification, and a product-specific third-party verified Environmental Product Declaration. Membrane properties as follows:
 - 1. Thickness: 60 mil.
 - 2. Exposed Face Color: White.
- C. Accessory Materials: Provide accessory materials supplied by or approved for use by Duro Last Roofing, Inc.
 - 1. Sheet Flashing: Manufacturer's standard reinforced PVC sheet flashing.
 - 2. Duro-Last Factory Prefabricated Flashings: manufactured using Manufacturer's standard reinforced PVC membrane.
 - a. Stack Flashings.
 - b. Curb Flashings.
 - c. Inside and Outside Corners.

- D. Sealants and Adhesives: Compatible with roofing system and supplied by Duro-Last Roofing, Inc.
 - 1. Duro-Caulk® Plus.
 - 2. Strip Mastic.
- E. Slip Sheet: Compatible with roofing system and supplied by Duro-Last Roofing, Inc.
- F. Fasteners and Plates: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane and insulation to substrate. Supplied by Duro-Last Roofing, Inc.
- G. Termination and Edge Details: Supplied by Duro-Last Roofing, Inc.
 - 1. 2-Piece Compression Metal System.
- H. Vinyl Coated Metal: Supplied by Duro-Last Roofing, Inc. 24 gauge, hot-dipped galvanized, grade 90 metal with a minimum of 17 mil of Duro-Last membrane laminated to one side.
- I. Two-Way Roof Vents: Supplied by Duro-Last Roofing, Inc. Install a minimum of 1 vent for each 1,000 ft² (93 m²) of roof area.
- J. Walkways: Provide non-skid, maintenance-free walkway pads in areas of heavy foot traffic and around mechanical equipment. Duro-Last Roof Trak® III Walkway Pad.
- K. Roof Insulation: Provide preformed roof insulation boards that comply with requirements and referenced standards, as selected from manufacturer's standard sizes. Provide preformed saddles, crickets, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated. Polyisocyanurate Board Insulation: Complying with ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces. Material as supplied by Duro-Last or other approved equal. Duro-Guard® ISO II.
- L. Contractor's Warranty: The contractor shall warrant the roof application with respect to workmanship and proper application for two (2) years from the effective date of the warranty issued by the manufacturer.
- M. Manufacturer's Warranty: Must be no-dollar limit type and provide for completion of repairs, replacement of membrane or total replacement of the roofing system at the then-current material and labor prices throughout the life of the warranty. In addition, the warranty must meet the following criteria:
 - 1. Warranty Period: 20 years from date issued by the manufacturer.
 - 2. No exclusion for damage caused by ponding water.
 - 3. No exclusion for damage caused by biological growth.
 - 4. Issued direct from and serviced by the roof membrane manufacturer.
 - 5. Transferable for the full term of the warranty.

PART 3 - PRODUCTS

3.1 EXECUTION

- A. Preparation of Substrate: Clean the roof sheathing of projections and substances detrimental to the work. Roofing subcontractor shall inspect substrate and notify the General Contractor in writing of any defects in the substrate, which may be detrimental to the work.
- B. Apply one layer of 15-pound roofing felt over roof sheathing in all areas. Felts shall be lapped 2 inches at head seams and 6 inches at end seams.
- C. In addition to roofing felt, apply at the eaves of the roof extending to a point at least 96 inches from the eaves, in all valleys, at each parapet wall projection, at each roof step and in any other locations indicated on the drawings, one layer of W.R. Grace & Co. Bituthene Ice & Water Shield material.
- D. Install all metal flashings, ridge vents, drip edges, rake edges, etc. in proper sequence with shingle installation.
- E. Install shingles with manufacturer recommended large head galvanized nails. Remove factory applied polyethylene tabs to assure proper sealing of shingles.
- F. Install flashings, etc. in accordance with manufacturer's standard installation procedures. Provide all accessories and other items essential to the completeness of the roofing and sheet metal installation. Nails, screws, bolts, clips, etc. shall be of a composition compatible with the metal to which it will contact.
- G. Guarantee: Furnish a written guarantee warranting all flashing and sheet metal to remain in good condition for a period of two (2) years following the date of final acceptance of the building and to promptly repair and place in good condition, without any additional expense to the Owner, any flashing and sheet metal which becomes defective within the period.
- H. PVC Roof Installation:
 - 1. Install insulation in accordance with the roof manufacturer's requirements.
 - 2. Insulation: Duro-Guard® ISO II (flat).
 - a. Install insulation in accordance with the roof manufacturer's requirements.
 - b. Insulation shall be adequately supported to sustain normal foot traffic without damage.

- c. Where field trimmed, insulation shall be fitted tightly around roof protrusions with no gaps greater than ¼ inch.
 - d. No more insulation shall be applied than can be covered with the roof membrane by the end of the day or the onset of inclement weather.
 - e. If more than one layer of insulation is used, all joints between subsequent layers shall be offset by at least 6 inches.
 - f. Mechanical Attachment: Use only fasteners, stress plates and fastening patterns accepted for use by the roof manufacturer. Fastening patterns must meet applicable design requirements.
 - g. Install fasteners in accordance with the roof manufacturer's requirements. Fasteners that are improperly installed must be replaced or corrected.
 - h. Install mechanical fasteners through top layer to attach Duro-Guard® ISO II (flat) insulation. Install all layers in parallel courses with end joints staggered 50% and adjacent boards butted together with no gaps greater than ¼ inch.
3. Roof Membrane: 60 mil, Duro-Last® PVC thermoplastic membrane.
- a. Use only fasteners, stress plates and fastening patterns accepted for use by the roof manufacturer. Fastening patterns must meet the applicable design requirements.
 - b. Install fasteners in accordance with the roof manufacturer's requirements. Fasteners that are improperly installed shall be replaced or corrected.
 - c. Mechanically fasten membrane to the structural deck utilizing fasteners and fastening patterns that in accordance with the roof manufacturer's requirements.
 - d. Cut membrane to fit neatly around all penetrations and roof projections.
 - e. Unroll roofing membrane and positioned with a minimum 6-inch overlap.
4. Seaming:
- a. Weld overlapping sheets together using hot air. Minimum weld width is 1-1/2 inches.

- b. Check field welded seams for continuity and integrity and repair all imperfections by the end of each work day.
- 5. Membrane Termination/Securement: All membrane terminations shall be completed in accordance with the membrane manufacturer's requirements.
 - a. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.
 - b. Provide securement at any angle change where the slope or combined slopes exceeds two inches in one horizontal foot.
- 6. Flashings: Complete all flashings and terminations as indicated on the drawings and in accordance with the membrane manufacturer's requirements.
 - a. Provide securement at all membrane terminations at the perimeter of each roof level, roof section, curb flashing, skylight, expansion joint, interior wall, penthouse, and other similar condition.
 - 1) Do not apply flashing over existing thru-wall flashings or weep holes.
 - 2) Secure flashing on a vertical surface before the seam between the flashing and the main roof sheet is completed.
 - 3) Extend flashing membrane a minimum of 6 inches (152 mm) onto the main roof sheet beyond the mechanical securement.
 - 4) Use care to ensure that the flashing does not bridge locations where there is a change in direction (e.g. where the parapet meets the roof deck).
- 7. Penetrations:
 - a. Flash all pipes, supports, soil stacks, cold vents, and other penetrations passing through the roofing membrane as indicated on the Drawings and in accordance with the membrane manufacturer's requirements.
 - b. Utilize custom prefabricated flashings supplied by the membrane manufacturer.
 - c. Existing Flashings: Remove when necessary to allow new flashing to terminate directly to the penetration.

8. Pipe Clusters and Unusual Shapes:
 - a. Clusters of pipes or other penetrations which cannot be sealed with prefabricated membrane flashings shall be sealed by surrounding them with a prefabricated vinyl-coated metal pitch pan and sealant supplied by the membrane manufacturer.
9. Roof Drains:
 - a. Coordinate installation of roof drains and vents specified in Section 15146 - Plumbing Specialties.
 - b. Remove existing flashing and asphalt at existing drains in preparation for sealant and membrane.
 - c. Provide a smooth clean surface on the mating surface between the clamping ring and the drain base.
10. Walkways:
 - a. Install walkways in accordance with the membrane manufacturer's requirements.
 - b. Provide walkways where indicated on the Drawings.
 - c. Install walkway pads at roof hatches, access doors, rooftop ladders and all other traffic concentration points regardless of traffic frequency. Provided in areas receiving regular traffic to service rooftop units or where a passageway over the surface is required.
 - d. Do not install walkways over flashings or field seams until manufacturer's warranty inspection has been completed.

END OF SECTION 073100

SECTION 074633 – VINYL SIDING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Horizontal and Vertical Vinyl Siding.
- B. Accessories and trim.

1.2 RELATED SECTIONS

- A. Section 061000 – Rough Carpentry
- B. Section 07260 - Vapor Retarders.
- C. Section 079200 - Joint Sealants.

1.3 REFERENCES

- A. ASTM D 3679 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding.
- B. ASTM D 4477 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Soffit.
- C. ASTM D 5206 - Standard Windload Resistance Test.
- D. ASTM E 84 - Standard test Method for Surface Burning Characteristics of Building Materials.
- E. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

1.4 DESIGN/PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Code compliance in accordance with the following:
 - 1. IBC and IRC
 - 2. ICC Evaluation Service
- B. PVC Fire Resistance: Provide vinyl siding products that meet or exceed the following ratings:
 - 1. Flame Spread Index < 25, smoke development rating <450, per ASTM E 84.
 - 2. Fire endurance classification of 1 hour, per ASTM E 119 in a wall assembly.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Verification Samples: For each finish product specified, two samples, minimum size 12 inches (300 mm) long, representing actual product, color, and patterns.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Provide installer with not less than three years of experience with products specified or has obtained 5-Star Green Contractor (Preferred), 5-Star Contractor (preferred), or Master Craftsman credentials from CertainTeed.
- B. Mock-Up: Provide a mock-up for evaluation of installation techniques and workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship and color is approved by Architect.
 - 3. Reinstall mock-up area as required to produce acceptable work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation. Refer to manufacturer's installation instructions for specific storage and handling requirements.

1.8 PROJECT CONDITIONS

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

1.9 WARRANTY

- A. Provide manufacturer's standard lifetime limited warranty on siding products, transferable to new owners.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Basis-of Design Manufacturer: CertainTeed Corporation
 - 2. Alternate manufacturers offering equivalent products include Alside, Royal, Crane, and Georgia Pacific, subject to Architect's review of available color and trim options.
- B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 MATERIALS

- A. Vinyl Siding, Soffit and Components: Provide products made of extruded polyvinyl chloride as specified in this section and manufactured to comply with requirements of ASTM D 3679.
 - 1. Provide elongated nailing slots on nailing flanges to allow for movement.
 - 2. Factory-notch ends of horizontal panels to form overlapping joints.
 - 3. Provide products that meet weathering requirements of ASTM D 3679.
- B. MainStreet D4:
 - 1. Design: Double 4 inch (102 mm) clapboard; woodgrain finish with STUDDfinder Installation System.
 - 2. Nail Hem: RigidForm 160 Roll Over Nail Hem.
 - 3. Lock: DuraLock post formed lock design.
 - 4. Width: 8 inch (203 mm).
 - 5. Length: 12 feet 6 inches (3.81 m) plus or minus .025 inch (6 mm).
 - 6. Average Thickness: 0.042 inch (1.07 mm).
 - 7. Panel Projection: 1/2 inch (12.7 mm).
 - 8. Panel Exposure: 4 inch (102 mm) plus or minus .062 inch (1.57 mm).
 - 9. Maximum Warp (per 2 panels): 0.250 inch (6 mm).
 - 10. Color: As selected by Architect from manufacturer's standards.
- C. Universal T4 soffit and vertical siding, solid.
 - 1. Design: Triple 4 inches (102 mm). solid; matte finish.
 - 2. Width: 12 inches (305 mm) plus or minus .062 inch (1.57 mm).
 - 3. Length: 12 feet (3.66 m) plus or minus .025 inch (6 mm)
 - 4. Average Thickness: 0.040 inch (1.0 mm).
 - 5. Exposure: 4 inches (102 mm) single nailing hem.
 - 6. Maximum Warp (per 2 panels): 0.250 inch (6 mm).

7. Color: As selected by Architect from manufacturer's standards.

2.3 VINYL CARPENTRY ACCESSORIES

A. 1-1/4 Inch Pocket Accessories:

1. Cornerpost: Standard width, 10 feet; (3.05 m) length.
2. J-Channel: Standard width, 12 feet, 6 inches (3.81 m) length.
3. Traditional SuperCorner: 5.5 (140 mm) inches by 20 feet (140 mm by 6.1 m) length.
4. Inside Cornerpost; Standard width, 10 feet (3.05 m) length.
5. Starter Strip: 3 inches (76 mm) by 12 feet, 6 inches (3.81 m) length.
6. Band Board: 7-1/4" (184 mm) width by 16'8" (5.08m) length
7. Finish Board: 3-1/2" (88.9mm) width by 12'6" 3.81 m) length
8. Color: as selected by Architect from manufacturer's standards.

B. Optional Accessories:

1. 5 inch (127 mm) Lineal: 5 inch by 20 feet (127 mm by 6.1 m) length.
2. 3-1/2 inch (89 mm) Lineal: 3-1/2 inches by 12 feet, 6 inches (89 mm by 3.81 m) length.
3. Color: as selected by Architect from manufacturer's standards.

C. Composite Exterior Trim boards:

1. Composite fascias and frieze boards, nominal sizes as indicated on the Drawings.
2. Certainteed ""Restoration Millwork"" or approved equal.
3. Color: Prefinished or painted, to match vinyl siding trim.

2.4 FASTENERS

- A. A. Provide galvanized or other corrosion-resistant nails as recommended by manufacturer of siding products.

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. Examine, clean, and repair as necessary any substrate conditions which would be detrimental to proper installation.
- B. Do not begin installation until unacceptable conditions have been corrected.

3.3 INSTALLATION

- A. Install products in accordance with the latest printed instructions of the manufacturer.
- B. Installer should have current 5-Star Contractor (preferred) or Master Craftsman credentials.
- C. Install products with all components true and plumb.
- D. *For Vinyl Siding:* Nail horizontal panels by placing nail in center of slot. Nail vertical panels by placing first nail at top of top slot and remaining nails in center of slots. Drive nails straight, leaving 1/16 inch (1.6 mm) space between nail head and flange of panel.
- E. Allow space between both ends of siding panels and trim for thermal movement. Overlap horizontal panel ends one-half the width of factory pre-cut notches.
- F. Stagger lap joints in horizontal siding in uniform pattern as successive courses of siding are installed.
- G. Install J-channel and flashing to accommodate successive courses of vertical siding. Install wood shims at building corners to bring cut edges of vertical siding out to correct plane.

3.4 PROTECTION

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

3.5 CLEANING

- A. At completion of work, remove debris caused by siding installation from project site.

END OF SECTION 074633

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END OF SECTION 074633

SECTION 079200 – CAULKING AND SEALANT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 GENERAL

- A. The extent of caulking and sealant work is shown on the drawings and as described herein.
- B. The work under this section includes but is not limited to the following:
 - 1. Interior caulking
 - 2. Fire barrier caulking
 - 3. Exterior caulking and sealants
 - 4. Air Sealing package
- C. All items described below to be caulked and sealed.
 - 1. Interior: All door frames, perimeters of windows, window sills, toilets, bathtubs, showers, interior control joints, countertops, vanity tops, lavatories and all joints at butting of dissimilar materials.
 - 2. Exterior: Exterior window perimeters, HVAC openings, door perimeters, louvers, all joints at butting of dissimilar materials, all control joints and any other areas indicated on the drawings. Replace all existing exterior sealants. Bed all exterior thresholds in sealant.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Interior Joints - Latex based, colors to match finished surfaces. Pecora Corporation

(AC-20 and Dynatrol); Tremco (Acrylic Latex).

- B. Fire Barrier Caulking - 3M CP25S/L Fire Barrier Self-Leveling Caulk and 3M CP 25N/S Fire Barrier No-Sag caulk.
- C. Joints Exposed to Exterior– Color to match adjacent materials. Maximum joint size shall not exceed 3/4" wide and 2" deep. Manufacturer: Dow Corning (#790), General Electrical (Silpruf and Silgaze).
- D. VOC (Volatile Organic Compound) content of caulks and sealants shall not exceed 250 grams per liter.

PART 3 - EXECUTION

3.1 INSTALATION

- A. Preparation - shall be as per manufacturer's instructions. Thoroughly clean joints dry, free of dust, oil, grease.
- B. Application - shall be as per manufacturer's instructions. Caulk shall be gun applied through a nozzle opening of such a diameter so that the full bead of caulk completely fills the joint. Joint shall be tooled immediately to insure contact with inner faces and flush surface. Remove all excess and smears as work progresses.
- C. Seal openings in fire rated walls and floors with intumescent 3M Fire Barrier Caulking. Fill openings completely around penetrating items.
- D. Guarantee - Furnish a written guarantee warranting all caulking and sealants to remain in a serviceable, watertight, elastic and adhesive condition, not staining or injuring adjoining materials, for a period of one (1) year from the date of substantial completion of the building, and to make good without expense to the Owner any defects appearing in the work within that period.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes hollow-metal work for doors and frames
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for substitutions requirements.
 - 2. Section 042000 "Unit Masonry" for grouting frames in masonry.
 - 3. Section 081650 "Composite Entry Doors" for pre-hung entrance door frames.
 - 4. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

- B. Shop Drawings: Include the following:
1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
 9. Details of conduit and preparations for power, signal, and control systems.
- C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Curries Company; an Assa Abloy Group company.
 2. Republic Doors and Frames.
 3. Steelcraft; an Ingersoll-Rand company.
 4. Substitutions per section 012500.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. Typical Interior door and frame.
1. Physical Performance: Level B according to SDI A250.4.
 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - f. Door lites: Provide 100 sq. inch door lites in all stairway doors
 3. Frames:
 - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Construction: Knocked down.
 4. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. All exterior doors and frames.
 - 1. Physical Performance: Level A according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm.)
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - d. Edge Construction: Model 1, Full Flush.
 - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
 - f. Core: Mineral board.
 - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu (0.370 K x sq. m/W) when tested according to ASTM C 1363.
 - 3. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm), with minimum A40 (ZF120) coating.
 - b. Construction: Knocked down.
 - 4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.

2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Glazing: Comply with requirements in Section 088000 "Glazing."
- J. Grout Materials: Grout hollow metal frames solid with Isolatek CAFCO 300.
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
 - 2. Top Edge Closures: Close top edges of doors with inverted closures of same material as face sheets.
 - 3. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
 - 4. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

- 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
- c. Compression Type: Not less than two anchors in each frame.
4. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
 5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with [butted] [or] [mitered] hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

- a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install door silencers in frames before grouting.
 - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
2. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or spray applied fire proofing.
4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: [3/4 inch (19.1 mm)] [5/8 inch (15.8 mm)] plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081113

SECTION 081416 – DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of wood doors and metal frames is shown on the drawings and the door schedule.
- B. Items included but not limited to the following:

Wood doors with wood or metal Redi-frames.

Metal clad wood doors with metal frames.

Doors shall be manufactured in accordance with Basic Hardboard Standard ANSI/AHA 135.4-1982 and NWWDA I.S. 1.1.-87, sec. 3.7.3.(B).

PART 2 - GENERAL

2.1 MATERIALS

- A. Hollow Core Wood Doors – Doors shall be of size, type, and thickness as indicated on the Door Schedule. Doors shall have a factory prefinished flush woodgrain masonite surface with processed wood grid or corrugated honeycomb core. Doors to comply with ANSI/AHA 135.4-1982 and NWWDA I.S. 1.1-87, sec. 3.7.3 (B) and bear label identifying manufacturer and certifying compliance with standard specified. Hollow core wood doors shall be hung in prehung type wood frames, ¾" fingerjointed paint grade Ponderosa pine with planted stops.
- B. Solid Core Wood Doors – Doors shall be of size, type and thickness as indicated on the Door Schedule. Doors shall have a factory prefinished flush woodgrain Masonite surface with processed wood grid or corrugated honeycomb core. Doors to comply with ANSI/AHA 135.4-1982 and NWWDA I.S. 1.1.-87, sec. 3.7.3 (B) and bear label indentifying manufacturer and certifying compliance with standard specified.

- C. Prehung Wood Frames – Frames for living unit interior doors shall be fabricated from ¾ inch thick finger-jointed paint grade Ponderosa pine with planted stops.
- D. Exterior doors to be 6 Panel, metal clad, insulated exterior entry doors, 1-3/4" thick with matching metal frame. See Door Schedule for sizes, color to be selected by Architect from Manufacturers full range.
 - 1. Therma-Tru TS210
 - 2. Jeld-Wen, steel edge, Gladiator Ovolo panel profile
 - 3. Other substitutions as acceptable to Owner and Architect.
- E. Metal Red-Frames – Prefinished, light gauge steel frames for interior wood doors to be "Redi-Frame" as manufactured by Timely Industries or Dunbarton Industries with clip-on steel or wood casings, see door details.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of Wood Doors and Metal Frames:

Hang and place all wood doors and metal frames in accordance with manufacturer's instructions for type of construction in which they are placed.

Place doors and frames plumb and true so doors operate freely. Doors shall be hung with a uniform margin around frame and shall fit snugly against rubber bumpers.

END OF SECTION 081416

SECTION 08 26 16 - VINYL PATIO DOOR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. All sliding glass doors of the types and sizes as called for in this specification shall be furnished with all necessary hardware and miscellaneous equipment as herein specified and shall be supplied by the same manufacturer.

1.2 RELATED SECTIONS

- A. Section 061000 – Rough Carpentry.

1.3 SUBMITTALS

- A. See Section 013300 – Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard details and catalog data demonstrating compliance with referenced standards. Include Installation Instructions.
- C. Provide third-party certification that Patio door meets or exceeds AAMA/WDMA/CSA 101/1.S.2/A440-08 Performance classes and levels per section 0.2. Performance classes and levels of standard

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum ten (10) years of documented experience producing products of the type Specified in this section.
- B. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size.
- C. Certifications:
 - 1. Provide patio door units rated for air infiltration, water penetration and structural performance per AAMA/WDMA/CSA 101/1.S.2/A440-08 and certified by independent third-party agent.
 - 2. Provide patio door units rated and certified for thermal performance by NFRC, and for seal integrity of insulating glass seal.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver windows to project site in undamaged condition; handle Patio doors to prevent damage to components and to finishes.
- B. Store products in manufacturer's unopened packaging, out of direct sunlight or high temperature locations, until ready for installations.

1.6 PROJECT CONDITIONS

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

1.7 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's Limited Lifetime Warranty on patio door products.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Acceptable Manufacturer: **Crystal Window & Door Systems, Ltd.**, which is located at: 31-10 Whitestone Expressway, Flushing, NY 11354; Tel: 718. 961.7300; Tel: 800. 472.9988; Fax: 718.460.4594; Web: www.crystalwindows.com
- B. Request for substitutions will be considered in accordance with provisions of Section 01 25 00.

2.2 VINYL PATIO DOORS

A. Construction:

1. Vinyl Extrusions: Multi-chamber extrusions of impact-resistant exterior-grade rigid polyvinyl chloride (PVC) complying with ASTM D 4726, ASTM D 4216 and ASTM D 638 standards.
2. Insulating Glass Unit: Unit thickness 1 inch, permanently marked with ID from Certification Program.
 - a. Insulating Glass shall comply with the ASTM E 2190 standard.
 - b. Insulating Glass type selection shall comply with the ASTM E 1300 standard.
 - c. Air Chamber: Hermetically sealed space between panes. Clear Glass is standard, Low-E6, Low-E7 glazing as well as argon gas filling options available.
3. Operating Hardware: Types for specified sliding door; sight-exposed hardware of UV-stabilized, engineered plastic; color matched to vinyl extrusions for uniform appearance.
4. Fasteners: All screws and other miscellaneous fastening devices incorporated shall be of aluminum, stainless steel, or other non-corrosive material compatible with vinyl extrusions. Cadmium or zinc plated steel, where used, shall be in accordance with ASTM B 766 or ASTM B 633.
5. Weather-stripping: Types for specified operable doors.

B. Performance:

1. Single Sliding Door Unit Air Infiltration shall not exceed 0.30 CFM/SqFt when tested in accordance with: AAMA/WDMA/CSA 101/1.S.2/A440-08

- a. For specific product air infiltration performance, contact Crystals' Engineering Department.
2. Unit Water Penetration Resistance Pressure vs. size when tested in accordance with: AAMA/WDMA/CSA 101/1.S.2/A440-08
 - a. 5.25 psf for Class LC-PG 35 unit sizes up to 86.75" x 80"
3. Unit Performance Grade vs. size when tested in accordance with: AAMA/WDMA/CSA 101/1.S.2/A440-08
 - a. Class LC-PG35 for unit sizes up to 86.75" x 80" Unit
4. Thermal Performance ratings vs. size when tested in accordance with: NFRC 100, 200 and 500
 - a. Sliding Glass Door shall achieve NFRC thermal u-value rating of 0.29 BTU/hr/SqFt/F° and a Solar Heat Gain Coefficient of 0.30 using Low-E7 on glass surface #3 and argon gas fill.

C. Configurations

1. Operation: One panel of the two-panel unit shall be movable. Operating panel shall glide on tandem metal adjustable wheels. Stationary panel shall be inserted head, jamb and sill, Panels shall have a positive interlock at the meeting stiles when in the closed position.
2. Operating Hardware:
 - a. Locks: Handle-type key lock, capable of meeting ASTM F 842 forced entry resistance, engineered to force meeting stiles/rails with interlock for minimum air infiltration.
3. Weatherstripping: High-density woven pile (double seal) shall be used in combination with continuous polyethylene rigid seal, & one Q-Lon seal between meeting stiles to minimize air infiltration, meeting requirements of AAMA 701/702.
4. Frame construction: Frame shall have an integral pre-punched nailing fin along the perimeter. All corners shall be mitered and fusion welded. Metal door-sliding track & foot board. Frame depth shall be 4-5/8".
5. Sash construction: All sash corners shall be mitered and fusion welded. There shall be integral interlock at the meeting rail. Metal reinforcement bars shall be installed in meeting rails
6. Color: As selected from manufacturers standard colors.
7. Styles and Sizes: As indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Installer to verify that project conditions are acceptable before beginning installation of products;

- B. Verify that rough openings are as indicated, and are correct sizes for clearance spaces specified in manufacturer's instructions.
- C. Correct any unacceptable conditions before proceeding with installation
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's printed installation instructions and approved shop drawings.
- B. Install products plumb and in true alignment; fasten to achieve maximum operational effectiveness and best appearance of unit
- C. Installation of flashing is specified in Section 07 62 00 - Sheet Metal Flashing and Trim.
- D. Installation of joint sealers is specified in Section 07 90 00 - Joint Protection.

3.3 ADJUSTING AND CLEANING

- A. Ensure that patio doors operate correctly, free from bidding or other defects
- B. Clean interior and exterior surfaces free of labels, mortar, plaster, paint, joint sealers, and other foreign matter to prevent damage to weather strip, and to prevent interference with operation of hardware.
- C. Clean and restore soled surfaces; remove scraps and debris, and leave site in clean condition.

3.4 PROTECTION

- A. Protect window unit from damage until substantial completion. Repair or replace damaged units

END OF SECTION 083216

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Storefront framing for window walls.
 - 2. Exterior and interior manual-swing entrance doors and door-frame units.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Expansion provisions.
 - d. Glazing.
 - e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.6 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including, but not limited to, excessive deflection.
 - b. Noise or vibration created by wind and thermal and structural movements.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. Water penetration through fixed glazing and framing areas.
 - e. Failure of operating components.
 2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
 - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
 - 2. Failure also includes the following:
 - a. Thermal stresses transferring to building structure.
 - b. Glass breakage.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Loosening or weakening of fasteners, attachments, and other components.
 - e. Failure of operating units.
- B. Structural Loads:
 - 1. Wind Loads: As indicated on Drawings.

2. Other Design Loads: As indicated on Drawings.
- C. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
 2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
 - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
 3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:
 - a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.
- D. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
 - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. .
 2. Entrance Doors:
 - a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. .
 - b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. .
- E. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.
- F. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F , material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
 - a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
 - b. Low Exterior Ambient-Air Temperature: 0 deg F.
 - c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

- 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. Kawneer.
 2. Tubelite.
 3. Efco.

2.3 FRAMING

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
 1. Construction: Thermally broken.
 2. Glazing System: Retained mechanically with gaskets on four sides.
 3. Glazing Plane: Refer to drawings.
 4. Finish: Color anodic finish.
 5. Fabrication Method: Field-fabricated stick system.
- B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.

2.4 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 2. Door Design: As indicated.
 3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

2.5 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

2.6 GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 2. Reinforce members as required to receive fastener threads.
 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
 2. Accurately fitted joints with ends coped or mitered.
 3. Physical and thermal isolation of glazing from framing members.
 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 5. Provisions for field replacement of glazing from exterior.
 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

- D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.
- F. Storefront Framing: Fabricate components for assembly using head-and-sill-receptor system with shear blocks at intermediate horizontal members.
- G. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- H. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- I. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- J. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.

2. Do not install damaged components.
 3. Fit joints to produce hairline joints free of burrs and distortion.
 4. Rigidly secure nonmovement joints.
 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
 - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
 - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
 - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION 084113

SECTION 085313 - VINYL WINDOWS AND PATIO DOORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Horizontal Sliding and Single Hung windows, and Sliding Patio Doors.
- B. All windows of the types and sizes as called for in this specification shall be furnished with all necessary hardware and miscellaneous equipment as herein specified and shall be supplied by the same manufacturer.

1.2 RELATED SECTIONS

- A. Section 061000 – Rough Carpentry.

1.3 SUBMITTALS

- A. See Section 013300 – Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's standard details and catalog data demonstrating compliance with referenced standards. Include Installation Instructions.
- C. Quality Assurance Submittals: Evidence of certifications of single-hung window units required in Quality Assurance Article of this section.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Minimum ten (10) years of documented experience producing products of the type Specified in this section.
- B. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size.
- C. Certifications:
 - 1. Provide Horizontal Sliding or Single-Hung window units, or Sliding Patio Door units, rated for air infiltration, water penetration and structural performance per AAMA/WDMA/CSA 101/1.S.2/A440 NAFS Specifications for Windows and certified by independent third-party agent.
 - 2. Provide Horizontal Sliding or Single Hung window units and Sliding Patio Door units rated and qualified for current Energy Star rating, for North Central region.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver windows to project site in undamaged condition; handle windows to prevent damage to components and to finishes.
- B. Store products in manufacturer's unopened packaging, out of direct sunlight or high temperature locations, until ready for installations.

1.6 PROJECT CONDITIONS

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

1.7 WARRANTY

- A. See Section 017800 – Closeout Submittals, for additional warranty requirements
- B. Manufacturer's Warranty: Furnish manufacturer's standard Limited Lifetime Warranty on Vinyl Products.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

- A. Acceptable Manufacturer: **Jeld-Wen Builders Vinyl (V-2500)**
- B. Acceptable Alternate- Crown Windows "Michigan Window"
- C. Request for substitutions will be considered in accordance with provisions of Section 012500.

2.2 HORIZONTAL SLIDING AND SINGLE-HUNG

- A. Construction:
 - 1. Vinyl Extrusions: Multi-chamber extrusions of impact-resistant exterior-grade rigid polyvinyl chloride (PVC) complying with ASTM D 4726, ASTM D 4216 and ASTM D 638 standards.
 - 2. Insulating Glass Unit: Unit thickness 7/8 inch, permanently marked with ID from Certification Program.
 - a. Insulating Glass shall comply with the ASTM E 2190 standard.
 - b. Insulating Glass type selection shall comply with the ASTM E 1300 standard.
 - c. Air Chamber: Hermetically sealed space between panes. Clear Glass is standard, Low-E6, Low-E7 glazing as well as argon gas filling options available.
 - d. Low conductance spacer
 - 3. Fasteners: All screws and other miscellaneous fastening devices incorporated shall be of aluminum, stainless steel, or other non-corrosive material compatible with vinyl extrusions. Cadmium or zinc plated steel, where used, shall be in accordance with ASTM B 766 or ASTM B 633.
 - 4. Weather-stripping: High-density woven pile shall be used in combination with continuous polyethylene rigid seal to minimize air infiltration.

B. Performance:

1. Air Infiltration shall not exceed 0.30 CFM/SqFt when tested in accordance with: AAMA/WDMA/CSA 101/1.S.2/A440-08
 - a. For specific product air infiltration performance, contact Crystals' Engineering Department.
2. Unit Water Penetration Resistance Pressure vs. size when tested in accordance with: AAMA/WDMA/CSA 101/1.S.2/A440-08
 - a. 5.25 psf for Class R-PG 25 unit sizes up to 40.0" x 63.0"
3. Unit Performance Grade vs. size when tested in accordance with: AAMA/WDMA/CSA 101/1.S.2/A440-08
 - a. Class R-PG35 for unit sizes up to 40" x 63" Unit
4. Thermal Performance ratings vs. size when tested in accordance with: NFRC 100, 200 and 500
 - a. Single-Hung Window PG35- Energy Star Qualified. Energy Star Northern glazing assembly. U = 0.26, SHGC = 0.53.
 - b. Horizontal Slider Window- Energy Star Qualified. Energy Star Northern glazing assembly. U = 0.26, SHGC = 0.53.
 - c. Sliding Patio Door- Energy Star Qualified. Energy Star Northern glazing assembly. U = 0.24, SHGC = 0.30.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Installer to verify that project conditions are acceptable before beginning installation of products;
- B. Verify that rough openings are as indicated, and are correct sizes for clearance spaces specified in manufacturer's instructions.
- C. Correct any unacceptable conditions before proceeding with installation
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's printed installation instructions and approved shop drawings.
- B. Install products plumb and in true alignment; fasten to achieve maximum operational effectiveness and best appearance of unit

3.3 ADJUSTING AND CLEANING

- A. Ensure that windows operate correctly, free from biding or other defects
- B. Clean interior and exterior surfaces free of labels, mortar, plaster, paint, joint sealers, and other foreign matter to prevent damage to weather strip, and to prevent interference with operation of hardware.
- C. Clean and restore soiled surfaces; remove scraps and debris, and leave site in clean condition.

3.4 PROTECTION

- A. Protect window unit from damage until substantial completion. Repair or replace damaged units

END OF SECTION 085313

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. Items included but not limited to the following:

Finish hardware - material supplied by the Hardware subcontractor and installed by Carpentry Subcontractor.

Furnish all accessories required for complete work.

- B. Standards:

1. All hardware shall conform to ANSI A-156.2 and Series 4000, grade 1 for building entry doors; grade 2 for unit entry doors and grade 3 for doors within apartments. All locksets shall be of the cylindrical type.
2. Shop Drawings - Provide 6 copies of hardware schedule and shop drawings for all locksets and panic exit devices as indicated in these specifications and as are required for completion of the work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Packing and Marking - Package each item of hardware and each lockset separately in individual containers, complete with necessary screws, keys, instructions and installation template for spotting mortising tools. Identify each container as to locations.
- B. Keying - The Hardware Subcontractor is to direct all keying prior to placing of the order with manufacturer. Coordinate with keying of the existing buildings. Each apartment shall be keyed individually. Provide properly labeled keys as per requirement. Carpentry Subcontractor is to obtain written receipt from project superintendent for same.

- C. Door stops – Provide door mounted door stops for all living unit doors, wall mounted door stops for all common area doors.
- D. U.L. Ratings: In all instances where doors are required to bear U.L. ratings, the hardware shall be of type to supply the required rating.

2.2 HARDWARE SCHEDULE - GENERAL

- A. Hardware Schedule - Items of hardware not specifically mentioned herein, but obviously necessary for the completion of the work shown on the drawings or requirement of code, shall be provided. Such items shall be of the type and quality suitable for the required service and comparable to and matching adjacent hardware.

2.3 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges.
 - 1. Hinge quantity
 - a. Provide 3 hinges per door up to and including 7'5" tall doors.
 - b. Provide 1 additional hinge for each additional 2'6" of door height.
 - 2. Hinge size:
 - a. Provide 4.5" x 4.5" hinges unless otherwise noted.
 - 3. Hinge weight:
 - a. Provide standard weight hinges .134" thick on doors up to and including 36" wide doors.
 - b. Provide heavy weight hinges .180" thick on doors over 36" wide.
 - 4. Hinge base material:
 - a. Exterior butt hinges: Non-ferrous with non-ferrous pin.
 - b. Interior doors: Steel with steel pin.
 - 5. Hinge Options:
 - a. All hinges to be ball bearing (except unit hollow core door hinges which are plain bearing).
 - b. Provide non-removable pins (NRP) at all outswinging exterior doors.
 - 6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. McKinney.
 - c. Stanley.
 - d. Bommer
 - e. Cal-Royal

2.4 MECHANICAL LOCKS AND LATCHES

- A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 - 2. Extra-Long-Lip Strikes: For locks used on aluminum frames and frames with applied wood casing trim.
 - 3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
 - 4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.
- B. Cylindrical Locks: BHMA A156.2; Series 4000, Grade 1 at common areas. Provide Grade 2 at unit interior doors. Provide mortise locks, BHMA A156.13, Series 1000, Grade 1 at toilet rooms where indicated in hardware sets.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best 9K Series at common areas. Best 45H series at toilet rooms in common areas. Dorma J300 series at unit entry doors. Dorma T900 series at unit interior.
 - b. Approved equal by Schlage.
 - c. No substitutions will be permitted without architect's written approval prior to bidding.

2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision (Apex 2000 Series).
 - b. No substitutions will be permitted without architect's written approval prior to bidding.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Cylinders shall be small format interchangeable core type cylinders.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Best.

- b. No substitutions will be permitted without architect's written approval prior to bidding.

2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.

- 1. Master Key System: Key all cylinders to the existing master key system. Verify keying requirements with Owner.

B. KEYS: NICKEL SILVER

- 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: "DO NOT DUPLICATE."
 - 2. Quantity: In addition to one extra key blank for each lock, provide the following:
 - a. Cylinder Change Keys: Three.
 - b. Master Keys: Five.
 - c. Grand Master Keys: Five.
 - d. Control Keys: Two.
 - e. Privacy Lock Emergency Keys: Five.

2.8 KEY CONTROL SYSTEM

- A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. [Lund Equipment Co., Inc.](#)
 - 2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

2.9 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sargent – 281 Series, Best, Dormakoba, Stanley.
 - b. No substitutions will be permitted without architect's written approval prior to bidding.

2.10 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16; stainless steel base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Ives.
 - c. Rockwood.
 - d. Baldwin
 - e. No substitutions will be permitted without architect's written approval prior to bidding.

2.11 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABH (Architectural Builders Hardware).
 - b. Glynn-Johnson.
 - c. Rixson.
 - d. Rockwood.
 - e. No substitutions will be permitted without architect's written approval prior to bidding.

2.12 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. National Guard Products.
 - c. Pemko.

- d. No substitutions will be permitted without architect's written approval prior to bidding.

2.13 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. National Guard Products.
 - c. Pemko.
 - d. No substitutions will be permitted without architect's written approval prior to bidding.

2.14 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from ~~0.050-inch-~~ (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

- 1. Kick Plates: 10 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs
- 2. Mop: 4 inches high by 1 inch less width of door on single doors and pairs
- 3. Armor Plates: 36 inches high by 2 inches less width of door on single doors, 1 inch less width of door on pairs.
- 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Rockwood Manufacturing Company.
 - c. Trimco
 - d. No substitutions will be permitted without architect's written approval prior to bidding.

2.15 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. HES.
 - b. Von Duprin

- c. No alternate manufacturers will be accepted without architect's approval prior to bidding.

2.16 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. Ives.
 - c. Rockwood.
 - d. No substitutions will be permitted without architect's written approval prior to bidding.

2.17 FABRICATION

- ### **A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.**
1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.18 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

3.2 INSTALLATION

- A. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

3.30 DOOR HARDWARE SCHEDULE

APARTMENTS

HARDWARE SET NO. 01 UNIT ENTRY DOOR

QTY		HARDWARE	DESCRIPTION	FINISH
1	EA	HINGE	4.5 X 4.5 HD	652
2	EA	SPRING HINGE		652
1	EA	ENTRY LOCKSET	INTERCONNECTED	626
1	EA	WALL STOP		GRY/652
1	SET	SMOKE SEALS		GRY
1	EA	KNOCKER/VIEWER		626
1	EA	VIEWER	ADA HEIGHT	626

FUNCTION: SIMULTANEOUS RETRACTION OF LATCHBOLT AND DEADBOLT FROM INSIDE WITH 1" THROW TO DEADBOLT AND KEY OPERATION FROM OUTSIDE

HARDWARE SET NO. 02 UNIT BEDROOM & BATHROOM

QTY		HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	3.5 X 3.5	652
1	EA	PRIVACY LATCHSET		626
1	EA	WALL STOP		GRY/652

HARDWARE SET NO. 03 UNIT CLOSET – SINGLE DOOR

QTY		HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	3.5 X 3.5	652
1	EA	PASSAGE LATCHSET		626
1	EA	WALL STOP		GRY/652

HARDWARE SET NO. 04 UNIT CLOSET – DOUBLE DOOR

QTY		HARDWARE	DESCRIPTION	FINISH
6	EA	HINGE	3.5 X 3.5	652
2	EA	DUMMY TRIM	LEVER/WASHER & LOCKNUT	626
2	EA	BALL LATCHES	TOP MOUNT	
2	EA	WALL STOP		GRY/652

HARDWARE SET NO. 06 SLIDING PATIO DOOR HARDWARE BY DOOR MANUFACTURER

HARDWARE SET NO. 06 PREHUNG BALCONY INSULATED DOOR HARDWARE BY DOOR MANUFACTURER FIXED UNEVEN SECOND LEAF WHERE SCHEDULED

QTY		HARDWARE	DESCRIPTION	FINISH
3	EA	HINGES	3.5 X 3.5	652
1	EA	PRIVACY LATCHSET	LEVER HANDLE	626
1	EA	DEADBOLT	BLANK @ EXTERIOR	626
1	EA	THRESHOLD	ADA SADDLE TYPE	ALUM
1	EA	WEATHERSTRIPPING		GRY

COMMON AREAS

HARDWARE SET NO. 11		EXTERIOR EXIT DOOR		
QTY		HARDWARE	DESCRIPTION	FINISH
3	EA	HINGES		652
1	EA	EXIT DEVICE	LEVER HANDLE TRIM @ EXT	626
1	EA	CYLINDER LOCK		626
1	EA	SURFACE CLOSER		689
1	EA	WALL OR OH STOP		GRY/652
1	EA	ADA THRESHOLD		ALUM
1	EA	WEATHERSTRIPPING		GRY
2	EA	KICK PLATE		

HARDWARE SET NO. 12		EXTERIOR EXIT DOOR W/ ACCESS CONTROL		
QTY		HARDWARE	DESCRIPTION	FINISH
3	EA	HINGES		652
1	EA	EXIT DEVICE	LEVER HANDLE TRIM	626
1	EA	SURFACE CLOSER		689
1	EA	WALL OR OH STOP		GRY/652
1	EA	ADA THRESHOLD		ALUM
1	EA	WEATHERSTRIPPING		GRY
2	EA	KICK PLATE		
1	EA	ELECTRIC STRIKE		630
1	EA	POSITION SWITCH		GRY
1	EA	CARD READER	BY OWNER'S LOW VOLTAGE CONTRACTOR	

FUNCTION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ ON SECURED SIDE UNLOCKS ELECTRIC LOCK TO ALLOW ENTRY. FREE EGRESS IS ALWAYS ALLOWED

HARDWARE SET NO. 13		OFFICE/ MAINTENANCE - RATED		
QTY		HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	4.5 X 4.5 HD	652
1	EA	MECH LATCHSET	CLASSROOM FUNCTION	626
1	EA	SURFACE CLOSER		689

DOOR HARDWARE

087100 - 10

1	EA	WALL STOP	GRY/652
1	SET	SMOKE SEALS	GRY
2	EA	KICK PLATE	630

HARDWARE SET NO. 14

OFFICE/ IT DOOR W/ ACCESS CONTROL - RATED

QTY	HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	4.5 X 4.5 HD
1	EA	MECH LATCHSET	CLASSROOM FUNCTION
1	EA	SURFACE CLOSER	
1	EA	WALL STOP	
1	SET	SMOKE SEALS	
2	EA	KICK PLATE	
1	EA	ELECTRIC STRIKE	
1	EA	POSITION SWITCH	
1	EA	CARD READER	
BY OWNER'S LOW VOLTAGE CONTRACTOR			

FUNCTION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ ON SECURED SIDE UNLOCKS ELECTRIC LOCK TO ALLOW ENTRY. FREE EGRESS IS ALWAYS ALLOWED

HARDWARE SET NO. 15

OFFICE INTERIOR DOOR

QTY	HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	4.5 X 4.5
1	EA	MECH LATCHSET	OFFICE FUNCTION
1	EA	WALL STOP	

HARDWARE SET NO. 16

STORAGE/ UTILITY

QTY	HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	4.5 X 4.5
1	EA	MECH LATCHSET	STOREROOM FUNCTION
1	EA	SURFACE CLOSER	
1	EA	WALL STOP	
1	EA	SMOKE SEALS	
2	EA	KICK PLATE	

HARDWARE SET NO. 17

OFFICE/ IT W/ ACCESS CONTROL- NOT RATED

QTY	HARDWARE	DESCRIPTION	FINISH
3	EA	HINGE	4.5 X 4.5 HD
1	EA	MECH LATCHSET	CLASSROOM FUNCTION
1	EA	WALL STOP	
2	EA	KICK PLATE	
1	EA	ELECTRIC STRIKE	
1	EA	POSITION SWITCH	

1 EA CARD READER BY OWNER'S LOW VOLTAGE CONTRACTOR

FUNCTION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ ON
SECURED SIDE UNLOCKS ELECTRIC LOCK TO ALLOW ENTRY. FREE EGRESS IS ALWAYS
ALLOWED

HARDWARE SET NO. 18

SINGLE-OCCUPANCY TOILET ROOM

QTY	HARDWARE	DESCRIPTION	FINISH
3 EA	HINGE	4.5 X 4.5	652
1 EA	MECH LATCHSET	PRIVACY W/ INDICATOR	626
1 EA	SURFACE CLOSER		689
1 EA	WALL STOP		GRY/652
1 SET	SMOKE SEALS		GRY
2 EA	KICK PLATE		630

HARDWARE SET NO. 19

COMMUNITY ROOM DOOR

QTY	HARDWARE	DESCRIPTION	FINISH
3 EA	HINGE	4.5 X 4.5 HD	652
1 EA	MECH LATCHSET	CLASSROOM FUNCTION	626
1 EA	SURFACE CLOSER		689
1 EA	WALL STOP		GRY/652
1 SET	SMOKE SEALS		GRY
2 EA	KICK PLATE		630

HARDWARE SET NO. 20

KITCHEN SINGLE DOOR

QTY	HARDWARE	DESCRIPTION	FINISH
1 EA	CONTINUOUS HINGE		652
1 EA	MECH LATCHSET	CLASSROOM FUNCTION	626
1 EA	SURFACE CLOSER		689
1 EA	WALL STOP		GRY/652
1 SET	SMOKE SEALS		GRY
2 EA	ARMOR PLATE		630
1 EA	ELECTRIC STRIKE		630
1 EA	POSITION SWITCH		GRY
1 EA	CARD READER	BY OWNER'S LOW VOLTAGE CONTRACTOR	

FUNCTION: DOOR NORMALLY LOCKED AND CLOSED. VALID CARD READ ON
SECURED SIDE UNLOCKS ELECTRIC LOCK TO ALLOW ENTRY. FREE EGRESS IS ALWAYS
ALLOWED

HARDWARE SET NO. 21

QTY		HARDWARE
3	EA	HINGE
1	EA	MECH LATCHSET
1	EA	SURFACE CLOSER
1	EA	WALL STOP
1	SET	SMOKE SEALS
2	EA	KICK PLATE

RESIDENT LAUNDRY ROOM DOOR

DESCRIPTION	FINISH
4.5 X 4.5 HD	652
CLASSROOM FUNCTION	626
	689
	GRY/652
	GRY
	G630

HARDWARE SET NO. 22

QTY		HARDWARE
3	EA	HINGE
1	EA	MECH LATCHSET
1	EA	SURFACE CLOSER
1	EA	WALL STOP
1	SET	SMOKE SEALS
2	EA	ARMOR PLATE

STAFF LAUNDRY ROOM DOOR

DESCRIPTION	FINISH
4.5 X 4.5 HD	652
CLASSROOM FUNCTION	626
	689
	GRY/652
	GRY
	G630

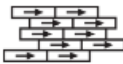
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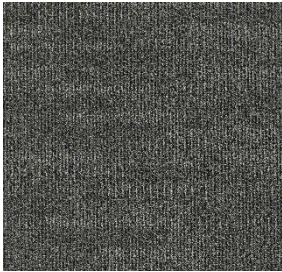
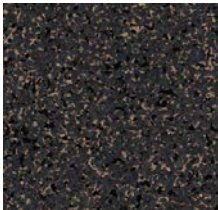
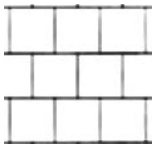
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Finish Specification-Common Areas

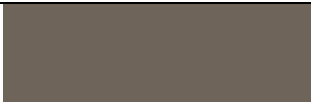
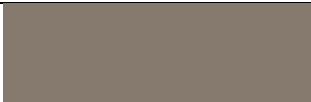
FLOOR FINISHES –REFER TO FINISH PLANS

Item	Code	Description	Location	Manufacturer
Flooring				
1.	CPT-1	Carpet – Modular	 601 Office/ IT 601A Computer Lounge 600B Group Fitness/ Multipurpose	Manufacturer: Philadelphia Commercial Style Name: Enlighten 54757 Color: Embrace Wisdom 00510 Product Type: Modular Construction: MultiLevel Patterned Loop Fiber Type: 100% Eco Solution Q Gauge: 1/12 Stitches per Inch: 12 Tufted Yarn Weight: 23 oz/sq yd Tufted Pile Height: .276 Dye Method: Solution Dyed Backing: Synthetic Product Size: 24” x 24” Installation: Ashlar  Local Rep: Ray Nolff 586.256.1529
2.	LVT-1	Luxury Vinyl Tile- Main	 600 Corridor (Partial) 600C Corridor 600D Corridor (Partial) <i>Refer to Flooring Finish Plan for locations and direction changes</i>	Manufacturer: Shaw Contract Collection: Cultura Style: In Unison 2.5 Style Number: 4430V Color: Summit 91760 Wear layer Thickness: 20 mil (0.51 mm) Total Thickness: 0.098” (2.5 mm)) Finish: Exoguard+ Size: 9” x 36” Installation: Direct Glue Adhesive Options: S150-95 Resilient Tile Spray, 4200 Resilient Tile 4 Gallon, 2200 Resilient Tile 4 Gallon, 4151 Multi-Use Premium 4 Gallon Installation Method: Stagger  Local Rep: Drew Pennington 248.310.9031
3.	LVT-2	Luxury Vinyl Tile- Accent	 600 Corridor (Partial) 600D Corridor (Partial) 607 Resident Laundry <i>Refer to Flooring Finish Plan for locations</i>	Manufacturer: Shaw Contract Collection: Cultura Style: Crossing Paths 2.5 Style Number: 4431V Color: Summit 91760 Wear layer Thickness: 20 mil (0.51 mm) Total Thickness: 0.098” (2.5 mm)) Finish: Exoguard+ Size: 18” x 18” Installation: Direct Glue Adhesive Options: S150-95 Resilient Tile Spray, 4200 Resilient Tile 4 Gallon, 2200 Resilient Tile 4 Gallon, 4151 Multi-Use Premium 4 Gallon Installation Method: Monolithic 

Item	Code	Description	Location	Manufacturer
Flooring Continued				
4.	VCT-1	Vinyl Composition Tile	 602 Main Laundry Expansion 603 Trash 604 Gas Heating 605 Main Laundry 606 Gas Heating 610 Janitor 611 Elect/ IT	Manufacturer: Tarkett Style: Tarkett VCT II Color: Mushroom 593 Size: 12" x 12" Total Thickness: .125" Installation Method: Glue-down Local Rep: Jennifer Conway 248.639.8161
5.	WO-1	Walk Off Carpet Tile	 600 Corridor (Partial) 600D Corridor (Partial) <i>Refer to Flooring Finish Plan for locations</i>	Manufacturer: Shaw Contract Collection: All Access Style: Path Tile 5T034 Color: Sterling 34557 Product Type: Carpet Tile Construction: Multi-Level Pattern Loop Secondary Backing: Ecoworx Tile Fiber: Eco Solution Q Nylon Tufted Weight: 28 oz/yd2 Product Size: 24" x 24" Installation Method: Ashlar  Local Rep: Drew Pennington 248.310.9031
6.	RS-1	Resilient Tile – Rubber	 600A Fitness	Manufacturer: Dinoflex Collection: Nature's Collection Color: Ashes COR3B Size: 38"x 38" Total Thickness: 5mm (3/16") Installation: Glue-down Installation Method: Brick  Local Rep: Jim Hagood 734-260-2177

Item	Code	Description	Location	Manufacturer
Flooring Continued				
7.	PCT-1	Porcelain Ceramic Tile and Cove Base	 608 Men's Toilet 609 Women's Toilet	Manufacturer: Virginia Tile-Caesar Tile Style: Stoneways Color: Flight Product Size: 12" x 24" Coefficient of Friction: Less than .42 Installation Pattern: Offset 33% Grout Joint Size: 1/8" Grout: TEC Power Grout® Color: 903 Birch Note: Built-in sealant, no sealant required Base: Coordinating 6"x 12" Cove Base Local Rep: Kathleen Black (248) 476.7850

WALL FINISHES – Refer to Wall Finish Plans for Accent Paint Locations

Item	Code	Description	Location	Manufacturer
Walls				
8.	PT-1	Main Paint		Sherwin Williams Color: Accessible Beige SW 7036 Locator Number: 249-C1 Finish: Eggshell
9.	PT-2	Accent Paint		Sherwin Williams Color Name: Storm Cloud SW 6249 Locator Number: 225-C5 Finish: Eggshell @ Walls Flat @ Ceiling Soffits
10.	PT-3	Accent Paint		Sherwin Williams Color Name: Jasper Stone SW 9133 Locator Number: 218-C4 Finish: Eggshell
11.	PT-4	Accent Paint		Sherwin Williams Color Name: Caramelized SW 9186 Locator Number: 291-C4 Finish: Eggshell
12.	PT-5	Ceiling Paint	Gypsum Board Ceilings in Common Areas, Unless Accent is indicated	Sherwin Williams Color: Pure White SW 7005 Locator Number: 255-C1 Finish: Flat
13.	PT-6	Common Area Door/ Resident Door Paint		Sherwin Williams Color Name: Griffin SW 7026 Locator Number: 241-C6 Finish: Semi-Gloss
14.	PT-7	Wood Trim/ Lean Rail/ Door Frame/ Unit Wall Niche Paint		Sherwin Williams Color Name: Backdrop SW 7025 Locator Number: 241-C5 Finish: Semi-Gloss

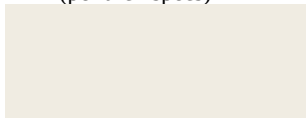
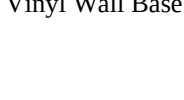
MISCELLANEOUS FINISHES

Item	Code	Description	Location	Specification
Miscellaneous				
15.	PL-1	Plastic Laminate	 Common Area Cabinetry and Casework	Manufacturer: Wilsonart Color: Sap Walnut Number: 8221-38 Note: Grain to run vertical on all vertical surfaces U.N.O.
16.	PL-2	Plastic Laminate	 Common Area Countertops	Manufacturer: Formica Color: Elemental Stone Number: 8831-58
17.	WB-1	Vinyl Base	 At all locations of new CPT or LVT flooring	MRF: Johnsonite/ Tarkett Profile: Millwork Reveal 4-1/2" Color: Welsh Castle TA8 Local Rep: Paul Brown 810.908.4344
18.	WB-2	Vinyl Base	 At all locations of new VCT flooring	MRF: Johnsonite/ Tarkett Profile: Standard 4" Cove Color: Welsh Castle TA8 Local Rep: Paul Brown 810.908.4344
19.	T-1	Transition	In Corridor 600 and Corridor 600D Between: LVT-1 and WO-1, LVT-1 and CPT-1, LVT-1 and RS-1 <i>Refer to Flooring Finish Plan for Locations</i>	Shaw Contract Micro Transition 5.5mm Style: Finish 0.22 in Number: 269VS Colorway: 00595 Onyx

General Notes:

- Multiple painted accent walls throughout. All walls not noted, to be painted PT-1. Refer to Wall Finish Plans for Accent locations.
- LVT-1 to be turned 90 degrees at Unit Entries. Refer to Floor Finish Plans for Layouts and Directions.

Finish Specification – Units

No.	Code	Description	Specification
Finishes			
1.	CPT-1U	Broadloom Carpet (Bedrooms Only) 	Shaw Floors – Philadelphia Style: Avenue Style Number: 54989 Color Number: Cleveland 00710 Product Type: Broadloom Construction: Level Loop Fiber Type: 100% PET Polyester Face Weight: 25 oz/ sq yd Product Size: 12 foot wide Local Rep: Ray Nolff 586.256.1529
2.	LVT-1U	Luxury Vinyl Tile- Typical Except in Bedrooms 	Shaw Contract Style: Reside 12mil Style Number: 4094V Color: Dwelling 94250 Wear layer: 12 mil Overall Thickness: 2.5mm Size: 6" x 47" plank Installation: Direct Glue Installation Method: Stagger Local Rep: Drew Pennington 248.310.9031
3.	PT-1U	Main paint 	Sherwin Williams Color: Gossamer Veil SW 9165 Locator Number: 238-C1 Finish: Eggshell
4.	PT-2U	Trim (per arch specs) 	Sherwin Williams Color: Greek Villa SW 7551 Locator Number: 254-C1 Finish: Semi-gloss
5.	PT-3U	Ceiling 	Sherwin Williams Color Name: Ceiling White Finish: Flat
6.	CAB-1U	Wood Cabinetry 	Smart Cabinetry Species: Maple Color: Stain color Slate Door Style: Brighton: Shaker Door with Flat panel drawers Type: Standard overlay
7.	PL-1U	Plastic Laminate Countertops 	Manufacturer: Wilsonart Color: Handspun Chestnut Number: 5036-38
8.	WB-1U	Vinyl Wall Base 	MRF: Johnsonite/ Tarkett Profile: Standard 4" Cove Color: 80 Fawn Local Rep: Paul Brown 810.908.4344

SECTION 092900 – GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of drywall is shown on the drawings.
- B. Acceptable Manufacturers - Drywall, accessories, and all related products as necessary to complete the work shall be as manufactured by, Domtar, Gold Bond, U.S. Gypsum, or Celotex.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fire-rated Drywall - Board shall be 5/8" thick with long edges tapered and shall bear Underwriter's Laboratories design number for type of use. Use type "X" drywall on walls and type "C" drywall on ceilings. Refer to drawings for assemblies requiring 1" core board.
- B. Non-fire Rated Drywall – Board shall be 1/2" thick with long edges tapered, of manufacturer's standard size.
- C. Moisture-resistant Drywall – Board shall be 5/8", thick regular or fire-rated as called for on the drawings. Use in areas at showers and bath tubs.
- D. Tile Backer Board – Board shall be 1/2" thick cement based, polymer coated and glass fiber reinforced. Use behind ceramic tile in bath and shower areas. Manufacturers: U.S. Gypsum Co. "Durock"; Modulars, Inc. "Wonder Board."
- E. Resilient furring channels – in locations shown on the drawings shall be Dietrich Metal Framing RC Deluxe, 2-1/2" wide by 1/2" deep galvanized steel channels in lengths as necessary.
- F. Drywall Joint Materials - Joint tape shall be perforated type. Joint compound shall be a pre-mixed vinyl type.

- G. Fasteners - Manufacturer's recommended drywall type screws and nails in lengths necessary for proper securement to studs.
- H. Adhesives – ASTM C557 Drywall and panel adhesives shall have a maximum VOC content of 50 grams per liter, less water and less exempt compounds.
- I. Accessories - Corner beads as required for each protruding corner shall be 1" x 1-1/4" galvanized steel and shall be used on all external corners.
- J. Fire-Rated, Flush Access Doors with Concealed Flanges – Typical Fire rated Access Door
 - 1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release.
 - 2. Locations: Wall and ceiling.
 - 3. Fire-Resistance Rating: 1 hour.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. For non-fire rated partitions, attach drywall to studs at 12" o.c. throughout. For fire rated partitions attach drywall to studs at 8" o.c. in the field and 8" o.c. along the vertical abutting edges. Vertical joints on opposite sides of the partitions to be staggered. Where abutments are made between studs, free ends are to be back-blocked. No two such joints shall occur between the same two studs. Conform to ANSI A97.1. Application for fire rated partitions to be as per Underwriters Laboratories for fire resistance required.
- B. Preparation of Drywall Surfaces
 - 1. All inside corners shall be coated with at least one coat of joint compound with edges feathered.
 - 2. All nail and screw head dimples shall be filled flush with surface of wallboard.
 - 3. All corner beads shall be concealed by two coats of joint compound. Feather out approximately 8" on both sides of exposed metal nose.
 - 4. All wallboard and treated areas shall be sanded smooth. Do not roughen wallboard.
 - 5. Finish drywall - A uniformly trim layer of joint compound shall be applied over joints and embedded in compound. Outside and inside wall angles shall be reinforced with the tape folded to conform to the angle. Drywall finish shall be done in the best workmanlike manner in preparation for finish painting and wall covering.
 - 6. After the first and second applications of joint compound are thoroughly dry, apply third coat, spread approximately 3" on each side of tape and feather out onto panel faces and sand smooth.
 - 7. Drywall installation and finishing procedures shall conform to the requirements of the "Gypsum Construction Handbook", latest edition.

END OF SECTION 092900

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END OF SECTION 092900

SECTION 093000 – TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of clay tile is shown on the drawings.
- B. Items included but not limited to the following:
 - Porcelain tile
 - Adhesives and grout

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Porcelain Tile and Base- Porcelain tile shall be nominal 12" x 24" x 5/16" by American Olean (Crossville, Dal Tile or other approved manufacturer). Installation shall be by thin set method over concrete slab-on-grade. Joints shall be 1/4" wide, grouted fully with colored grout. Style: Historic Limestone, Color: HS12 Lineage. The static coefficient of friction for porcelain tile surfaces shall be 0.6 or higher in accordance with ADA slip resistance requirements. Base at porcelain tile shall be 12" x 4" x 5/16" of same material and color as porcelain tile floor with finished edge (NO RAW EDGES) or Schluter "Schiene" edge trim.
- B. Adhesive - Material shall be an organic adhesive as furnished by ceramic tile manufacturer. Application shall be as per manufacturer's recommendation for the type of surface on which the tile is to be installed. Adhesives, adhesive bonding primers, adhesive primers, other primers shall have a VOC (Volatile Organic Compound) content not exceeding 65 grams per liter less water and less exempt compounds. Ceramic tile adhesives shall have a maximum VOC content of 65 grams per liter less water and less exempt compounds.

- C. Grout - Material shall be dry tile grout similar to Tile Mate Formula 763 as manufactured by Upco Chemical or approved equal. Application shall be as per manufacturer's recommendations. Color shall be as selected by the Architect from manufacturers standard colors.

PART 3 - EXECUTION

- A. Installation - Ceramic tile shall be installed according to recommendations of the "Tile Council of America, Inc." and the tile manufacturer for the surfaces to which it is to be applied and its final intended function.

END OF SECTION 093000

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Acoustical tiles for ceilings.

PART 2 - PRODUCTS

2.1 ACOUSTICAL TILES

- A. AT:
 - 1. Basis of Design: Armstrong Cirrus Item No. 556
 - a. 15/16" Angled Tegular tile: 24" x 24" x 3/4"
 - b. Suspension System: 15/16" Prelude

2.2 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements: Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
- D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

2.3 METAL SUSPENSION SYSTEM

- A. Basis of Design: Armstrong's 15/16" Prelude.
- B. Color: to be selected by Architect from Manufacturer's full range.

2.4 ACOUSTICAL SEALANT

- A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 1. Exposed and Concealed Joints: Non-sag, paintable, non-staining latex sealant.
 - 2. Concealed Joints: Nondrying, nonhardening, non-skinning, non-staining, gunnable, synthetic-rubber sealant.

2.5 MISCELLANEOUS MATERIALS

- A. Provide all miscellaneous materials and accessories required to provide a complete installation.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION & CLEANING

- A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.
- B. Clean exposed surfaces of acoustical tile ceilings, including trim and edge moldings. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095123

SECTION 096500 – RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of resilient flooring is shown on the drawings and finish schedule.
- B. Items included but not limited to the following:
 - 1. Resilient sheet flooring
 - 2. Luxury Vinyl tile
 - 3. Resilient stair treads and nosings
 - 4. Resilient base
 - 5. Adhesive

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Samples - Samples of materials to be used shall be submitted to the Architect for color and pattern selection immediately upon request thereof.
- B. Resilient Floor Tile (VCT) – Material shall be standard commercial grade vinyl tile which meets the requirements of Federal Specifications SS-T-312 Type IV. Tile shall be 1/8" thick, 12" x 12" size, as manufactured by Armstrong or Tarkett. See Interior Finish Specifications, Section 090000, for basis of design selection.
- C. Luxury Vinyl Tile (LVT)
 - 1. In Residential Units shall be equal to Shaw Contract commercial luxury vinyl tile. Style and color as indicated in Interior Finish Specification, Section 090000.
 - 2. In Public areas shall be equal to Shaw Contract commercial luxury vinyl tile. Style and color as indicated in Interior Finish Specifications, Section 090000.

- D. Resilient Base – All floor areas indicated on the finish schedule shall receive vinyl base. Base shall be 4" high vinyl cove. See Interior Finish Specification, Section 090000.
- E. Adhesive – Application material for vinyl tile and vinyl base shall be as per flooring manufacturer's recommendations for specific material, and the surface to which it is applied. Adhesive shall be an asphalt emulsion type similar to Amtic #350 or Armstrong Permiflor cement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of all materials as specified under this section shall be as per flooring manufacturer's recommendations.
- B. This subcontractor is responsible for whatever surface preparation is required prior to installation of flooring including vacuum cleaning, if required, to prepare surface in accordance with flooring manufacturer's recommendations.
- C. Apply one coat of manufacturer recommended sealer to fully cleaned vinyl composition tile floors prior to turning area over to owner.
- D. This subcontractor is responsible for disposing of all cartons, containers, scrap, etc. related to this work. All materials shall be disposed of off the jobsite.

END OF SECTION 096500

SECTION 096800 - CARPET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of carpeting is shown in the drawings and the finish schedule.
- B. Items included but not limited to the following:
 - Carpet
 - Adhesive
 - Installation accessories
- C. Certification – The Contractor shall furnish a written certification from the manufacturer that the carpet(s) furnished under this specification meets all the requirements contained herein. Carpet and Rug Institute's "Green Label" certified carpet shall be used.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Carpet selections shall be as indicated in Interior Finish Specifications, Section 09000. Where materials and installation methods differ from this specification, the specified product and manufacturer installation requirements shall govern.
- B. Carpet shall be solution dyed nylon with fire hazard classification of Class A or Class B per ASTM E-84. Pile weight per square yard shall be as specified above. Carpet shall have a synthetic secondary backing and shall meet requirements of FHA Bulletin UM 44D for Type II carpets (Class 2 for corridors and common areas, Class 1 for living units). Testing laboratory reports indicating compliance with UM-44D requirements shall be submitted for each proposed carpet at the time samples are submitted. Each carpet shall have a maximum emission factor measured in mg/m² as follows:

1.	Total volatile organic compounds	0.5	mg/m ² – hr
2.	.4-PC (4-Phenylcyclohexene)	0.05	mg/m ² – hr
3.	Formaldehyde (to prove none is used)	0.05	mg/m ² – hr

4. Styrene 0.4 mg/m² - hr
- C. Samples – The Contractor shall furnish to the Architect a complete set of samples indicating patterns and colors of material to be used for his use in selecting colors and patterns for the building.
- D. The carpet subcontractor shall submit a complete layout of each area to be carpeted, showing the pattern direction, location of seams and location of edge strips. Do not proceed with any installation until this layout plan has been reviewed by the General Contractor and the Architect.
- E. Unless otherwise called for by the drawings or finish schedule, all carpet colors and/or patterns will be selected by the Architect and approved by the Owner from the manufacturer's current standard colors and patterns. All materials shall be packaged, stored, and handled carefully so as to prevent damage.
- F. Carpet Edge Guard – Manufacturer's standard bend-down type or formed or extruded aluminum carpet edge guard stripping. Provide mill or natural aluminum finish.
- G. Carpet cushion shall satisfy any conditions imposed by H.U.D. UM-72 dated 2/6/80 for carpet in its location and shall be Carpet and Rug Institute (CRI) "Green Label" approved. Where applicable to its materials, carpet cushion shall also satisfy "Bonded Urethane Carpet Cushion" (Use of Materials Bulletin No. 47a dated July 8, 1971) as published by H.U.D. Carpet padding shall be 3/8" thick. Padding is not to be installed in building stairwells, public areas within the building and in physically handicapped living units. Provide tack strip, edge guards, receptor tracks and all other accessories for a complete installation, including manufacturer's recommended cement for direct glued carpets. Carpet cushion shall have a maximum emission factor as follows:
- | | | |
|----|----------------------------------|-----------------------------|
| 1. | Total volatile organic compounds | 1.00 mg/m ² – hr |
| 2. | BHT (butylated hydroxytoluene) | 0.30 mg/m ² – hr |
| 3. | Formaldehyde | 0.05 mg/m ² – hr |
| 4. | 4-PC (4-phenylcyclohexene) | 0.05 mg/m ² - hr |
- H. Tackless strips as manufactured by Roberts Co. or Roths Co.
- I. Carpet adhesive shall be Carpet and Rug Institute (CRI) "Green Label" approved as manufactured by Advanced Adhesive Technologies, All Purpose Adhesive Co., Mapei, Inc., W.W. Henry Co., Chicago Adhesives Products Co. Carpet adhesive shall have a maximum emission factor measured in mg/m² – hr as follows:
- | | | |
|----|----------------------------------|------------------------------|
| 1. | Total volatile organic compounds | 10.00 mg/m ² – hr |
| 2. | Formaldehyde | .05 mg/m ² – hr |
| 3. | 2-Ethyl-1-Hexanol | 3.00 mg/m ² - hr |

- J. Aluminum Receptor Track – Standard mill finish aluminum with vinyl snap down “T” piece installed at suite entry door at transition of unit and corridor carpet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install – Prior to installation of carpet and its accessories this contractor shall be responsible to clean all debris, oil stains, concrete accumulations and all other conditions from the subfloor which will affect the proper installation of the carpet and its accessories.
- B. Padding – Install padding over entire floor area to be carpeted. Padding is not to be installed below carpet in public areas and in physically handicapped (PH) units.
- C. Installation of carpet in non-padded areas shall be by direct cement method in accordance with manufacturer’s recommendations. Carpet installed over padding shall be secured with tackless strips.
- D. Cleaning – At completion of installation, remove dirt and debris from carpet, cut loose threads with sharp scissors, vacuum clean.

END OF SECTION 096800

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END OF SECTION 096800

SECTION 099000 PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of painting is shown on the drawings and the finish schedule.
- B. Items included but not limited to the following:
 - 1. Prime and finish painting of:
 - a. Drywall
 - b. Doors and frames
 - c. Grilles, louvers and miscellaneous metals
 - d. Millwork and trim
 - e. Ceilings
 - 2. Interior caulking:
 - a. Exposed joints in corridors and ceilings. Also, perimeters of rooms, corridors, exterior walls and party walls. Refer to Section 079200.
- C. Samples:
 - 1. Color charts of the manufacturer selected for the different types of finishes to be used shall be furnished to the Owner for his use in selecting colors to be used in the building.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Manufacturers - All paint, varnish, stains, fillers and reducers shall be standard brands as made by the following manufacturers: Sherwin Williams, Pittsburgh Paint, Benjamin Moore, O'Leary Paint Co.
- B. All materials shall be of high quality and have identifying labels on the cans. Material shall be applicable for the surface on which it is to be applied as indicated in the Paint Schedule herein.

- C. The VOC (Volatile Organic Compound) content of painting and finishing products used shall not exceed those as determined by the U.S. Environmental Protection Agency (EPA) Reference Test Method 24 (Determination of Volatile Matter Content, Water Content Density Volume Solids and Weight Solids of Surface Coatings), Code of Federal Regulations Title 40, Part 60, Appendix A. The calculation of VOC shall exclude water and tinting color added at the point of sale. Maximum VOC level for interior coatings, VOC weight in grams per liter of product minus water, for non-flat products shall not exceed 50 and for flat products shall not exceed 50. Maximum VOC level for exterior coatings, VOC weight in grams per liter shall not exceed 200 for non-flat products and for flat products shall not exceed 100. Gloss readings shall be as determined by ASTM D523-89, Standard Test Method for Specular Gloss.

Selection of colors shall be by the Architect.

- E. Interior caulking shall comply with ASTM specifications for interior latex caulks. Pecora Corp. (AC-20, Dynatrol), Tremco Acrylic latex. Use white stone or stone color.
- F. Wall and trim paints are to have washability and scrubbability characteristics as follows:
1. Washability – Soil is removed by Test Method 6141 of Federal Test Standard 141, without exposure of undercoat, more than 5% reduction of reflection, and without change of color as compared to the unwashed area.
 2. Scrubbability – Paint is not worn through when subjected to 400 strokes of ASTM test D-2486.
 3. Painting subcontractor shall submit manufacturer's printed information indicating conformance with the above listed standards to the Architect prior to the start of paint application.

PART 3 - PRODUCTS

3.1 MATERIALS

- A. Preparation - Painting shall not be done in damp or rainy weather, or until surfaces have adequately dried.
- B. Surfaces shall be cleaned of dust, dirt, loose or excess mortar or concrete and holes and cracks shall be properly filled.
- C. Applications - Methods of applying materials, types of materials and amount of materials shall be as per manufacturer's recommendations and specifications for the type of surface on which it is to be applied and the intended service the finish is to provide.

D. Finish Paint - Upon completion, all work shall be uniform, of approved color, smooth and free from runs, sags, defective brushing, clogging or excessive flooding. Edges of paint adjoining other colors or materials shall be sharp and clean without overlapping. Any defects or poor workmanship as described above as determined by the Architect shall be corrected by the Painting Contractor at no extra cost to the Owner.

E. Painting Schedule:

Products as indicated in the schedule below shall be as manufactured by O'Leary Paint. Comparable products as manufactured by other acceptable manufacturers will be considered upon submittal to the Architect for review and approval.

1. Areas Designated to Receive Semi-Gloss Finish
 - a. 1st coat –Drywall-ProPrime Hi-Hide Latex Wall Primer
 - 1) Metal-ProPrime Sunguard Metal Primer
 - 2) Wood-ProPrime Hi-Hide Latex Wall Primer
 - 3) Block- ProPrime Interior/Exterior Block
 - b. 2nd coat – Prohide Interior Zero VOC Latex Semi-Gloss
 - c. 3rd coat – Prohide interior Zero VOC Latex Semi-Gloss Enamel.
2. Drywall Designated to Receive Eggshell Finish
 - a. 1st coat- ProPrime Hi-Hide Latex Wall Primer
 - b. 2nd coat – ProHide Interior Zero VOC Latex Wall Paint.
 - c. 3rd coat – Prohide Interior Zero VOC Latex Flat Wall Paint.
3. Drywall Designated to receive Flat Finish
 - a. 1st coat- Proprime Hi-Hide Latex Wall Primer
 - b. 2nd coat-Prohide Interior Zero VOC Latex Flat Wall Paint.
 - c. 3rd coat-Prohide Interior Zero VOC Latex Flat Wall Paint.

NOTE: All bathrooms, kitchens, laundry rooms and toilet rooms and shall receive semi-gloss enamel finish.

4. Wood Door Trim - Painted
 - a. 1st coat-ProPrime Hi-Hide Latex Wall Primer
 - b. 2nd coat-ProHide Interior Zero VOC Latex Semi-Gloss
 - c. 3rd coat-ProHide Interior Zero VOC Latex Semi-Gloss
5. Metal – Interior not galvanized.

- a. 1st coat – ProPrime Sunguard Metal Primer
 - b. 2nd coat – Prohide Interior Latex Semi-Gloss
6. Exterior vents, stacks, etc. on roof, dryer vents, exposed exterior Piping:
- a. 1st coat-ProPrime Sunguard Metal primer
 - b. 2nd coat-Duramax Latex Satin
 - c. 3rd coat-Duramax Latex Satin
7. Exterior Wood Trim
- a. 1st coat-Sunguard Latex Satin
 - b. 2nd coat-Sunguard Latex Satin

F. **GENERAL:**

1. Access doors, electric breaker panels, registers, and grilles located in walls shall be painted same color as wall.
2. Before commencing work, remove hardware, accessories, plates and similar items that are not to be painted, or provide ample protection of such items. Re-install such items after completion of work in each space.
3. Wood doors, trim and floors to receive stain and varnish shall be sanded prior to staining, after staining and between varnish coats.
4. All duct work and studs visible through grilles or registers shall be painted black.
5. Exterior grilles, louvers, vent caps, vents through roof, etc. shall be painted to blend with adjacent surfaces.
6. Exposed piping shall generally be painted to match walls or ceilings adjacent to it.
7. Caulking and flashing, where visible shall be painted or pre-colored to match adjacent surface.
8. At completion of work, touch up and restore finish where damaged and leave in good condition. Paint top and bottom edges of wood doors one coat after fitting.

END OF SECTION 099000

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates (Also includes existing painted surfaces on similar substrates):
 - 1. Steel.
 - 2. Galvanized metal.
 - 3. Pavement Marking Paint.
 - 4. Concrete Masonry Units
 - 5. Brick Stain
- B. Related Requirements:
 - 1. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that adhesives comply with requirements.
- B. Environmental Certifications: Submit data sheets indicating compliance with low-emitting materials requirements for third party certification. Compliance with Zero VOC as determined by EPA Method 24, Green Seal GS-11 Standard for Paints and Coatings or CARB Suggested Control Measures for Architectural Coatings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction. Zero VOC per EPA Method 24.
- D. Colors: Match Architect's samples.

2.2 PRIMERS/SEALERS

- A. Primer, Bonding, Water Based: MPI #17.

2.3 METAL PRIMERS

- A. Primer, Galvanized: As recommended in writing by topcoat manufacturer.

2.4 WATER-BASED PAINTS

- A. Latex, Exterior Flat (Gloss Level 1): MPI #10.
- B. Latex, Exterior Semi-Gloss (Gloss Level 5): MPI #11.
- C. Latex, Exterior, Gloss (Gloss Level 6): MPI #119.

2.5 SOLVENT-BASED PAINTS

- A. Alkyd, Exterior Flat (Gloss Level 1): MPI #8.
- B. Alkyd, Exterior, Semi-Gloss (Gloss Level 5): MPI #94.
- C. Alkyd, Exterior Gloss (Gloss Level 6): MPI #9.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Prepare existing painted substrates as required for repainting.
- C. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Wood: 15 percent.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.

3.4 FIELD QUALITY CONTROL

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

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

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

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Alkyd System:

- a. Prime Coat: Primer, alkyd, anticorrosive for metal, MPI #79.
- b. Prime Coat: Shop primer specified in Section 051200 "Structural Steel Framing" where substrate is specified.
- c. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- d. Topcoat: Alkyd, exterior, semi-gloss (Gloss Level 5), MPI #94.

B. Brick Substrates:

- 1. Mineral Based vapor permeable stain: Products as manufactured by PermaTint Limited of Concord, ON Canada, or approved equal.
 - a. Masonry Strengthener: Mineral based solidifier that penetrates into absorbent masonry surfaces, hardens and strengthens previously unstable masonry surfaces. 1075 Masonry Strengthener.
 - b. Prime Coat: Clear primer, conditioner, and thinner for mineral based stains. 1050 PrimaSil.
 - c. Opaque Mineral Stain: 1010 QuartzGuard.
 - d. Water Repellant Topcoat: 1055 RainSil.

END OF SECTION 099113

SECTION 100000 – MISCELLANEOUS EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. The extent of the miscellaneous equipment is indicated on the drawings and described herein.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Identification Signage:
Provide formed plastic address number plaques with characters 4" high at each unit entry. Shape and colors of plaque shall be selected by the Architect.

Signs for identification of public rooms shall be of raised plastic. Letters shall be one inch high, with Helvetica Medium letters and shall be accompanied with Grade 2 Braille markings. Letters and numbers shall have a width-to-height ratio between 3:5 and 1:1 and a stroke width-to-height ratio between 1:5 and 1:10. Sign colors to be selected by the Architect. Signs shall be adhesively mounted on walls adjacent to the latch side of doors. Provide sample of sign for approval by the Architect. All signs shall be attached approximately 60 inches above floor level to the center of the sign.

- B. Fire Extinguishers and Cabinets: Where indicated on the drawings furnish J.L. Industries "Ambassador" series epoxy coated steel cabinets with full glass door, model #1017G with semi-recessed wall trim, door locks and break-glass tool. Fire extinguishers shall be J.L. Industries "Cosmic 10E", 10- pound ABC type.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Handling

Deliver products to the General Contractor on the jobsite.

Store products on the site to prevent damage from vandalism, theft, and weather.

Protection:

1. Provide protective material on each item during shipping and handling.
2. Remove protective material when directed or at completion of the job.
3. Repair or remove and replace, items damaged during shipment or construction.

B. Installation

Install products in strict accordance with the manufacturer's written directions.

Fasten product securely to the structure using expansion bolts, lead inserts, screws or other means as recommended or required for each product.

C. Finish

Clean and adjust each product for proper operation to the Owner's satisfaction.

Touch-up paint finishes as directed.

END OF SECTION 100000

SECTION 102800 – TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. Work Included

- 1. Furnish all labor, materials and equipment required, and furnish and install all toilet accessories, complete with all incidentals required, in accordance with the Drawings and these Specifications.

1.3 QUALITY ASSURANCE

- A. Codes and Standards

- 1. Perform all work in accordance with the Michigan Construction Code requirements for Barrier Free Design.

- B. Inserts and Anchorage

- 1. Furnish inserts and anchoring devices which must be set in gypsum wallboard framing for the installation of toilet accessories. Coordinate delivery with other work to avoid delay.

- C. Products

- 1. Provide products of the same manufacturer for each type of accessory unit and for units exposed in the same areas, unless otherwise acceptable to the Architect-Engineer.
 - 2. Stamped names or labels on exposed faces of units will not be permitted, except where otherwise indicated.
 - 3. Provide locks, where indicated, with the same keying for each type of accessory unit in the project wherever possible. Furnish two keys for each lock.

1.4 SUBMITTALS

A. Materials List

1. Submit to the Architect-Engineer a complete list of all materials, including manufacturers' names, to be furnished and installed under this portion of the Work.

B. Shop Drawings

1. Submit complete shop drawings to the Architect-Engineer for review.

C. Manufacturers Data

1. For information only, submit two (2) copies of manufacturer's technical data and installation instructions for each toilet accessory. Transmit copies of installation instructions to the installer.

D. Setting Drawings

1. Provide setting drawings, templates, instructions and directions for installation of anchorage devices in other work.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. For simplicity, the products of a single manufacturer are specified as the basis of design, to establish design and performance standards. Manufacturers offering products to comply with the requirements for toilet accessories include the following:
1. Basco
 2. McKinney Parker Company
 3. Bradley Corp.
 4. Bobrick
 5. Cweco
 6. American Specialties

2.2 MATERIALS

- A. Stainless Steel: AISI, type 302/304, with satin finish, unless otherwise indicated.
- B. Galvanized Steel Mounting Devices, ASTM A386, hot-dip galvanized after fabrication.

2.3 ACCESSORIES: Residence Unit Bath Accessories - The following accessories shall be provided in areas indicated on the drawings.

- A. Recessed Medicine Cabinet – Zenith 1424. Beveled edge mirror, plastic tub with 2 adjustable shelves.
- B. Mirror - 1/4" polished glass or mirror glazing quality, silvered for natural reflection and copper backed with edges clean cut and polished.
- C. Toilet Paper Holder – Basco 711, chrome plated, white roller.
- D. Shower Rod – Basco 1200B, stainless steel, length as required, 1" diameter concealed screw installation.
- E. Towel Bar – Basco 7918/ 7924/ 7930 square stainless steel towel bar.
- F. Robe Hook – Basco 719, single hook, chrome plated.
- G. Wall-Mount Grab Bars – Bradley 800 Series, 1-1/2" outside diameter 18-gauge type 304 stainless steel. All grab bars shall be mounted to withstand a 300-pound hanging load.
- H. Fold-Down Grab Bars – American Specialties, Inc. Model 3420-P. 1 1/4" dia. Swing-up Grab Bar with Support Leg – Peened.
- I. Fold-Down Shower Seat – Bobrick B-5191. Solid phenolic folding shower seat. Load rated to support 500 lbs. Wall-mounted retainer hook to hold seat up when in storage position.

2.3 ACCESSORIES: Public Toilet Rooms, and Janitor Closets - The following accessories shall be provided in areas indicated on the drawings.

- A. Mirror - 1/4" polished glass or mirror glazing quality, silvered for natural reflection and copper backed with edges clean cut and polished.
- B. Toilet Paper Holder – ASI Model 7305-4. Surface mounted, dual roll, stainless steel with satin finish.
- C. Robe Hook – ASI Model 7308. Surface mounted, stainless steel with satin finish.
- D. Grab Bars – ASI Model 3800. 1-1/2" outside diameter 18-gauge type 304 stainless steel. All grab bars shall be mounted to withstand a 300-pound hanging load.
- E. Surface Mounted Sanitary Napkin Disposal – Provide surface- mounted napkin disposal in all single-occupancy unisex and female Toilet Rooms. ASI Model B-254. Stainless steel with satin finish.
- F. Surface Mounted Soap Dispenser – ASI Model 0362. Surface mounted, stainless steel automatic liquid soap dispenser. 30 Ounce capacity, battery operated.
- G. Surface Mounted Towel Dispenser – ASI Model 0210. Surface mounted, stainless steel with satin finish. 525 Standard multi-fold towel capacity.
- H. Mop Holder - ASI #8215-4. Provide in each Janitor's Closet and at each mop sink, whether indicated on drawings or not.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine the areas and conditions under which toilet accessories are to be installed and notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 INSTALLER

- A. Provide anchors, bolts and other necessary anchorages and attached accessories security to walls and partitions in locations as shown or directed.
- B. Install concealed mounting devices and fasteners fabricated of the same material as the accessories or of galvanized steel, as recommended by manufacturer.
- C. Install exposed mounting devices and fasteners finished to match the accessories.
- D. Provide theft-resistant fasteners for all accessory mountings.
- A. Secure toilet room accessories in accordance with the manufacturer's instructions for each item and each type of substrate construction.
- B. Mount all toilet accessories in Toilet Rooms with physically handicapped facilities at heights conforming to the latest published requirements of ICC/ANSI A.117.01-2009 and Fair Housing 1998 and the requirements of the Michigan Building Code 2012.

END OF SECTION 102800

SECTION 105301 – HANGER ROD SUPPORTED CANOPY

PART 1 – GENERAL

1.1 DESCRIPTION OF WORK

1. Work in this section includes furnishing and installation of roll-formed aluminum overhead hanger rod style canopies as manufactured by Mapes Industries Inc.
2. Related Items and Considerations:
 - a. Flashing of various designs may be required. Generic flashing supplied by Mapes. Specialty flashing to be supplied by installer.
 - b. Determine wall construction, make-up and thickness.
 - c. Ensure adequate wall condition to carry canopy loads where required.
 - d. Consider water drainage away from canopy where necessary.
 - e. Any necessary removal or relocation of existing structures, obstructions or materials.

1.2 QUALITY ASSURANCE

1. Products meeting these specifications established standard of quality required as manufactured by Mapes Industries, Inc. Lincoln, Nebraska 1-888-273-1132.

1.3 FIELD MEASUREMENT

1. Confirm dimensions prior to preparation of shop drawings when possible.
2. If requested, supply manufacturer's standard literature and specifications for canopies.
3. Submit shop drawings showing structural component locations/positions, material dimensions and details of construction and assembly.

1.4 PERFORMANCE REQUIREMENTS

1. Canopy must conform to local building codes.
2. PE Stamped calculations are required and must be signed and sealed by an engineer licensed within the state canopy is installed.

1.5 DELIVER, STORAGE, HANDLING

1. Deliver and store all canopy components in protected areas.

PART 2 – PRODUCTS

2.1 MANUFACTURER

1. Mapes Canopies
Lincoln, Nebraska
Phone: 1-888-273-1132.
Fax: 1-877-455-6572.
2. Subject to compliance with performance, appearance, size, finish, and engineering requirements, submit substitutions in accordance with Section 012500 Substitution Procedures.

2.2 MATERIALS

1. Decking shall consist of an interlocking roll-form 2 1/2 W style pan (.040" aluminum).
2. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown in current Mapes brochures.
3. Hanger rods and attachment hardware shall be a standard finish.
4. Fascia shall be standard extruded 8" J style.

2.3 FINISHES

1. Finish type shall be 2-Coat Kynar Finish. Color as selected by Architect from manufacturer's full range of standard colors.

2.4 FABRICATION

1. All Mapes canopies are shipped in preassembled sections for ease of installation.
2. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.

3. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Downspout From Rear Gutter.

PART 3 – EXECUTION

3.1 INSPECTION

1. Confirm that surrounding area is ready for the canopy installation.
2. Installer shall confirm dimensions and elevations to be as shown on drawings provided by Mapes Industries.
3. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed

3.2 INSTALLATION

1. Installation shall be in strict accordance with manufacturer's shop drawings. Particular attention should be given to protecting the finish during handling and erection.

END OF SECTION 105301

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END OF SECTION 105301

SECTION 110000 – EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. Related work described in other Sections of the Specifications includes appliances, finish carpentry, garbage disposal units.
- B. Shop Drawings are required in accordance with the General Conditions. Do not commence fabrication of cabinets until reviewed shop drawings have been received from the Architect. Submit catalog cuts of appliances to be provided.

PART 2 - PRODUCTS

2.1 CABINETS AND COUNTERTOPS

- A. Kitchen and bathroom vanity cabinets shall be in traditional design as manufactured by Smart Cabinetry, Merillat Industries, Futura Cabinet Co. or Armstrong Cabinet Co. Kitchen and bathroom cabinets shall be equal to Smart "Brighton" cabinets, Shaker Door with Flat Panel Doors. Frames, ends and other exposed portions shall have low luster varnished finish. Colors to be selected by the Architect.
- B. Cabinet frames shall be of 13/16" select solid wood, with their joints doweled and glued. End panels shall be of 3-ply hardwood plywood. Doors and drawer fronts shall be solid wood. All doors and drawers shall have metal wire pull handles. Filler pieces, trim and scribe moldings, matching cabinet finishes shall be provided to close all gaps between cabinets and cabinets, between cabinets and walls and between cabinets and ceilings or soffits.
- C. Cabinet work shall meet the standards of NKCA and ANSI 161.1 and shall bear the seal of an independent inspection agency certifying compliance.
- D. Surfacing of countertops and vanity tops shall be plastic laminate surfacing in rolled edge or straight edge profile on core of particleboard conforming to U.S. Department of Commerce Commercial Standard CS-236-66 (type 2, grade B, Class 2) in 1-1/2" thickness, with 3/4" thick, 4" high backsplash. Provide side splashes at all walls adjacent to countertop. Exposed finishes shall be of "WilsonArt"4811-60 Titanium EV.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Confirm appliance sizes and required clearances.
- B. Install all cabinets and countertops in accordance with industry standards.
- C. Apply sealant at all joints between countertops and walls.

END OF SECTION 110000

SECTION 113000 – APPLIANCES

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 DESCRIPTION OF WORK

- A. Furnish all labor, materials and equipment required, and furnish and install all miscellaneous items, complete with all installation devices, fasteners, accessories and incidentals required in accordance with the Drawings and these Specifications.
- B. Related work described in other Sections of the Specifications includes finish carpentry, garbage disposal units.
- C. Appliances shall be Energy Star Rated as applicable.
- D. Products specified As Basis of Design.

1.3 SUBMITTALS

- A. Shop Drawings are required in accordance with the General Conditions. Do not commence fabrication of cabinets until reviewed shop drawings have been received from the Architect. Submit catalog cuts of appliances to be provided.

1.4 JOB CONDITIONS

- A. Measurements: The parties responsible for the fabrication or installation of a specified item shall take measurements at the site to ensure accurate installation, and shall exchange information with Trades installing adjacent work so that all work shall be coordinated.

PART 2 – PRODUCTS

2.1 REFRIGERATOR

- A. At Satellite Dining 612 – True Food Service Equipment commercial refrigerator – Model T-23-HC
 - 1. Stainless Steel finish
 - 2. NSF Approved
 - 3. Relocate existing refrigerator at this location to kitchenette at Fitness 600A.

- B. At all units – GE Appliances Energy Star 16.6 Cu Ft Top- Freezer Refrigerator – Model GTE17GTNRWW
 - 1. White finish
 - 2. Energy Star
 - 3. ADA and UFAS compliant

2.2 RANGES

- A. At all Units – Frigidaire 24” Freesanding Electric Range – Model FFEH2422UW
 - 1. White finish
 - 2. Front controls
 - 3. ADA compliant
- B. Provide each range with a FireAvert - Electric Stove Automatic Shut-off device, plugged into range receptacle.
- C. Confirm electrical requirements. Provide with all required cords.

2.5 RANGE HOODS

- A. At all units – Broan Buezo Series Under-Cabinet Hood– Model BUEZ024WW
 - 1. White Finish
 - 2. Recirculating
 - 3. At all PH units- Supply with toggle switch, mounted in Work Space skirt, to control Range Hood power.
- B. Provide each Range Hood with with 2- Stovetop Firestop canisters, secured to underside of Hood.
- C. Confirm electrical, plumbing, and venting requirements. Supply with all required cords, hoses, and metal vent.

PART 3 – EXECUTION

3.1 Install per manufacturers recommendations.

- A. Record serial numbers of appliances installed in each apartment. Turn over to Owner.
- B. Turn over all supplied Owner’s manuals and warranty information to Owner.

END OF SECTION 113000

SECTION 122100 – WINDOW BLINDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

- A. Furnish and install window blinds for all exterior windows and sliding glass doors. Provide all necessary tracks, hardware and related accessories.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Horizontal Blinds, 1" aluminum slat style by Bali Contract or similar product by Levelor or Graber. Provide with all required components, including but not limited to head channel, headrail, tilting control, drum and cradles, tilt rod and brace, braided ladders, factory prefinished aluminum slats, bottom rail, intermediate brackets and installation brackets. Cordless with Wand Tilt. Colors shall be as selected by the Architect from manufacturer's standard range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installer shall field measure all openings to receive window blinds. Installation shall be as per blind manufacturer's printed instructions. All brackets shall be screw mounted through finish wall materials into wood blocking provided by carpentry subcontractor.

END OF SECTION 122100

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END OF SECTION 122100

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SECTION 22 05 17 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 ACTION SUBMITTALS

- A. Product Data: Only for products used.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop unless otherwise indicated.
- B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- D. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
- E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Smith, Jay R. Mfg. Co.
 2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.
- B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. Metraflex Company (The).
 4. Pipeline Seal and Insulator, Inc.
 5. Proco Products, Inc.
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Stainless steel.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Presealed Systems.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 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 (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Using grout, seal the space around outside of stack-sleeve fittings.
- B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

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

3.4 SLEEVE-SEAL-FITTING INSTALLATION

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

3.5 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 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.
 2. Exterior Concrete Walls below Grade:

- a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
- a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
- a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves, PVC-pipe sleeves, Stack-sleeve fittings, Molded-PE or -PP sleeves, Molded-PVC sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves, PVC-pipe sleeves, Stack-sleeve fittings.
5. Interior Partitions:
- a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves, PVC-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 22 05 17

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SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 ACTION SUBMITTALS

- A. Product Data: Only for products used.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- B. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:

- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
 - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
 - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with exposed-rivet hinge.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 22 05 18

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Bronze angle valves.
- 2. Brass ball valves.
- 3. Bronze ball valves.
- 4. Bronze swing check valves.
- 5. Bronze gate valves.
- 6. Iron gate valves.
- 7. Bronze globe valves.
- 8. Iron globe valves.
- 9. Lubricated plug valves.

- B. Related Sections:

- 1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- 2. Section 221116 "Domestic Water Piping" for valves applicable only to this piping.

1.3 DEFINITIONS

- 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. RS: Rising stem.

1.4 ACTION SUBMITTALS

- A. Product Data: Only for products used.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 2. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 (DN 200) and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 (DN 150) and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug-valve head.
 - 5. 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.

- E. Valves in Insulated Piping: With 2-inch (50-mm) stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With 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: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE ANGLE VALVES

- A. Class 125, Bronze Angle Valves with Bronze Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Milwaukee Valve Company.
 - c. Apallo Valve.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- B. Class 125, Bronze Angle Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. NIBCO INC.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).

- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded.
- e. Stem: Bronze.
- f. Disc: PTFE or TFE.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron, bronze, or aluminum.

C. Class 150, Bronze Angle Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Stockham Division.
 - b. Kitz Corporation.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

D. Class 150, Bronze Angle Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 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. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
- 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig (2070 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 BRASS BALL VALVES

A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Kitz Corporation.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.

- i. Ball: Chrome-plated brass.
- j. Port: Full.

C. Two-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - d. Hammond Valve.
 - e. Jamesbury; a subsidiary of Metso Automation.
 - f. Kitz Corporation.
 - g. Marwin Valve; a division of Richards Industries.
 - h. Milwaukee Valve Company.
 - i. RuB Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

D. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hammond Valve.
 - b. Jamesbury; a subsidiary of Metso Automation.
 - c. Legend Valve.
 - d. Marwin Valve; a division of Richards Industries.
 - e. Milwaukee Valve Company.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.

- h. Stem: Brass.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

E. Two-Piece, Regular-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jamesbury; a subsidiary of Metso Automation.
 - b. Marwin Valve; a division of Richards Industries.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Brass or bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Regular.

F. Three-Piece, Full-Port, Brass Ball Valves with Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jomar International, LTD.
 - b. Kitz Corporation.
 - c. Red-White Valve Corporation.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Three piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.

G. Three-Piece, Full-Port, Brass Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Jomar International, LTD.
 - b. Kitz Corporation.
 - c. Marwin Valve; a division of Richards Industries.
 - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Three piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.4 BRONZE BALL VALVES

A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.

B. One-Piece, Reduced-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.

b. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. CWP Rating: 600 psig (4140 kPa).
- c. Body Design: One piece.
- d. Body Material: Bronze.
- e. Ends: Threaded.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel, vented.
- i. Port: Reduced.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Crane Valves.
- d. Hammond Valve.
- e. Lance Valves; a division of Advanced Thermal Systems, Inc.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Hammond Valve.

- d. Lance Valves; a division of Advanced Thermal Systems, Inc.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

E. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DynaQuip Controls.
- f. Hammond Valve.
- g. Lance Valves; a division of Advanced Thermal Systems, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

F. Two-Piece, Regular-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Regular.

G. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. DynaQuip Controls.
- c. Hammond Valve.
- d. Milwaukee Valve Company.
- e. NIBCO INC.
- f. Red-White Valve Corporation.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

H. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Hammond Valve.
- c. Milwaukee Valve Company.

d. NIBCO INC.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Three piece.
- e. Body Material: Bronze.
- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- 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. Powell Valves.
- j. Red-White Valve Corporation.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 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. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- 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. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Red-White Valve Corporation.
- i. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 3.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: Bronze.

D. Class 150, Bronze Swing Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Hammond Valve.
- d. Milwaukee Valve Company.

- e. NIBCO INC.
- f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 4.
- b. CWP Rating: 300 psig (2070 kPa).
- c. Body Design: Horizontal flow.
- d. Body Material: ASTM B 62, bronze.
- e. Ends: Threaded.
- f. Disc: PTFE or TFE.

2.6 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - 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. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-80, Type 1.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
- d. Ends: Threaded or solder joint.
- e. Stem: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.7 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

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

- 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. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 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. Flo Fab Inc.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Legend Valve.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Powell Valves.
- k. Red-White Valve Corporation.
- l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- m. Zy-Tech Global Industries, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.

- g. Packing and Gasket: Asbestos free.

2.8 LUBRICATED PLUG VALVES

A. Class 125, Regular-Gland, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

B. Class 125, Regular-Gland, Lubricated Plug Valves with Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Nordstrom Valves, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type II.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

C. Class 125, Cylindrical, Lubricated Plug Valves with Threaded Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).

- c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.
- D. Class 125, Cylindrical, Lubricated Plug Valves with Flanged Ends:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Homestead Valve; a division of Olson Technologies, Inc.
 - b. Milliken Valve Company.
 - c. R & M Energy Systems; a unit of Robbins & Myers, Inc.
 - 2. Description:
 - a. Standard: MSS SP-78, Type IV.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 48/A 48M or ASTM A 126, cast iron with lubrication-sealing system.
 - d. Pattern: Regular Venturi.
 - e. Plug: Cast iron or bronze with sealant groove.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.

- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for ball gatevalves NPS 4 (DN 100) and larger and more than 96 inches above floor. Extend chains to 60 inches (1520 mm) > above finished floor.
- F. Install check valves for proper direction of flow and as follows:
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Lift Check Valves: With stem upright and plumb.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, gate, or plugvalves.
 - 2. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze nonmetallic disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient seat check valves.
- B. 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.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) 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 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.
 - 7. For Grooved-End Copper Tubing and Steel Piping Valve ends may be grooved.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 125, bronze disc.
 3. Ball Valves: One or Two piece, full port, brass or bronze with stainless-steel trim.
 4. Bronze Swing Check Valves: Class 125, bronze disc.
 5. Bronze Gate Valves: Class 125, NRS or RS.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): May be provided with threaded ends instead of flanged ends.
 2. Iron Ball Valves: Class 150.
 3. Iron Swing Check Valves: Class 125, nonmetallic-to-metal seats.
 4. Iron Gate Valves: Class 125, OS&Y.
 5. Iron Globe Valves: Class 125.

END OF SECTION 22 05 23

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Pipe stands.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

- A. Product Data: Only for products used.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

- B. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with intumed lips.

5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: Hot-dipped galvanized.
8. Paint Coating: Alkyd.
9. Plastic Coating: PVC.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 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.
 - 2. 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.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- 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 lateral bracing with pipe hangers and supports to prevent swaying.
- L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 (DN 65) and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- N. 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.
- O. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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.

3.3 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.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.5 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 (0.05 mm).
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in [Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and [copper] [or] [stainless-steel] attachments for copper piping and tubing.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- J. 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- K. 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. C-Clamps (MSS Type 23): For structural shapes.
 6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 10. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 11. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 12. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 13. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. 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.
- M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Stencils.
 - 5. Valve tags.

1.3 ACTION SUBMITTALS

- A. Product Data: Only for products used.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
 - 2. Letter Color: White.
 - 3. Background Color: Black.
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).

6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.
 - 1. Stencil Material: Fiberboard or metal.
 - 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 - 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."
- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1,] on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. 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 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule:
 - 1. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 - 2. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.

3.4 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 similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

- a. Cold Water: 1-1/2 inches (38 mm), round.
- b. Hot Water: 1-1/2 inches (38 mm), round.

2. Valve-Tag Color:

- a. Cold Water: Natural.
- b. Hot Water: Natural.

3. Letter Color:

- a. Cold Water: Black.
- b. Hot Water: Black.

3.5 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

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SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Aboveground domestic water pipes, tubes, and fittings inside buildings.

1.3 ACTION SUBMITTALS

- A. Product Data: For transition fittings and dielectric fittings.

1.4 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L and ASTM B 88, Type M water tube, drawn temper.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

G. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkhart Products Corporation.
 - b. NIBCO Inc.
 - c. Viega.
2. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

H. Copper Push-on-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company.
2. Description:
 - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
 - b. Stainless-steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

I. Copper-Tube, Extruded-Tee Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
 - a. T-Drill Industries Inc.
2. Description: Tee formed in copper tube according to ASTM F 2014.

J. Appurtenances for Grooved-End Copper Tubing:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Anvil International.
 - b. Shurjoint Piping Products.

- c. Victaulic Company.
- 2. Bronze Fittings for Grooved-End, Copper Tubing: ASTM B 75 (ASTM B 75M) copper tube or ASTM B 584 bronze castings.
- 3. Mechanical Couplings for Grooved-End Copper Tubing:
 - a. Copper-tube dimensions and design similar to AWWA C606.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating: 300 psig (2070 kPa).

2.3 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe:

- 1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
- 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

- 1. AWWA C110/A21.10, ductile or gray iron.
- 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

- 1. AWWA C153/A21.53, ductile iron.
- 2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Pipe:

- 1. AWWA C151/A21.51.
- 2. Push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

E. Standard-Pattern, Push-on-Joint Fittings:

- 1. AWWA C110/A21.10, ductile or gray iron.
- 2. Gaskets: AWWA C111/A21.11, rubber.

F. Compact-Pattern, Push-on-Joint Fittings:

- 1. AWWA C153/A21.53, ductile iron.
- 2. Gaskets: AWWA C111/A21.11, rubber.

G. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

H. Appurtenances for Grooved-End, Ductile-Iron Pipe:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Shurjoint Piping Products.
 - b. Star Pipe Products.
 - c. Victaulic Company.
2. Fittings for Grooved-End, Ductile-Iron Pipe: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions that match pipe.
3. Mechanical Couplings for Grooved-End, Ductile-Iron-Piping:
 - a. AWWA C606 for ductile-iron-pipe dimensions.
 - b. Ferrous housing sections.
 - c. EPDM-rubber gaskets suitable for hot and cold water.
 - d. Bolts and nuts.
 - e. Minimum Pressure Rating:
 - 1) NPS 14 to NPS 18 (DN 350 to DN 450): 250 psig
 - 2) NPS 20 to NPS 46 (DN 500 to DN 900): 150 psig

2.4 CPVC PIPING

- A. CPVC Pipe: ASTM F 441/F 441M, Schedule 40.
 1. CPVC Socket Fittings: ASTM F 438 for Schedule 40.
 2. CPVC Threaded Fittings: ASTM F 437, Schedule 80.
- B. CPVC Piping System: ASTM D 2846/D 2846M, SDR 11, pipe and socket fittings.
- C. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.5 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
- B. Fittings for PEX Tube: ASTM F 1807, full line size, metal-insert type.
- C. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.

2.6 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys.
- D. Flux: ASTM B 813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
1. CPVC solvent cement shall have a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Solvent cement and adhesive primer 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."
- G. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.7 TRANSITION FITTINGS

- A. General Requirements:
1. Same size as pipes to be joined.
 2. Pressure rating at least equal to pipes to be joined.
 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Plastic-to-Metal Transition Fittings:
1. Manufacturers: Subject to compliance with requirements, products by one of the following:
 - a. Charlotte Pipe and Foundry Company.
 - b. Harvel Plastics, Inc.
 - c. Spears Manufacturing Company.
 2. Description:

- a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
- b. One end with threaded brass insert and one solvent-cement-socket or threaded end.

D. Plastic-to-Metal Transition Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Colonial Engineering, Inc.
 - b. NIBCO Inc.
 - c. Spears Manufacturing Company.
- 2. Description:
 - a. CPVC four-part union.
 - b. Brass threaded end.
 - c. Solvent-cement-join plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.
 - d. Jomar International.
 - e. Matco-Norca.
 - f. McDonald, A. Y. Mfg. Co.
 - g. Watts; a division of Watts Water Technologies, Inc.
 - h. Wilkins; a Zurn company.
- 2. Standard: ASSE 1079.
- 3. Pressure Rating: 125 psig minimum at 180 deg F
- 4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Nipples:

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

- a. Elster Perfection Corporation.
 - b. Grinnell Mechanical Products; Tyco Fire Products LP.
 - c. Matco-Norca.
 - d. Precision Plumbing Products, Inc.
 - e. Victaulic Company.
2. Standard: IAPMO PS 66.
 3. Electroplated steel nipple complying with ASTM F 1545.
 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties" and per local requirements.
- F. Install shutoff valve immediately upstream of each dielectric fitting.
- G. Install domestic water piping level and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- N. Install piping free of sags and bends.
- O. Install fittings for changes in direction and branch connections.
- P. Install PEX piping with loop at each change of direction of more than 90 degrees.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2104. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- L. Joints for PEX Piping: Join according to ASTM F 1807.
- M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings or nipples.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- E. Install supports for vertical copper tubing every 10 feet (3 m).
- F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.

- G. Install supports for vertical steel piping every 15 feet (4.5 m).
- H. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
 - 8. NPS 8 to NPS 12 (DN 200 to DN 300): 12 feet (3.7 m) with 7/8-inch (22-mm) rod.
- I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
 - 4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
 - 5. NPS 6 (DN 150): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
 - 6. NPS 8 (DN 200): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.
- J. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- K. Install vinyl-coated hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 32 inches (815 mm) with 3/8-inch (10-mm) rod.
- L. Install hangers for vertical PEX piping every 48 inches (1200 mm).
- M. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Label pressure piping with system operating pressure.

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit

- a separate report for each test, complete with diagram of portion of piping tested.
- c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
- d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
- e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
- f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
5. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

- d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller, shall be one of the following:
 - 1. Soft copper tube, ASTM B 88, Type K ASTM B 88, Type L without joints.
 - 2. PEX, without joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 DN 100 to DN 200 and larger, shall be one of the following:
 - 1. Mechanical-joint, ductile-iron pipe; standard compact pattern, mechanical-joint fittings; and mechanical joints.
- F. Aboveground domestic water piping, NPS 2 (DN 50) and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L ASTM B 88, Type M, cast-] [or] wrought-copper, solder-joint fittings; and [soldered joints.
 - 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper pressure-seal-joint fittings; and pressure-sealed joints.
 - 3. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; copper push-on-joint fittings; and push-on joints.
 - 4. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
 - 5. PEX tube, NPS 1 (DN 25) and smaller; fittings for PEX tube.
- G. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100), shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L ASTM B 88, Type M; cast or wrought copper, solder-joint fittings; and brazed soldered joints.

2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M]; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Hard copper tube, [ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.
 4. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
- H. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), shall be one of the following:
1. Hard copper tube, ASTM B 88, Type L ASTM B 88, Type M; cast or wrought copper, solder-joint fittings; and soldered joints.
 2. Hard copper tube, ASTM B 88, Type L or ASTM B 88, Type M; grooved-joint, copper-tube appurtenances; and grooved joints.
 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 5. CPVC, Schedule 40; socket fittings; and solvent-cemented joints.
 6. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.

3.13 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 22 11 16

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SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Balancing valves.
 - 4. Temperature-actuated, water mixing valves.
 - 5. Strainers.
 - 6. Hose stations.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water-hammer arresters.
 - 11. Air vents.
 - 12. Specialty valves.
 - 13. Flexible connectors.

1.3 ACTION SUBMITTALS

- A. Product Data: Only for products used.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Potable-water piping and components shall comply with NSF 61 and NSF 14. Mark "NSF-pw" on plastic piping components.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; a division of Watts Water Technologies, Inc.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Toro Company (The); Irrigation Div.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
3. Standard: ASSE 1012.
4. Operation: Continuous-pressure applications.
5. Size: NPS 3/4 (DN 20).
6. Body: Bronze.
7. End Connections: Union, solder joint.
8. Finish: Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.

- d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1013.
 - 3. Operation: Continuous-pressure applications.
 - 4. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
 - 5. Pressure Loss at Design Flow Rate: 12 psig for sizes NPS 2 (DN 50) and smaller; 10 psig for NPS 2-1/2 (DN 65) and larger.
 - 6. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 (DN 65) and larger.
 - 7. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged or grooved for NPS 2-1/2 (DN 65) and larger.
 - 8. Configuration: Designed for horizontal, straight-through flow.
 - 9. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
 - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check, Backflow-Prevention Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Standard: ASSE 1015.
- 3. Operation: Continuous-pressure applications unless otherwise indicated.
- 4. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
- 5. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.
- 6. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
- 7. Configuration: Designed for horizontal, straight-through flow.
- 8. Accessories:
 - a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
 - b. Valves NPS 2-1/2 (DN 65) and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

D. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; a division of Watts Water Technologies, Inc.
 - d. Flomatic Corporation.
 - e. Ford Meter Box Company, Inc. (The).
 - f. Honeywell International Inc.
 - g. Legend Valve.
 - h. McDonald, A. Y. Mfg. Co.
 - i. Mueller Co. Ltd.; a subsidiary of Mueller Water Products Inc.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Size: [NPS 1/2 (DN 15)] [NPS 3/4 (DN 20)] [NPS 1 (DN 25)] [NPS 1-1/4 (DN 32)].
5. Body: Bronze with union inlet.

E. Hose-Connection Backflow Preventers

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Woodford Manufacturing Company; a division of WCM Industries, Inc.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water (30-kPa) back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4 (DN 15 or DN 20).
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm (0.19-L/s) flow.

2.5 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Flo Fab Inc.
 - c. ITT Corporation; Bell & Gossett Div.
 - d. NIBCO Inc.
 - e. TAC.
 - f. TACO Incorporated.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
2. Type: Ball valve with two readout ports and memory-setting indicator.

3. Body: Brass or bronze.
4. Size: Same as connected piping, but not larger than NPS 2 (DN 50).
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO Inc.
 - h. Red-White Valve Corp.
2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
4. Size: NPS 2 (DN 50) or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong International, Inc.
 - b. Cash Acme; a division of Reliance Worldwide Corporation.
 - c. Conbraco Industries, Inc.
 - d. Honeywell International Inc.
 - e. Legend Valve.
 - f. Leonard Valve Company.
 - g. Powers; a division of Watts Water Technologies, Inc.
 - h. Symmons Industries, Inc.
 - i. TACO Incorporated.
 - j. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - k. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig (860 kPa).
4. Type: Thermostatically controlled, water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Valve Finish: Chrome plated.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme; a division of Reliance Worldwide Corporation.
 - b. Conbraco Industries, Inc.
 - c. Honeywell International Inc.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company.
 - f. Powers; a division of Watts Water Technologies, Inc.
 - g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 110 deg F.

2.7 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm) .
 - b. Strainers NPS 2-1/2 to NPS 4 (DN 65 to DN 100): 0.045 inch (1.14 mm).
 - c. Strainers NPS 5 (DN 125) and Larger: 0.10 inch (2.54 mm).
6. Drain: Pipe plug.

2.8 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products.
 - g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig (860 kPa).
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.

10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

2.10 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. Precision Plumbing Products, Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.
 - h. Watts Drainage Products.
 - i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.11 SPECIALTY VALVES

A. Comply with requirements for general-duty metal valves in Section 220523 "General-Duty Valves for Plumbing Piping."

B. CPVC Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX.
 - g. NIBCO Inc.
 - h. Spears Manufacturing Company.
 - i. Thermoplastic Valves Inc.
2. Description:
 - a. Standard: MSS SP-122.

- b. Pressure Rating and Temperature: 125 psig (860 kPa) at [73 deg F (23 deg C).
- c. Body Material: CPVC.
- d. Body Design: Union type.
- e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
- f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket socket or threaded.
- g. Ball: CPVC; full port.
- h. Seals: PTFE or EPDM-rubber O-rings.
- i. Handle: Tee shaped.

C. PVC Union Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Asahi/America.
 - c. Colonial Engineering, Inc.
 - d. Georg Fischer LLC; GF Piping Systems.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX.
 - g. Jomar International.
 - h. KBI Company.
 - i. Legend Valve.
 - j. McDonald, A. Y. Mfg. Co.
 - k. NIBCO Inc.
 - l. Spears Manufacturing Company.
 - m. Thermoplastic Valves Inc.
- 2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating and Temperature: 125 psig (860 kPa) at 73 deg F (23 deg C).
 - c. Body Material: PVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket or threaded.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket or threaded.
 - g. Ball: PVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.

D. CPVC Non-Union Ball Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Asahi/America.

- c. KBI Company.
- d. Legend Valve.
- e. NIBCO Inc.
- f. Spears Manufacturing Company.
- g. Thermoplastic Valves Inc.

2. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating and Temperature: 125 psig (860 kPa) at 73 deg F (23 deg C).
- c. Body Material: CPVC.
- d. Body Design: Non-union type.
- e. End Connections: Socket or threaded.
- f. Ball: CPVC; full or reduced port.
- g. Seals: PTFE or EPDM-rubber O-rings.
- h. Handle: Tee shaped.

E. PVC Non-Union Ball Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. American Valve, Inc.
- b. Asahi/America.
- c. Colonial Engineering, Inc.
- d. Georg Fischer LLC; GF Piping Systems.
- e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
- f. IPEX.
- g. Jomar International.
- h. KBI Company.
- i. Legend Valve.
- j. McDonald, A. Y. Mfg. Co.
- k. NIBCO Inc.
- l. Spears Manufacturing Company.
- m. Thermoplastic Valves Inc.

2. Description:

- a. Standard: MSS SP-122.
- b. Pressure Rating and Temperature: 125 psig (860 kPa) at 73 deg F (23 deg C).
- c. Body Material: PVC.
- d. Body Design: Non-union type.
- e. End Connections: Socket or threaded.
- f. Ball: PVC; full or reduced port.
- g. Seals: PTFE or EPDM-rubber O-rings.
- h. Handle: Tee shaped.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
 2. Flexicraft Industries.
 3. Flex Pression, Ltd.
 4. Flex-Weld Incorporated.
 5. Hyspan Precision Products, Inc.
 6. Mercer Gasket & Shim, Inc.
 7. Metraflex, Inc.
 8. Proco Products, Inc.
 9. TOZEN Corporation.
 10. Unaflex.Universal Metal Hose; a Hyspan company.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
1. Working-Pressure Rating: Minimum 200 psig (1380 kPa) 250 psig (1725 kPa).
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
1. Working-Pressure Rating: Minimum [200 psig (1380 kPa)] [250 psig (1725 kPa)].
 2. End Connections NPS 2 (DN 50) and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Install balancing valves in locations where they can easily be adjusted.
- C. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install cabinet-type units recessed in or surface mounted on wall as specified.

- D. Install Y-pattern strainers for water on supply side of each water pressure-reducing valve, solenoid valve and pump.
- E. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch (38-by-89-mm) fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Section 061000 "Rough Carpentry."
- F. Install water-hammer arresters in water piping according to PDI-WH 201.

3.2 CONNECTIONS

- A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Pressure vacuum breakers.
 - 2. Intermediate atmospheric-vent backflow preventers.
 - 3. Reduced-pressure-principle backflow preventers.
 - 4. Double-check, backflow-prevention assemblies.
 - 5. Dual-check-valve backflow preventers.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 22 11 19

SECTION - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipe, tube, and fittings.
 - 2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class(es).
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
- C. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
 - a. ANACO-Husky.
 - b. Dallas Specialty & Mfg. Co.
 - c. Fernco Inc.
 - d. Matco-Norca, Inc.
 - e. MIFAB, Inc.
 - f. Mission Rubber Company; a division of MCP Industries, Inc.
 - g. Stant.
 - h. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and CISPI 310.
 - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- D. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky.
 - b. Clamp-All Corp.
 - c. Dallas Specialty & Mfg. Co.
 - d. MIFAB, Inc.
 - e. Mission Rubber Company; a division of MCP Industries, Inc.
 - f. Stant.
 - g. Tyler Pipe.
 - 2. Standards: ASTM C 1277 and ASTM C 1540.
 - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.

1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer 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."

D. Solvent Cement: ASTM D 2564.

1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement 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."

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Dallas Specialty & Mfg. Co.
 - 2) Fernco Inc.
 - 3) Mission Rubber Company; a division of MCP Industries, Inc.
 - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
 - b. Standard: ASTM C 1173.
 - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Mission Rubber Company; a division of MCP Industries, Inc.
 - b. Standard: ASTM C 1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
5. Pressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cascade Waterworks Mfg. Co.
 - 2) Dresser, Inc.
 - 3) EBAA Iron, Inc.
 - 4) JCM Industries, Inc.
 - 5) Romac Industries, Inc.
 - 6) Smith-Blair, Inc.; a Sensus company.
 - 7) The Ford Meter Box Company, Inc.
 - 8) Viking Johnson.
 - b. Standard: AWWA C219.
 - c. Description: Metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - d. Center-Sleeve Material: Manufacturer's standard.
 - e. Gasket Material: Natural or synthetic rubber.
 - f. Metal Component Finish: Corrosion-resistant coating or material.
6. Dielectric Flanges:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Capitol Manufacturing Company.
 - 2) Central Plastics Company.
 - 3) Matco-Norca, Inc.
 - 4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 5) Wilkins; a Zurn company.
 - b. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).

- 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants and other installation requirements.

- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install aboveground PVC piping according to ASTM D 2665.
- O. Install underground PVC piping according to ASTM D 2321.
- P. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- Q. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in OD's.
 - 2. In Drainage Piping: Unshielded, nonpressure transition couplings.

3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 - 1. Install shutoff valve on each sewage pump discharge.
 - 2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 - 3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 3. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 - 4. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 5. Install individual, straight, horizontal piping runs:
 - a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 - 6. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 7. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 - 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 - 4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 - 5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.
 - 6. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4-inch (19-mm) rod.
5. NPS 10 and NPS 12 (DN 250 and DN 300): 48 inches (1200 mm) with 7/8-inch (22-mm) rod.

- I. Install supports for vertical PVC piping every 48 inches (1200 mm).
- J. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 5. Install horizontal backwater valves with cleanout cover flush with floor or in pit with pit cover flush with floor.
 6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections according to the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints where approved by local code, do not install in return air plenum.
 - 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints where approved by local code, do not install in return air plenum.
 - 4. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints where approved by local code, do not install in return air plenum.
 - 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 13 16

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SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Air-admittance valves.
6. Through-penetration firestop assemblies.
7. Miscellaneous sanitary drainage piping specialties.
8. Oil/Grease interceptors.

- B. Related Requirements:

1. Section 221423 "Storm Drainage Piping Specialties" for storm drainage piping inside the building, drainage piping specialties, and drains.
2. Section 224300 "Medical Plumbing Fixtures" for plaster sink interceptors.
3. Section 334100 "Storm Utility Drainage Piping" for storm draining piping and piping specialties outside the building.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

- A. Product Data: Only for products used.

1. Oil/Grease interceptors.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- 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.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1) Josam Company.
 - 2) MIFAB, Inc.
 - 3) Smith, Jay R. Mfg. Co.
 - 4) Tyler Pipe.
 - 5) Watts Drainage Products.

6) Zurn Plumbing Products Group.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, brass or plastic plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. ASME A112.36.2M, Cast-Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Josam Company.
- 2) Oatey.
- 3) Sioux Chief Manufacturing Co., Inc.
- 4) Smith, Jay R. Mfg. Co.
- 5) Tyler Pipe.
- 6) Watts Drainage Products.
- 7) Zurn Plumbing Products Group.

2. ASME A112.3.1, Cast Iron Cleanouts:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Josam Company.
- 2) J.R. Smith.
- 3) Zurn.

3. Standard: ASME A112.36.2M for heavy-duty, adjustable housing.
4. Size: Same as connected branch.
5. Type: Heavy-duty, adjustable housing.
6. Body or Ferrule: Cast iron.
7. Clamping Device: Not required.
8. Outlet Connection: Inside calk.
9. Closure: Brass plug with straight threads and gasket.
10. Adjustable Housing Material: Cast iron with threads.
11. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
12. Frame and Cover Shape: Round.
13. Top Loading Classification: Heavy Duty.
14. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
15. Standard: ASME A112.3.1.
16. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, nickel-bronze, wall-installation frame and cover.

D. Plastic Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. NDS Inc.
 - d. Plastic Oddities.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Zurn Plumbing Products Group; Light Commercial Operation.
2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.

- e. Smith, Jay R. Mfg. Co.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products.
 - h. Zurn Plumbing Products Group.
- 2. Standard: ASME A112.6.3.
 - 3. Refer to schedule on drawings.

B. Plastic Floor Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Canplas LLC.
 - b. IPS Corporation.
 - c. Josam Company; Josam Div.
 - d. Oatey.
 - e. Plastic Oddities; a division of Diverse Corporate Technologies.
 - f. Sioux Chief Manufacturing Company, Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
- 2. Standard: ASME A112.6.3.
- 3. Material: ABS or PVC.
- 4. Refer to Schedule on drawings.

2.3 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ayrlett, LLC.
 - b. Durgo, Inc.
 - c. Oatey.
 - d. ProSet Systems Inc.
 - e. RectorSeal.
 - f. Studor, Inc.
- 2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
- 3. Housing: Plastic.
- 4. Operation: Mechanical sealing diaphragm.
- 5. Size: Same as connected fixture or branch vent piping.

B. Stack Air-Admittance Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Durgo, Inc.

- b. Oatey.
 - c. Studor, Inc.
- 2. Standard: ASSE 1050 for vent stacks.
 - 3. Housing: Plastic.
 - 4. Operation: Mechanical sealing diaphragm.
 - 5. Size: Same as connected stack vent or vent stack.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - b. 3M Hilti.
- 2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 3. Size: Same as connected soil, waste, or vent stack.
- 4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
- 5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
- 6. Special Coating: Corrosion resistant on interior of fittings.

2.5 OIL INTERCEPTORS

A. Oil Interceptors:

- 1. Plastic Oil Interceptors:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Ashland Trap Distribution Co.
 - 2) Schier Products Company.
 - 3) Town & Country Plastics, Inc.
- 2. Type: Factory-fabricated interceptor for separating and removing light oil from wastewater.
- 3. Body Material: Plastic.
- 4. Interior Lining: Not required.
- 5. Exterior Coating: Not required.
- 6. Refer to schedule on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install fixture air-admittance valves on fixture drain piping.
- G. Install air-admittance-valve wall boxes recessed in wall.
- H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- J. Install through-penetration firestop assemblies in plastic [conductors] [and] [stacks] at floor penetrations.

- K. Assemble open drain fittings and install with top of hub 1 inch (25 mm) above floor.
- L. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- M. Install floor-drain, trap-seals on inlet to floor drains.
 - 1. Size: Same as floor drain inlet.
- N. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- O. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch (25-mm) clearance between vent pipe and roof substrate.
- P. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
- Q. Install wood-blocking reinforcement for wall-mounting-type specialties.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Oil Interceptors: Connect inlet, outlet and vent piping to unit.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft. (30-kg/sq. m), 0.0938-inch (2.4-mm) thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft. (20-kg/sq. m), 0.0625-inch (1.6-mm) thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches (250 mm), and skirt or flange extending at least 8 inches (200 mm) around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches (200 mm) around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 076200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 22 13 19

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SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes 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.
- I. Code Letter Designation:
 - 1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. 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. 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 23 05 13

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SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

- B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230516 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 233113 "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

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

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.
 - c. Flex-Strut Inc.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut Corporation; Tyco International, Ltd.
 - g. Wesanco, Inc.
3. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
4. Standard: MFMA-4.
5. Channels: Continuous slotted steel channel with intumed lips.
6. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
8. Metallic Coating: Electroplated zinc.
9. Paint Coating: Vinyl
10. Plastic Coating: PVC.

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. NIBCO INC.
 - f. PHD Manufacturing, Inc.
 - g. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with inturred lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Carpenter & Paterson, Inc.
 2. Clement Support Services.
 3. ERICO International Corporation.
 4. National Pipe Hanger Corporation.
 5. PHS Industries, Inc.
 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 7. Piping Technology & Products, Inc.
 8. Rilco Manufacturing Co., Inc.
 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Plastic.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand:
 - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 2. Bases: One or more; plastic.
 - 3. Vertical Members: Two or more protective-coated-steel channels.
 - 4. Horizontal Member: Protective-coated-steel channel.
 - 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 EQUIPMENT SUPPORTS

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

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
 - 1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi , 28-day compressive strength.

PART 3 - EXECUTION

3.1 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.
 2. 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.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

- I. 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.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. 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.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. 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.
- N. 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.
 - 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.

3.2 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.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- 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.

3.4 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.

3.5 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 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, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel 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 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8 (DN 20 to DN 200).
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).

10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 (DN 65 to DN 900) if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24 (DN 65 to DN 600), from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 (DN 50 to DN 600) if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- 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 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.
- 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 (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F (49 to 232 deg C) piping installations.
- 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb
 - b. Medium (MSS Type 32): 1500 lb
 - c. Heavy (MSS Type 33): 3000 lb
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- 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. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 23 05 29

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets or self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.

- B. Letter Color: Black
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.
 - 1. Tag Material: Brass, 0.032-inch (0.8-mm) or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches (100 by 178 mm)
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

- 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.

- B. 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 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 (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- C. Pipe Label Color Schedule:

- 1. Refrigerant Piping:
 - a. Background Color: White
 - b. Letter Color: Black

3.4 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. 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, if lettering larger than 1 inch (25 mm) high is needed for proper identification because of distance from normal location of required identification.
- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet (15 m) in each space where ducts are exposed or concealed by removable ceiling system.

3.5 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 Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
 - 1. Valve-Tag Size and Shape:
 - a. Gas: 1-1/2 inches (38 mm) round
 - 2. Valve-Tag Color:
 - a. Gas: Natural.
 - 3. Letter Color:
 - a. Refrigerant: White.
 - b. Gas: White.

3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC NEBB or TABB.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC NEBB or TABB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Owner, Construction Manager & Commissioning Authority on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days advance notice of scheduled meeting time and location.
 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. TAB Report Forms: Use standard TAB contractor's forms approved by Architect Owner Construction Manager Commissioning Authority.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- F. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- G. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.6 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine operating safety interlocks and controls on HVAC equipment.
- K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
 2. Automatic temperature-control systems are operational.
 3. Equipment and duct access doors are securely closed.
 4. Balance, smoke, and fire dampers are open.
 5. Isolating and balancing valves are open and control valves are operational.
 6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance", ASHRAE 111, or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
 - 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling-unit components.
- K. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 - 6. Obtain approval from Architect and Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
 - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure airflow of submain and branch ducts.

- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
 3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.8 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.

3.9 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.10 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. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB 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. Face and bypass damper settings at coils.
 - d. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. 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. Duct, outlet, and inlet sizes.
 3. Terminal units.
 4. Balancing stations.
 5. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).

- c. Fan rpm.
- d. Discharge static pressure in inches wg (Pa).
- e. Filter static-pressure differential in inches wg (Pa).
- f. Outdoor airflow in cfm (L/s).
- g. Return airflow in cfm (L/s).
- h. Outdoor-air damper position.
- i. Return-air damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Make and model number.
- f. Face area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm (L/s).
- b. Average face velocity in fpm (m/s).
- c. Air pressure drop in inches wg (Pa).
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F (deg C).
- e. Return-air, wet- and dry-bulb temperatures in deg F (deg C).
- f. Entering-air, wet- and dry-bulb temperatures in deg F (deg C).
- g. Leaving-air, wet- and dry-bulb temperatures in deg F (deg C).

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

- a. System and air-handling-unit number.
- b. Location and zone.
- c. Traverse air temperature in deg F (deg C).
- d. Duct static pressure in inches wg (Pa).
- e. Duct size in inches (mm).
- f. Duct area in sq. ft. (sq. m).
- g. Indicated air flow rate in cfm (L/s).
- h. Indicated velocity in fpm (m/s).
- i. Actual air flow rate in cfm (L/s).
- j. Actual average velocity in fpm (m/s).
- k. Barometric pressure in psig (Pa).

H. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.11 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Verify that balancing devices are marked with final balance position.
 - d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect, Owner, Construction Manager and Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect, Owner, Construction Manager and Commissioning Authority.
3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

END OF SECTION 23 05 93

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SECTION 23 07 13 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 - 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 exhaust between isolation damper and penetration of building exterior.
 - 6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 7. Outdoor air intake duct.
- B. Related Sections:
 - 1. Section 230716 "HVAC Equipment Insulation."
 - 2. Section 230719 "HVAC Piping Insulation."
 - 3. Section 233113 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Shop Drawings:
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 - 3. Detail application of field-applied jackets.
 - 4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM 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. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. K-Flex USA; Insul-Sheet, K-Flex Gray Duct Liner, and K-FLEX LS.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; SOFTR All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. CertainTeed Corp.; Commercial Board.
 - b. Fibrex Insulations Inc.; FBX.
 - c. Johns Manville; 800 Series Spin-Glas.
 - d. Knauf Insulation; Insulation Board.
 - e. Manson Insulation Inc.; AK Board.
 - f. Owens Corning; Fiberglas 700 Series.
- I. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k-value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- J. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 1-hour fire rating by an NRTL acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Super Firetemp M.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."

- D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
1. Products: Subject to compliance with requirements, DJacobs@a3c.com:
 - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.

- b. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
 - b. Eagle Bridges - Marathon Industries; 501.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
 - d. Mon-Eco Industries, Inc.; 55-10.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9-mm) dry film thickness.
 - 3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
 - 4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
 - 5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8-mm) dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 5. Color: White.

2.6 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - c. Mon-Eco Industries, Inc.; 44-05.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
 5. Color: Aluminum.

6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.9 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, [1/2 inch (13 mm)] wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; CD.
 - 3) Midwest Fasteners, Inc.; CD.
 - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) diameter shank, length

to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; CHP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
 - b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
 - c. Spindle: Nylon, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
 - 2) GEMCO; Peel & Press.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
 - c. Spindle: Copper- or zinc-coated, low-carbon steel or Aluminum or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel or aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
 - 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) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.
- D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. C & F Wire.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Keep insulation materials dry during application and finishing.
- G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- H. Install insulation with least number of joints practical.
- I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- K. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50 mm).
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" and fire-resistive joint sealers.
- E. Insulation Installation at Floor Penetrations:
 - 1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 INSTALLATION OF MINERAL-FIBER INSULATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 - 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.7 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.8 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, and outdoor air.
 - 2. Indoor, concealed supply and return located in unconditioned space.
 - 3. Indoor, exposed supply and return located in unconditioned space.
 - 4. Indoor, exhaust within 5 ft. of penetration of building exterior.
- B. Items Not Insulated:
 - 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 2. Factory-insulated flexible ducts.
 - 3. Factory-insulated plenums and casings.
 - 4. Flexible connectors.

5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed return and supply-air duct insulation shall be one of the following:
 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density. With factory applied FSK jacket.
- B. Exposed and Concealed, Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated blanket or board; thickness as required to achieve 2-hour fire rating.
- C. Concealed and Exposed, outdoor-air duct insulation shall be the following:
 1. Mineral-Fiber Blanket: 1-1/2 inches (38 mm) thick and 3-lb/cu. ft. (48-kg/cu. m) nominal density with factory applied FSK jacket.

END OF SECTION 23 07 13

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SECTION 23 07 19 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following HVAC piping systems:
 - 1. Condensate drain piping, indoors.
 - 2. Refrigerant suction and hot-gas piping, indoors and outdoors.
- B. Related Sections:
 - 1. Section 230713 "Duct Insulation."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 - 2. Detail attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties.
 - 6. Detail application of field-applied jackets.
 - 7. Detail application at linkages of control devices.
- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
 - 1. Preformed Pipe Insulation Materials: 12 inches (300 mm) long by NPS 2 (DN 50).
 - 2. Sheet Form Insulation Materials: 12 inches (300 mm) square.
 - 3. Jacket Materials for Pipe: 12 inches (300 mm) long by NPS 2 (DN 50).
 - 4. Sheet Jacket Materials: 12 inches (300 mm) square.
 - 5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting 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. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule, articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- E. Calcium Silicate:
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
 - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
 - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.

- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Aeroflex USA, Inc.; Aeroseal.
 - b. Armacell LLC; Armaflex 520 Adhesive.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
 - d. K-Flex USA; R-373 Contact Adhesive.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
 - b. Eagle Bridges - Marathon Industries; 225.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
 - d. Mon-Eco Industries, Inc.; 22-25.
 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 3. Adhesive 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."
- D. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

- a. Dow Corning Corporation; 739, Dow Silicone.
 - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 - c. P.I.C. Plastics, Inc.; Welding Adhesive.
 - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

2.3 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
 - b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - c. Vimasco Corporation; 713 and 714.
 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
 5. Color: White.

2.4 SEALANTS

- A. Joint Sealants:
 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
 - d. Mon-Eco Industries, Inc.; 44-05.

- e. Pittsburgh Corning Corporation; Pittseal 444.

B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
 - b. Eagle Bridges - Marathon Industries; 405.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 - d. Mon-Eco Industries, Inc.; 44-05.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants 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."

2.5 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
 4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
 5. PVDC Jacket for Indoor Applications: 4-mil- (0.10-mm-) thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm (0.013 metric perm) when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Johns Manville; Zeston.
 - b. P.I.C. Plastics, Inc.; FG Series.
 - c. Proto Corporation; LoSmoke.
 - d. Speedline Corporation; SmokeSafe.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

- a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
 - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
 - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat-bonded polyethylene and kraft paper or 2.5-mil- (0.063-mm-) thick polysurlyn.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
 3. Thickness: 11.5 mils (0.29 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches (75 mm).
 3. Thickness: 6.5 mils (0.16 mm).
 4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
 2. Width: 2 inches (50 mm).
 3. Thickness: 6 mils (0.15 mm).
 4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
 3. Thickness: 3.7 mils (0.093 mm).
 4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
 2. Width: 3 inches (75 mm).
 3. Film Thickness: 4 mils (0.10 mm).
 4. Adhesive Thickness: 1.5 mils (0.04 mm).
 5. Elongation at Break: 145 percent.
 6. Tensile Strength: 55 lbf/inch (10.1 N/mm) in width.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F (0 and 149 deg C) with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm).

- a. For below-ambient services, apply vapor-barrier mastic over staples.
- 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
- 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable

- insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FINISHES

A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
- B. Refrigerant Suction Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Flexible Elastomeric: 1 inch (25 mm) thick.

3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed.
- D. Piping, Exposed:
 - 1. None.

END OF SECTION 23 07 19

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SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping specialties.
 - 3. Piping and tubing joining materials.
 - 4. Valves.
 - 5. Pressure regulators.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig 690 kPa minimum unless otherwise indicated.
- B. Natural-Gas System Pressure within Buildings: 0.5 psig 3.45 kPa or less.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Piping specialties.
 - 2. Corrugated, stainless-steel tubing with associated components.

3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.8 PROJECT CONDITIONS

- A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

1.9 COORDINATION

- A. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 083113 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 2. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 3. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded to match pipe.

- c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
 - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- 4. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.
 - a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. OmegaFlex, Inc.
 - b. Parker Hannifin Corporation; Parflex Division.
 - c. Titeflex.
 - d. Tru-Flex Metal Hose Corp.
 - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
 - 3. Coating: PE with flame retardant.
 - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1) Flame-Spread Index: 25 or less.
 - 2) Smoke-Developed Index: 50 or less.
 - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
 - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
 - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
 - 7. Operating-Pressure Rating: 5 psig 34.5 kPa.
- C. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type L (ASTM B 88M, Type B).
 - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
 - 2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
 - a. Copper fittings with long nuts.
 - b. Metal-to-metal compression seal without gasket.
 - c. Dryseal threads complying with ASME B1.20.3.

3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch (0.56 mm) thick.

D. PE Pipe: ASTM D 2513, SDR 11.

1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
 - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
 - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
 - c. Aboveground Portion: PE transition fitting.
 - d. Outlet shall be threaded or flanged or suitable for welded connection.
 - e. Tracer wire connection.
 - f. Ultraviolet shield.
 - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
4. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
 - 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) Dresser Piping Specialties; Division of Dresser, Inc.
 - 2) Smith-Blair, Inc.
 - b. Stainless-steel flanges and tube with epoxy finish.
 - c. Buna-nitrile seals.
 - d. Stainless-steel bolts, washers, and nuts.
 - e. Factory-installed anode for steel-body couplings installed underground.

2.2 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.
5. Operating-Pressure Rating: 0.5 psig (3.45 kPa).
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.

8. Maximum Length: 72 inches (1830 mm.)
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
 1. Copper-alloy 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.
- C. 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.

2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.

2.4 MANUAL GAS SHUTOFF VALVES

- A. General Requirements for Metallic Valves, NPS 2 (DN 50) and Smaller: Comply with ASME B16.33.
 1. CWP Rating: 125 psig (862 kPa).
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch (25 mm) and smaller.
 6. Service Mark: Valves 1-1/4 inches (32 mm) to NPS 2 (DN 50) shall have initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 (DN 65) and Larger: Comply with ASME B16.38.
 1. CWP Rating: 125 psig (862 kPa).
 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated brass.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig (4140 kPa).
 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BrassCraft Manufacturing Company; a Masco company.
 - b. Conbraco Industries, Inc.; Apollo Div.
 - c. Lyall, R. W. & Company, Inc.
 - d. McDonald, A. Y. Mfg. Co.
 - e. Perfection Corporation; a subsidiary of American Meter Company.
 2. Body: Bronze, complying with ASTM B 584.
 3. Ball: Chrome-plated bronze.
 4. Stem: Bronze; blowout proof.
 5. Seats: Reinforced TFE; blowout proof.
 6. Packing: Threaded-body packnut design with adjustable-stem packing.
 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
 8. CWP Rating: 600 psig (4140 kPa).
 9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Lee Brass Company.
 - b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig (862 kPa).
7. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. McDonald, A. Y. Mfg. Co.
 - b. Mueller Co.; Gas Products Div.
 - c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, Class B.
3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Flowserve.
 - b. Homestead Valve; a division of Olson Technologies, Inc.
 - c. McDonald, A. Y. Mfg. Co.
 - d. Milliken Valve Company.
 - e. Mueller Co.; Gas Products Div.
 - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
2. Body: Cast iron, complying with ASTM A 126, Class B.

3. Plug: Bronze or nickel-plated cast iron.
4. Seat: Coated with thermoplastic.
5. Stem Seal: Compatible with natural gas.
6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. Operator: Square head or lug type with tamperproof feature where indicated.
8. Pressure Class: 125 psig (862 kPa).
9. Listing: Valves NPS 1 (DN 25) and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.5 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Actaris.
 - b. American Meter Company.
 - c. Eclipse Combustion, Inc.
 - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
 - e. Invensys.
 - f. Maxitrol Company.
 - g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

12. Maximum Inlet Pressure: 5 psig (34.5 kPa).

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Canadian Meter Company Inc.
 - b. Eaton Corporation; Controls Div.
 - c. Harper Wyman Co.
 - d. Maxitrol Company.
 - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig (34.5 kPa).

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 the International Fuel Gas Code requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.

- B. Install underground, PE, natural-gas piping according to ASTM D 2774.

3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Verify final equipment locations for roughing-in.
- L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
 - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches (75 mm) long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

- P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches (38 mm) of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
 - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
 5. Prohibited Locations:
 - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - b. Do not install natural-gas piping in solid walls or partitions.
- Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- R. Connect branch piping from top or side of horizontal piping.
- S. Install unions in pipes NPS 2 (DN 50) and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- T. Do not use natural-gas piping as grounding electrode.
- U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.5 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

3.6 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. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- E. 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.
- F. 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.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for pipe hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1 (DN 25) and Smaller: Maximum span, 96 inches (2438 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1-1/4 (DN 32): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): Maximum span, 108 inches (2743 mm); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 2-1/2 to NPS 3-1/2 (DN 65 to DN 90): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch (13 mm).
 - 5. NPS 4 (DN 100) and Larger: Maximum span, 10 feet (3 m); minimum rod size, 5/8 inch (15.8 mm).
- C. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1/2 and NPS 5/8 (DN 15 and DN 18): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 3/4 and NPS 7/8 (DN 20 and DN 22): Maximum span, 84 inches (2134 mm); minimum rod size, 3/8 inch (10 mm).
 - 4. NPS 1 (DN 25): Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).
- D. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/8 (DN 10): Maximum span, 48 inches (1220 mm); minimum rod size, 3/8 inch (10 mm).
 - 2. NPS 1/2 (DN 15): Maximum span, 72 inches (1830 mm); minimum rod size, 3/8 inch (10 mm).
 - 3. NPS 3/4 (DN 20) and Larger: Maximum span, 96 inches (2440 mm); minimum rod size, 3/8 inch (10 mm).

3.8 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches (1800 mm) of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.9 LABELING AND IDENTIFYING

- A. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.10 PAINTING

- A. Comply with requirements in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

- a. Prime Coat: Alkyd anticorrosive metal primer.
- b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
- c. Topcoat: Exterior alkyd enamel semigloss.
- d. Color: Yellow.

- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Latex Over Alkyd Primer System: MPI INT 5.1Q.

- a. Prime Coat: Alkyd anticorrosive metal primer.
- b. Intermediate Coat: Interior latex matching topcoat.
- c. Topcoat: Interior latex semigloss.
- d. Color: Yellow

2. Alkyd System: MPI INT 5.1E.

- a. Prime Coat: Alkyd anticorrosive metal primer.
- b. Intermediate Coat: Interior alkyd matching topcoat.
- c. Topcoat: Interior alkyd semigloss.
- d. Color: Yellow

- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Test, inspect, and purge natural gas according to NFPA 54 the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
 - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
 - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
 - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
 - 1. Steel pipe with malleable-iron fittings and threaded joints.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG (3.45 kPa)

- A. Aboveground, branch piping NPS 1 (DN 25) and smaller shall be one of the following:
 - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
 - 2. Annealed-temper, copper tube with wrought-copper fittings and flared joints.

3. Steel pipe with malleable-iron fittings and threaded joints.

- B. Aboveground, distribution piping shall be one of the following:

1. Steel pipe with malleable-iron fittings and threaded joints.
2. Steel pipe with wrought-steel fittings and welded joints.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 (DN 50) and smaller at service meter shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

- B. Valves for pipe sizes NPS 2-1/2 (DN 65) and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

- C. Distribution piping valves for pipe sizes NPS 2 (DN 50) and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

- D. Distribution piping valves for pipe sizes NPS 2-1/2 (DN 65) and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.
3. Cast-iron, nonlubricated and lubricated plug valve.

- E. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.
3. Bronze plug valve.

END OF SECTION 23 11 23

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
 - 2. Suction Lines for Heat-Pump Applications: 535 psig (3689 kPa).
 - 3. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K or L (ASTM B 88M, Type A or B).
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch- (180-mm-) long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
 - 5. Maximum Operating Temperature: 250 deg F (121 deg C).

2.2 REFRIGERANTS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Atofina Chemicals, Inc.
 - 2. DuPont Company; Fluorochemicals Div.
 - 3. Honeywell, Inc.; Genetron Refrigerants.
 - 4. INEOS Fluor Americas LLC.

- C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 (DN 40) and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type ACR L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
- C. Hot-Gas and Liquid Lines[, and Suction Lines for Heat-Pump Applications]: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with [brazed] [or] [soldered] joints.
- D. Hot-Gas and Liquid Lines and Suction Lines for Heat-Pump Applications:
 - 1. NPS 5/8 (DN 18) and Smaller: Copper, Type ACR L (B), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.
 - 2. NPS 3/4 to NPS 1 (DN 20 to DN 25) and Smaller: Copper, Type K (A), annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15 and equipment manufacturer.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.

- J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- L. Slope refrigerant piping as follows:
 - 1. Install traps and double risers to entrain oil in vertical runs.
 - 2. Liquid lines may be installed level.
- M. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.
- O. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."
- P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
- Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

3.3 PIPE 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. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing to prevent scale formation.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
 - 1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.4 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
 - 2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
 - 1. NPS 1/2 (DN 15): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 2. NPS 5/8 (DN 18): Maximum span, 60 inches (1500 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 3. NPS 1 (DN 25): Maximum span, 72 inches (1800 mm); minimum rod size, 1/4 inch (6.4 mm).
 - 4. NPS 1-1/4 (DN 32): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 5. NPS 1-1/2 (DN 40): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 6. NPS 2 (DN 50): Maximum span, 96 inches (2400 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 7. NPS 2-1/2 (DN 65): Maximum span, 108 inches (2700 mm); minimum rod size, 3/8 inch (9.5 mm).
 - 8. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (9.5 mm).
 - 9. NPS 4 (DN 100): Maximum span, 12 feet (3.7 m); minimum rod size, 1/2 inch (13 mm).
- D. Support multifloor vertical runs at least at each floor.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Comply with ASME B31.5, Chapter VI.
 - 2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
 - 3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.

- b. System shall maintain test pressure at the manifold gage throughout duration of test.
- c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
- d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

- 1. Install core in filter dryers after leak test but before evacuation.
- 2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers (67 Pa). If vacuum holds for 12 hours, system is ready for charging.
- 3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig (14 kPa).
- 4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

- A. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
- B. Adjust set-point temperature of air-conditioning controllers to the system design temperature.
- C. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
 - 1. Verify that compressor oil level is correct.
 - 2. Open compressor suction and discharge valves.
- D. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 23 31 13 - METAL DUCT

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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Duct liner.
5. Sealants and gaskets.
6. Hangers and supports.

- B. Related Sections:

1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 233116 "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Section 233300 "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".
- 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 the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Penetrations through fire-rated and other partitions.
2. Equipment installation based on equipment being used on Project.
3. Hangers and supports, including methods for duct and building attachment and vibration isolation.

1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- 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 SINGLE-WALL ROUND[AND FLAT-OVAL] 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. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.
 - c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate 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."
- D. 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."
- E. 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."

2.3 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 A 653/A 653M.
 1. Galvanized Coating Designation: G60.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. CertainTeed Corporation; Insulation Group.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning.
 - e. Maximum Thermal Conductivity:
 - 1) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Adhesive 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."
- B. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm (12.7 m/s) or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch (2.4-mm) diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 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: 3 inches (76 mm) 4 inches (102 mm) [6 inches (152 mm)].
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
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 (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

2.6 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 (Table 5-1M), "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 A 603.
- E. 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.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 SEISMIC-RESTRAINT DEVICES

- A. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- B. Restraint Cables: ASTM A 603, galvanized steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- C. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

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 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 233300 "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."

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 at each change in direction and at maximum intervals of 20 feet (6 m) 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 C.
 - 4. Outdoor, Return-Air Ducts: Seal Class C.
 - 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
 - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
 - 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 - 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 - 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
 - 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
 - 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
 - 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 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.

- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Test for leaks before applying external insulation.
 - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

3.9 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Supply Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 24.

- d. SMACNA Leakage Class for Round and Flat Oval: 24.
- 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg (500 Pa) (1000 Pa).
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 3.
 - d. SMACNA Leakage Class for Round and Flat Oval: 3.
- C. Return Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or 2-inch wg (500 Pa).
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 24.
- D. Exhaust Ducts:
 - 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 24.
 - 2. Ducts Connected to Commercial Kitchen Hoods: Comply with NFPA 96.
 - a. Concealed: Carbon-steel sheet.
 - b. Welded seams and joints.
 - c. Pressure Class: Positive or negative 4-inch wg (1000 Pa).
 - d. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
 - e. SMACNA Leakage Class: 3.
- E. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
 - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
 - a. Pressure Class: Positive or negative 1-inch wg (250 Pa).
 - b. Minimum SMACNA Seal Class: B.
 - c. SMACNA Leakage Class for Rectangular: 24.
 - d. SMACNA Leakage Class for Round and Flat Oval: 24.
 - 2. 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."
- 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

F. Branch Configuration:

- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
- 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
 - c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION 23 31 13

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling radiation dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Flange connectors.
10. Turning vanes.
11. Remote damper operators.
12. Duct-mounted access doors.
13. Flexible connectors.
14. Flexible ducts.
15. Duct accessory hardware.

- B. Related Requirements:

1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.
3. Section 283112 "Zoned (DC-Loop) Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: For duct accessories.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.

- c. Control-damper installations.
- d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Duct security bars.
- f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

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 A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 (Z180).
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts.

- C. 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.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Pottorff.
 - g. Ruskin Company.
 - h. Trox USA Inc.
 - i. Vent Products Company, Inc.
 - 3. Standard leakage rating, with linkage outside airstream.
 - 4. Suitable for horizontal or vertical applications.
 - 5. Frames:
 - a. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 6. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch (1.62 mm) thick.
 - 7. Blade Axles: Galvanized steel.
 - 8. Bearings:

- a. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
9. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 - h. Vent Products Company, Inc.
 3. Standard leakage rating, with linkage outside airstream.
 4. Suitable for horizontal or vertical applications.
 5. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 6. 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- (2.5-mm-) thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
 7. Blade Axles: Galvanized steel.
 8. Bearings:
 - a. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 9. Tie Bars and Brackets: Aluminum.
- C. Low-Leakage, Steel, Manual Volume Dampers:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Nailor Industries Inc.
 - e. Pottorff.
 - f. Ruskin Company.
 - g. Trox USA Inc.
 - h. Vent Products Company, Inc.
3. Comply with AMCA 500-D testing for damper rating.
4. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
5. Suitable for horizontal or vertical applications.
6. Frames:
 - a. Hat shaped.
 - b. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
 - c. Mitered and welded corners.
 - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
7. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized, roll-formed steel, 0.064 inch (1.62 mm) thick.
8. Blade Axles: Galvanized steel.
9. Bearings:
 - a. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
10. Blade Seals: Neoprene.
11. Jamb Seals: Cambered stainless steel.
12. Tie Bars and Brackets: Galvanized steel.
13. Accessories:
 - a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.4 FIRE 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:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Greenheck Fan Corporation.
 5. Nailor Industries Inc.
 6. NCA Manufacturing, Inc.
 7. Pottorff.
 8. Prefco; Perfect Air Control, Inc.
 9. Ruskin Company.
 10. Vent Products Company, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- C. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.
- D. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.
- E. Fire Rating: 1-1/2 and 3 hours.
- F. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.
- G. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.05 (1.3 mm) 0.138 inch (3.5 mm) or 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.
 2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- H. Mounting Orientation: Vertical or horizontal as indicated.
- I. Blades: Roll-formed, interlocking, 0.024-inch- (0.61-mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.
- J. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- K. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.
- L. Heat-Responsive Device: replaceable link and switch package, factory installed, 165 deg F (74 deg C) rated.

2.5 CEILING RADIATION 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Nailor Industries Inc.
 - 4. Pottorff.
 - 5. Prefco; Perfect Air Control, Inc.
 - 6. Ruskin Company.
 - 7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- C. General Requirements:
 - 1. Labeled according to UL 555C by an NRTL.
 - 2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
 - 3. Volume control factory mounted.
- D. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
- E. Blades: Galvanized sheet steel with refractory insulation.
- F. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.
- G. Fire Rating: 1 hour.

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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. Cesco Products; a division of Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Nailor Industries Inc.
 - 5. Pottorff.
 - 6. Ruskin Company.
- C. General Requirements: Label according to UL 555S by an NRTL.
- D. Smoke Detector: Integral, factory wired for single-point connection.

- E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded or mechanically attached corners and mounting flange.
- F. Blades: Roll-formed, horizontal, interlocking, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel.
- G. Leakage: Class I.
- H. Rated pressure and velocity to exceed design airflow conditions.
- I. Mounting Sleeve: Factory-installed, 0.039-inch- (1.0-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- J. Damper Motors: two-position action.
- K. 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 230900 "Instrumentation and Control 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 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
 - 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 (minus 40 deg C).
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- L. Accessories:
 - 1. Auxiliary switches for position indication.
 - 2. Test and reset switches mounted.

2.7 COMBINATION FIRE AND 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Greenheck Fan Corporation.
 4. Nailor Industries Inc.
 5. Pottorff.
 6. Ruskin Company.
- C. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- D. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.
- E. Fire Rating: 1-1/2 and 3 hours.
- F. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with mechanically attached corners and mounting flange.
- G. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) rated, fusible links.
- H. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- I. Smoke Detector: Integral, factory wired for single-point connection.
- J. Blades: Roll-formed, horizontal, interlocking, 0.063-inch- (1.6-mm-) thick, galvanized sheet steel.
- K. Leakage: Class I.
- L. Rated pressure and velocity to exceed design airflow conditions.
- M. Mounting Sleeve: Factory-installed, 0.039-inch- (1.0-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- N. Master control panel for use in dynamic smoke-management systems.
- O. Damper Motors: two-position action.
- P. 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 230900 "Instrumentation and Control 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 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
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 (minus 40 deg C).
 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
 7. Electrical Connection: 115 V, single phase, 60 Hz.

Q. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, damper mounted.

2.8 FLANGE CONNECTORS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Ductmate Industries, Inc.
 2. Nexus PDQ; Division of Shilco Holdings Inc.
 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- C. Description: Add-on, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- D. Material: Galvanized steel.
- E. Gage and Shape: Match connecting ductwork.

2.9 TURNING VANES

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. METALAIRE, Inc.
 5. SEMCO Incorporated.
 6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- C. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- D. 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.
- E. 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."
- F. Vane Construction: Single wall.
- G. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.10 REMOTE DAMPER OPERATORS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Pottorff.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- C. Description: Cable system designed for remote manual damper adjustment.
- D. Tubing: Copper.
- E. Cable: Steel.
- F. Wall-Box Mounting: Recessed.
- G. Wall-Box Cover-Plate Material: Stainless steel.

2.11 DUCT-MOUNTED ACCESS DOORS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. American Warming and Ventilating; a division of Mestek, Inc.

2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

- C. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "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 (25-by-25-mm) 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 (300 mm) Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches with outside and inside handles.

2.12 DUCT ACCESS PANEL ASSEMBLIES

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
- C. Labeled according to UL 1978 by an NRTL.
- D. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon steel.

- E. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- F. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).
- G. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.13 FLEXIBLE CONNECTORS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Elgen Manufacturing.
 - 4. Ventfabrics, Inc.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- C. Materials: Flame-retardant or noncombustible fabrics.
- D. Coatings and Adhesives: Comply with UL 181, Class 1.
- E. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7-mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.
- F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
 - 2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
- G. 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. (810 g/sq. m).
 - 2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).
- H. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
 - 2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.

3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

2.14 FLEXIBLE DUCTS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Ward Industries, Inc.; a division of Hart & Cooley, 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 (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
- D. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.
 1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
 2. Maximum Air Velocity: 4000 fpm (20 m/s).
 3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
- 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 (75 through 460 mm), to suit duct size.

2.15 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 from duct filters.
 - 3. 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.
 - 4. Control devices requiring inspection.
 - 5. 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 (200 by 125 mm).
 - 2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
 - 3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
 - 4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).

- 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. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- N. Connect flexible ducts to metal ducts with adhesive.
- 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, smoke, and combination 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.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 23 33 00

SECTION 23 81 26 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 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. LEED Submittals:
 - 1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
- 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.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Filters: One set for each air-handling unit.

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 concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

- B. 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: One year from date of Substantial Completion.
 - b. For Parts: One year from date of Substantial Completion.

- c. For Labor: One year 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
1. Carrier Corporation; Home Comfort and HVAC Building & Industrial Systems.
 2. Lennox International Inc.
 3. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
 4. Trane; a business of American Standard companies.
 5. Fujitsu.

2.2 INDOOR UNITS 5 TONS OR LESS

- A. Wall-Mounted, Evaporator-Fan Components:
1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, 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. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
 4. Fan: Direct drive, centrifugal.
 5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 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.
 6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
 7. Condensate Drain Pans:

- a. Fabricated with 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.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: Per MFG.
 - b. Single-wall, steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: Per MFG
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. 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 OR LESS

A. Air-Cooled, Compressor-Condenser Components:

- 1. Casing: Steel, finished with baked enamel in color selected by Architect, 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: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
- 3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
- 4. Fan: Aluminum-propeller type, directly connected to motor.
- 5. Motor: Permanently lubricated, with integral thermal-overload protection.
- 6. Low Ambient Kit: Permits operation down to 0 deg F.

7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- C. Automatic-reset timer to prevent rapid cycling of compressor.
- D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- E. Drain Hose: For condensate.
- F. Additional Monitoring:
 1. Monitor constant and variable motor loads.
 2. Monitor variable-frequency-drive operation.
 3. Monitor economizer cycle.
 4. Monitor cooling load.
 5. Monitor air distribution static pressure and ventilation air volumes.

2.5 CAPACITIES AND CHARACTERISTICS

- A. Refer to mechanical schedules on project plans for capacities.

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 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Provide with equipment stand to elevate unit 18" above grade.
- E. 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.
1. Water Coil Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return coil connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
 2. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.
- C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply[**and return**] ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

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. Perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 238126

SECTION 260505 – SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

PART 2 – PRODUCTS

2.1 MATERIAL AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as shown on Drawings.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observations.
- D. Report discrepancies to Owner before disturbing existing installation.
- E. Report discrepancies to Architect before disturbing existing installation.
- F. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.

- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling systems.
 - 2. Make temporary connections to maintain service in areas adjacent to work areas.
- E. Existing Low Voltage Communications Systems (Emergency Call, Wandering, Fire Alarm, etc.): maintain existing systems in service until new systems are complete and ready for service and new services are accepted. Disable systems only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner at least 48 hours before partially or completely disabling any systems.
 - 2. Notify Low Voltage Systems contractor at least 72 hours before partially or completely disabling any system.
 - 3. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets and conduits servicing them. Provide blank cover for abandoned outlets boxes which are not removed.
- E. Disconnect and remove electrical panelboards and distribution equipment indicated to be removed.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.

- I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with current constructions standards. .

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment which remain or are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Update all panel directories affected by new work with new type written directories mounted behind clear plastic covers.
- C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps and broken electrical parts.

END OF SECTION 260505

SECTION 260510 - COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.2 SUMMARY

- A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.

1.3 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 02 through 11 for rough-in requirements.

1.4 ELECTRICAL INSTALLATIONS

- A. Coordinate electrical equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient Flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Coordinate the cutting and patching of building components to accommodate the installation of

electrical equipment and materials.

- G. Where mounting heights are not detailed or dimensioned, install electrical services and overhead equipment to provide the maximum headroom possible.
- H. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- I. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- J. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

1.5 SLEEVES

- A. Conduits passing through masonry and concrete walls, high stress floor slabs and roof slabs shall be Provided with segments of steel pipe sleeves. Sleeves shall finish flush with top and bottom of slab.
- B. Conduits passing through regular slab construction shall have sleeves of a minimum #26 gauge Galvanized steel. Sleeves shall be flush with finished floor. In exposed areas the sleeve shall be steel pipe extended 1-inch above finished floor.
- C. Sleeves in concrete slab or walls shall be fastened in place on forms before concrete is poured. If omitted prior to pour, cutting shall be done in accordance with "Cutting and Patching" paragraph.
- D. Location of required openings shall be the responsibility of the contractor installing conduit and appurtenances.

1.6 FIRE AND SMOKE BARRIERS

- A. Fire Proofing of holes shall be provided and shall be of specified material, and approved by the authority having jurisdiction.
- B. Cast-in Fire Stop Devices:
 - 1. Cast-in Fire Stop Devices shall be tested in accordance with UL 1479, ASTM E 814 and ASTM G21.
 - a. Maximum temperature resistance shall be 212 deg. F. (100 deg. C.)
 - b. Approved for use in concrete floor assemblies rated up to 4-hours.
 - c. Manufacturer shall be Hilti type CP 680-M, or, approved equal.
- C. All conduit penetrations in fire-rated walls and floors and designated smoke barriers shall be sealed with an approved fire barrier material.

1. System shall pass fire test exposure per ASTM E 814, UL 1479 and will provide a 3-hour fire rating.
2. Barrier shall consist of a ¼ inch thick composite sheet. Bonded on one side shall be a layer of 28 gauge galvanized steel. The other side shall be reinforced with steel wire mesh and covered with aluminum foil. Sandwiched between shall be an organic/inorganic, fire-resistive elastomeric sheet which when exposed to temperatures in excess of 250 deg. F. (121 deg. C.), the sheet shall expand 8-10 times its original size forming a hard characteristic tightly sealing against spread of flame, gases and smoke.
3. Product:
 - a. 3M Fire Barrier Composite Sheet CS-195.
 - b. All seams and edges shall be sealed with 3M CP—25 fire barrier caulk or 303putty.
4. Subject to compliance with requirements of this specification, alternate manufacturers offering similar products may be incorporated in the work.

1.7 CUTTING AND PATCHING

- A. This Article specifies the cutting and patching of electrical equipment, components, and materials to Include removal and legal disposal of selected materials, components, and equipment.
- B. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- C. Arrange for repairs required to restore other work, because of damage caused as a result of Electrical installations.
- D. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- E. Perform cutting, fitting, and patching of electrical equipment and materials required to uncover work to provide for installation of ill-timed Work;
- F. Remove and replace defective work;
 1. Remove and replace Work not conforming to requirements of the Contract Documents.
 2. Remove samples of installed Work as specified for testing;
- G. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
- H. Locate, identify, and protect electrical services passing through remodeling or demolition area and serving other areas required to be maintained operational. When transit services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

1.8 ELECTRICAL SUBMITTALS

- A. Refer to Division 01 Section: SUBMITTAL PROCEDURES for submittal definitions, requirements, and

- B. Submittal of shop drawings, product data, and samples will be accepted only when submitted by the Contractor. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

1.10 PRODUCT OPTIONS AND SUBSTITUTIONS

- A. Refer to Division 01 Section SUBSTITUTION PROCEDURES for requirements in selecting products and requesting substitutions.

1.11 NAMEPLATE DATA:

- A. Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- B. Protect stored equipment and materials from damage.
- C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.13 RECORD DOCUMENTS

- A. Refer to the Division 01 Section: PROJECT RECORD DOCUMENTS for requirements.
- B. The following paragraphs supplement the requirements of Division 01.
 - 1. Mark Drawings to indicate revisions to conduit size and location both exterior and interior. Drawings shall include final equipment locations dimensioned to column lines, concealed equipment dimensioned to column lines; distribution and branch electrical circuitry; fuse and circuit breaker size and arrangements; support and hanger details; Change Orders; concealed control system devices.
 - 2. Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

1.14 OPERATION AND MAINTENANCE DATA

- A. Refer to the Division 01 Section CLOSEOUT PROCEDURES for procedures and requirements for preparation and submittal of maintenance manuals.
- B. In addition to the information required by Division 01 for Maintenance Data, include the following

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, routine and normal operating instructions; regulation, control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.15 DEMONSTRATIONS

- A. Prior to acceptance of the work, the Contractor shall demonstrate to the Owner and the Architect, all features and functions of all systems and shall instruct the Owner in the proper operation of the systems. Each system shall be demonstrated.
- B. Prepare and submit to the Owner operation and service manuals at least two weeks prior to the scheduled demonstrations.
- C. The demonstrations shall consist of not less than the following:
 1. Point out the actual location of each component of a system and demonstrate its function and its relationship to other components within the system.
 2. Demonstrate the electrical systems by actual "start-stop" operation showing how to work controls, how to reset protective devices, how to replace fuses, and what to do in emergency.
 3. Demonstrate communication, signal, alarm and detection systems by actual operation of the systems and show how to reset signal, alarm and detection devices.
 4. Instruct the Owner's operating and maintenance personnel in the proper maintenance of the equipment supplied including, but not limited to:
 - a. Combination motor starters and motor control equipment
 - b. Panelboards
 - c. Light Fixtures and Lighting Control Systems
 - d. Miscellaneous low-voltage Systems
- D. Systems to be demonstrated shall include the following:
 1. Service and power distribution systems.
 2. Lighting and lighting controls systems.
 3. Emergency lighting systems.
 4. Motor and equipment control.
 5. Fire alarm detection and signal systems.
 6. Standby Power System.
 7. Emergency Call System.
 8. Fire Alarm System
 9. Apartment Entry Intercom and Door Access System.

- E. Contractor shall furnish the necessary trained personnel to perform the demonstrations and instructions, and shall arrange to have the manufacturer's representatives present to assist with the demonstrations.
- F. Contractor shall arrange with the Architect the dates and times for performing the demonstrations.

1.16 INSPECTION, TESTING AND START-UP

A. Scope

1. Intent: The intent of the inspection, testing, and check-out work specified herein, or required, is to ensure that all electrical workmanship and equipment, whether Owner furnished or Contractor furnished, is installed and performs in accordance with the design specifications, drawings, manufacturer's instructions and all applicable codes and requirements. Also, it is intended to provide, insure, or to determine the following:
 - a. If the equipment or installation has been subjected to damage during shipment or installation.
 - b. If the equipment is in accordance with the purchase orders and specifications.
 - c. Provide initial acceptance tests and recorded data that can be used as a benchmark for future routine maintenance and troubleshooting by Owner's maintenance forces.
 - d. Insure a successful start-up with a minimum of last-minute interruptions and problems.
 - e. Determine the suitability of the equipment and systems for energization and placing into operating service.
 - f. Provide assurance that each system component is not only installed satisfactorily but performs, and will continue to perform, its function in the system with reasonable reliability throughout the life of the project.
2. Contractor Responsibility: The Contractor shall provide all necessary supervision and labor, materials, tools, test instruments or other equipment or service and expenses required to inspect, test, adjust, set, calibrate, functionally and operationally check all work and components of the various electrical systems and circuitry shall include the installation. Also, the Contractor shall include the furnishing of sufficient personnel to assist operating forces in any additional checks they may require for acceptance, start-up, run-in and placing the equipment and systems into continuous service.
3. Independent Testing Laboratory: As specified herein, the Contractor shall engage the services of a competent nationally recognized independent electrical equipment testing laboratory or organized to perform part of the required field inspections, tests, and adjustments, specified. The testing firm shall not be a subsidiary, division, nor department of either the installing Contractor or the manufacturer of the equipment materials or systems being inspected and tested. The testing firm proposed for use by the Contractor must be approved by the Engineers and Owner prior to the close of the bid period as required under the Supplementary Conditions of the Contract. The testing firm shall be a fully accredited member of the National Electrical Testing Association, Incorporated (NETA) and have the specialized experience and skill in the supervision and performance of all inspection and testing specified herein. The Contractor shall submit proof of the proposed testing firm's qualifications, accreditation, and experience for evaluation for approval by the Engineer and Owner.
4. Testing Laboratory/Contractor Responsibility: The Contractor's engagement of the testing

firm to perform inspections and tests near the start-up and completion of the facilities in no way relieves the Contractor of the responsibility for the performance of the many and varied tests, checkouts, and inspections required during the various stages of construction.

5. Listing and Descriptions of Work: The listings and description of the inspections, tests and checks described herein shall not be considered as complete and all inclusive. Additional normal standard construction (and sometimes repetitive) checks and tests will be necessary throughout the job, prior to final acceptance of the Owner.

B. General Requirements for All Inspection, Testing and Start-Up:

1. Preparation of Procedures and Schedules: The Contractor is responsible for the preparation of proposed procedures and schedules for all inspections, test, settings and calibrations specified or otherwise required prior to or during the checkout for start-up and acceptance of all the electrical components, equipment and systems. This work shall be coordinated and shall be compatible with both the work of other crafts and the project schedule. The above must be organized and submitted with all proposed testing and checkout forms for the review and approval of the Owner's representative. The procedures must provide specific instructions for the checking and testing of each component in addition to the system functional checks. Testing and inspections shall also be scheduled as the job progresses and may require repetition in greater detail at a later stage of construction. All procedures submitted shall include job safety rules proposed.
2. Inspection of Purchased Equipment: Equipment purchased by the Contractor or purchased by the Owner for Contractor installation shall be inspected and tested to determine its condition. See other applicable sections of the specifications and contract documents for required Contractor checks and responsibilities.
3. Report of Damage: At any stage of construction and when observed, any electrical equipment or system determined to be damaged, faulty, or requiring repairs shall be reported to the Owner's representative. Corrective action may require prior approval.

C. Specific Work Scope:

1. The following items or equipment shall be tested in accordance with Section 8 of NETA STD ATS-1987.
 - a. Feeder Cables Larger than size 4/0
 - b. Circuit Breakers Larger than 250 Amperes
 - c. Grounding System
 - d. Ground Fault Systems
 - e. Surge Protective Device Systems
 - f. Emergency Lighting Systems
 - g. Automatic Lighting Control System
 - h. Emergency Electric Generator and Automatic Transfer Systems

1.17 IDENTIFICATION

- A. Provide identification for wiring systems and equipment.
- B. Lettering for identification shall be of engraved laminated phenolic tags, black background

C.

with 1/2" high white lettering. Tags shall be held in place with small bolts and nuts; adhesive tape of any form shall not be acceptable. All central equipment shall be identified with phenolic tags.

C. Panelboards within equipment rooms or closets, motor and equipment controls, disconnect switches and similar equipment may be identified with one half inch black lettering in lieu of with phenolic tag. Flush mounted panels shall be lettered inside the door.

D. All major pull and junction boxes in service areas, tunnels, above accessible ceilings and in accessible chases shall have 1/2" black lettering identifying the feeder or system. In addition: Panelboards and boxes, as well as covers, for emergency systems shall be painted with the finish color as follows:

- | | |
|---------------------------------|--------|
| 1. Emergency | Red |
| 2. Critical | Orange |
| 3. Essential Automatic Services | Yellow |
| 4. Fire Alarm | Red |

E. Equipment and panelboards shall be color coded only within equipment rooms.

F. Panelboards, equipment and boxes for emergency wiring systems shall be identified with red lettering or on a red background.

G. Systems with conductors exceeding 250 volts to ground shall have voltage identification stenciled with 1/2" high black letters on all panels, switches, pull boxes, junction boxes, and every 30' on exposed conduits. Flush panels shall be lettered inside the door. Example: "208 VOLTS".

H. Panelboards shall have typewritten circuit directories installed inside the doors under transparent plastic cover. Circuit directories shall identify, for each circuit, the type of load (lighting, outlets, equipment item) and room numbers of areas served.

I. Power panels and switchgear, without doors, shall have circuit breakers and switches identified by engraved plastic tags attached to the cabinet adjacent to the device.

J. Central equipment phenolic nameplates shall be on the equipment doors.

1.18 CONCRETE WORK

A. Provide concrete bases and housekeeping pads for electrical equipment where required. Concrete bases and housekeeping pads shall be 4" high having a 3000 PSI compressive strength after a 28 day cure. Reinforcement shall be 6" x 6" x W1.4/W1.4 wire mesh covering the plan view dimension of the base and centered vertically within the base pad.

B. Provide equipment anchor bolts and coordinate installation and accurate location.

1.19 EXCAVATING, TRENCHING AND BACKFILLING

A. Complete excavating necessary for underground wiring, conduit and duct banks. Backfill trenches

and excavations after work has been inspected. Work shall be in accordance with the requirements as follows, and the requirements of Section 02 50 00. Care shall be taken in excavating, that walls and footings and adjacent load bearing soils are not disturbed in any way, except where lines must cross under a wall footing. Where a line must pass under a footing, the crossing shall be made by the smallest possible trench to accommodate the conduit. Excavation shall be kept free from water by pumping, if necessary. No greater length of trench shall be left open, in advance of conduit installation, than that which is authorized or directed by the Owner's Representative.

- B. Roots shall be removed to a level 18" below finished grades and deeper as required for duct runs, manholes, and light pole bases. No roots shall be allowed to remain under the work.
- C. Backfill about the structures shall be placed, when practicable, as the work of construction progresses. Backfilling on or against concrete work shall be done only when directed. Backfilling of duct lines shall progress as rapidly as the testing and acceptance of the finished sections of the work will permit and shall be carried to a crown approximately 6" above the existing grades. In backfilling around duct lines, fill sand shall be compacted firmly around and to a depth of not less than 6" over the top of the duct. Fill, backfill and rough grading shall be compacted thoroughly in layers, and shall be brought up to within 6" of finished grades. The final layer of backfill, from 6" below to 6" above grade, shall be done using good quality topsoil. Fill and backfill shall be clean and free from vegetable matter and refuse.

1.20 WARRANTIES

- A. Refer to the Division 01 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.
- B. Compile and assemble the warranties specified in Division 26, into a separate set of vinyl covered, three ring binders, tabulated and indexed for easy reference.
- C. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.21 CLEANING

- A. Refer to the Division 01 Section 01 77 00 CLOSEOUT PROCEDURES for general requirements for final cleaning.
- B. Clean all light fixtures, and lenses prior to final acceptance. Replace all inoperable LED light engines or modules.

END OF SECTION 260510

SECTION 260519 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 Edition the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

PART 2 – PRODUCTS

2.1 GENERAL

- A. This Section describes the basic materials and methods of installation for general wiring systems of 600 volts and less. Wiring for a higher voltage rating shall be as specified in other Sections.
- B. Minimum size conductors shall be No. 14 AWG for power and lighting and No. 14 AWG for signal and control.

2.2 MATERIALS

- A. The material used for the wiring systems shall be the products of a manufacturer regularly engaged in the manufacturing of the specified material. Where a manufacturer is named for a particular material, the material of other manufacturers will be acceptable provided the material meets requirements of the Specifications.

2.3 WIRE AND CABLE

- A. Wire and cable for power, lighting, control and signal circuits shall have copper conductors of not less than 98% conductivity. Provide conductor material as indicated on Drawings. All conductors larger than #10 AWG shall be stranded.
- B. Type of wire and cable for the various applications shall be as follows:
 - 1. Type THW, THWN or XHHW (75°C.): Use for branch circuits, panel and equipment feeders

- In wet and dry locations.
2. Type RHH, THHN or XHHW (90°C.): Use for branch circuits, panel and equipment feeders in dry location only. Use where lighting branch circuit conductors are routed through fixture channels.
 3. Type TW dry and wet locations, Type "T" dry locations only (60°C.): Use for low voltage signal and control circuits operating at 25 volts or less.
 4. Type A (150°C.): Use for field tap-off connections to high operating temperature equipment connections where operating temperature exceeds 90°C.
 5. Type "XHHW" (75°C.): Use for all branch circuit wiring from Surgical Panels within the procedures rooms OR #1 through 4. Contractor shall not use wire pulling compound which increases the dielectric constant of the wire, which increases the leakage current. Use only talcum powder or powdered soap stone as a lubricant to aid in pulling the wires.
- C. Home runs to panelboards 75 feet in length or over shall be not less than #10 AWG, whether shown or not shown on the Drawings. See Drawings for additional requirements.
- D. Armored Cable (AC) and Metal Clad (MC) cable types may be used where allowable per NEC Article 334 and/or 330, as applicable.
- E. Nonmetallic Sheathed Cable (NM/NMC/NMS) shall be used on this project where allowable per Article 334.

2.4 CONDUCTOR COLOR CODING

- A. Wiring systems shall be color coded. Ungrounded conductor insulation shall be colored in sizes up through No. 10 AWG, conductors No. 8 AWG and larger shall have black insulation and shall be phase color coded with ½" band of colored tape at all pull boxes, junctions and terminations. Colors shall be assigned to each conductor as described below and carried throughout all main and branch circuit distribution.

	<u>120/240 V</u>
1. Phase "A" Line Conductor -	Black
2. Phase "B" Line Conductor -	Red
3. Phase "C" Line Conductor -	Blue
4. Grounded Conductor (Sizes #6 AWG or smaller)* -	White
5. Equipment Grounding Conductor (Sizes #6 or smaller)* -	Green

*Refer to NEC Articles 200.6, and 250.119 for specific requirements and limitations.

2.5 CONNECTORS

- A. In-line splices and taps for conductor sizes No. 8 AWG and smaller: Use 3M Co. "Scotchloc" vinyl insulated spring connectors or Architect approved equivalent.
- B. In-line connectors for conductor sizes No. 6 AWG and larger: Use THOMAS & BETTS two way connectors long barrel type, Series 54800 with Interlocking Covers or Architect approved equivalent.

- C. Taps for conductor sizes No. 6 AWG and larger: Use THOMAS & BETTS "C" Taps, Series 54700 or Architect approved equivalent.
- D. Cable terminations to bus bars, switch studs and terminal blocks: Use two hole lugs, long barrel mechanical type.
- E. Insulate splices and taps to thickness of conductor insulation with half-lapped layers of 3M "Scotch" brand No. 88 vinyl electrical tape or Architect approved equivalent. Connectors having irregular surfaces: Fill voids and smooth contours with 3M "Scotchfil" electrical putty prior to taping.
- F. Splices to existing aluminum wiring shall be made using aluminum to copper lug connectors (AL-CU).
 - 1. AL-CU connectors shall be approved by the Consumer Products Safety Commission (CPSC).
 - 2. Maximum voltage shall be 300V.
 - 3. For wire range from #18 to #10.
 - 4. Temperature rating of 105 deg. C.
 - 5. Flammability rating: V-2.
 - 6. Tin plated lug with nickel-plated compression screws.
 - 7. Ports of connectors shall contain a Corrosion Inhibitor to provide resistance from oxidation.
 - 8. Aluminum to Copper lugs shall be type "AlumiConn" as manufactured by King Innovation.

PART 3 – EXECUTION

3.1 PREPARATION

- A. Wire shall not be installed in the conduit system until the building is enclosed and masonry work is completed.
- B. Conduit shall be swabbed free of moisture and debris prior to pulling in wire.

3.2 INSTALLATION

- A. Cable for all feeders shall be continuous from origin to termination.
- B. Splices in branch circuit wires shall be made only in accessible junction boxes.
- C. Power feeder cable shall be pulled with cable lubricating compound suitable for the wire insulation and conduit it is used with. Compound shall not harden or become adhesive.
- D. All receptacles and equipment circuits shall be provided with a separate, green, insulated copper grounding conductor, #12 minimum run with the circuit conductors.
- E. Install wiring in raceway systems, as indicated on the Drawings and as specified, except here exposed or direct burial wiring is indicated or specified. Install wiring only in

completed raceway systems and when systems are protected from the weather. Install conductors continuous, without splices are required, make-up slices in boxes; do not use fittings for same. Sufficient lengths shall be left at outlets, boxes, etc., for splicing and connecting to apparatus without straining.

- F. Install conductors in such a manner that the bending radius of any wire or cable is not less than the minimum recommended by IPCEA and/or the manufacturer. Do not exceed manufacturer's recommended values for maximum pulling tension applied to any wire or cable.
- G. Branch circuit wiring for lighting and receptacle shall be installed in accordance with layout shown on the Drawings and shall be divided and approximately balance about the neutral.
 - 1. Phasing for all feeder and branch circuit wiring shall be color coded. Color Code system shall be per NEC.
- H. UL Type W rope lay cable shall be installed in open cable tray and shall be supported at 6" intervals. Installation shall be in strict accordance with NEC Article 392.

3.3 TESTING

- A. After wires and cables are in place and before being connected to device and equipment, the system shall be tested for shorts and grounds.
- B. All hot wires, if shorted or grounded, shall be removed and replaced.
- C. All meters, cables, connections, equipment, or apparatus necessary for making tests shall be furnished by the Contractor.

3.4 SPLICES AND TERMINATION

- A. Splice and terminate conductors with connections and lugs as specified for the specific size and type of conductor. Indent all compression type connectors and lugs with tools recommended by the connector or lug manufacturer.
- B. Thoroughly clean wire ends before connectors or lugs are applied.
- C. Insulate all bare surfaces of conductors with a minimum of four (half lap in two directions) of electrical insulating tape. On larger splices and terminals, build up connection with electrical insulating putty before applying tape, to eliminate both sharp edges and voids. The insulating value of the joint or splice must be at least equal to the insulating value of the conductor to which it is applied.

END OF SECTION 269519
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SECTION 260526 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 SUMMARY

- A. Section includes:
 - 1. System grounding
 - a. Secondary service neutrals shall be grounded at the supply side of the secondary disconnecting means and at the related transformers.
 - b. Separately derived systems (transformers downstream from the service entrance) shall have the secondary neutral grounded.
 - 2 . Equipment bonding
 - a. All metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames and other conductive items in close proximity with electrical circuits shall be bonded for personnel safety and to provide a low impedance path for possible ground fault currents.

1.4 SUBMITTALS

- A. Submit catalog cuts and descriptive literature with sufficient information, clearly presented, to determine compliance with contract documents.
- B. Submit certified test reports of ground resistance.
- C. Submit, two weeks prior to final inspection, certification that the material and installation is in

accordance with the contract documents and has been properly installed.

PART 2 – PRODUCTS

2.1 GROUNDING WIRES

- A. Grounding wires shall be UL and NEC approved types, copper, insulated and color identified green, except where indicated otherwise.
- B. Wire size shall not be less than that indicated on the drawings and not less than required by the 2023 NEC.

2.2 GROUND RODS

- A. Ground rods shall be copper clad steel, 3/4" diameter x 10'-0" long.

2.3 GROUNDING SYSTEM

- A. Fixed equipment, lighting and receptacles shall be grounded and bonded with separate green insulated ground conductor sized in accordance with NEC, minimum size #14, run with circuit conductors.
- B. Ground system shall be obtained by extending insulated ground conductor throughout the system from the service entrance point. Equipment ground conductors shall be sized in accordance with NEC Table 250.122.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Grounding shall be in accordance with 2023 NEC and as indicated in the Contract Documents.

3.2 EQUIPMENT AND CIRCUITS

- A. Connect the secondary service neutral to the ground bus in the service equipment.
- B. Distributions Panels, Power Panels, and Panelboards.
 - 1. Connect the various feeder green grounding conductors to the ground bus in the enclosure with suitable pressure connectors.
 - 2. Connect the grounding electrode conductors to the ground bus.
 - 3. Connect the neutral to the ground bus (main bonding jumper).
 - 4. Connect metallic conduits, which terminate without mechanical connection to the housing, by grounding bushings and ground wire to the ground bus.
 - 5. The equipment grounding terminal buses of the normal and essential branch-circuit panelboards serving the same individual patient care vicinity shall be connected together with an insulated continuous copper conductor not smaller than 10 AWG.

C. Separately Derived Systems:

1. Separately derived systems (transformers and engine generators downstream from service equipment): ground the secondary neutral at the transformer or generator. Provide a grounding electrode conductor from the engine generator to the nearest cold water pipe and to a driven ground rod at generator. Provide a grounding electrode conductor from each transformer to the nearest cold water pipe and to the building steel. All exterior transformers shall be grounded to the nearest cold water pipe and to a driven ground rod.

D. Conduit System

1. Ground all metallic conduit systems
2. Conduit provided for mechanical protection containing only a grounding conductor shall be bonded to that conductor at the entrance and exit from the conduit.

E. Feeders and branch circuits: Install green insulated grounding conductors with all feeders and branch circuits.

F. Boxes, cabinets, enclosures and panelboards

1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets and other enclosures through which the ground wires pass (except for special grounding systems for critical systems indicated on the drawings).
2. Provide lugs in each box and enclosure for ground wire termination.
3. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.

G. Motors and starters

1. Provide lugs in motor terminal box and starter housing for ground wire termination.
2. Make ground wire connections to ground bus in power and distribution panels.

END OF SECTION 260526

SECTION 260529 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 DESCRIPTION OF WORK

- A. Extent of supports, anchors, sleeves and seals is indicated by drawings and schedules and/or specified in other sections of this specification.
- B. Types of supports, anchors, sleeves and seals specified in this section include the following:
 - 1. Clevis hangers
 - 2. C-clamps
 - 3. I-beam clamps
 - 4. Conduit straps
 - 5. Round steel rods
 - 6. Lead expansion anchors
 - 7. Toggle bolts
 - 8. Wall and floor seals
 - 9. Power-driven threaded studs
- C. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly in other sections of this specification.

PART 2 - PRODUCTS

2.1 MANUFACTURED SUPPORTING DEVICES

- A. General: Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device

meets indicated requirements, selection is Installer's option.

- B. Supports: Provide supporting devices of types, sizes and materials indicated; and having the following construction features:
- C. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with ½" dia. hole for round steel rod; approximately 54 pounds per 100 units.
- D. Reducing Couplings: Steel rod reducing coupling, ½" x 5/8"; black steel; approximately 16 pounds per 100 units.
- E. C-Clamps: Black malleable iron; ½" rod size; approximately 70 pounds per 100 units.
- F. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
- G. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
- H. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
- I. Hexagon Nuts: For ½" rod size; galvanized steel; approximately 4 pounds per 100 units.
Round Steel Rod: Black steel; ½" dia.; approximately 67 pounds per 100 feet.
- J. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.
- K. Anchors: Provide anchors of types, sizes and materials indicated, with the following construction features:
 - 1. Lead Expansion Anchors: ½"; approximately 38 pounds per 100 units.
 - 2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.
 - 3. Power-driven threaded studs: Heat-treated steel, designed specifically for the intended service.
 - 4. Manufacturers: Subject to compliance with requirements, provide anchors of one of the following:
 - a. Abbeon Cal Inc.
 - b. Ackerman Johnson Fastening Systems Inc.
 - c. Elcen Metal Products Co.
 - d. Hilti Manufacturing
 - e. Ideal Industries, Inc.
- L. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated; with the following construction features:

1. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls.
 2. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- M. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- N. U-Channel Strut Systems:
1. Provide U-channel strut system for supporting electrical equipment, 12-gage hot-dip galvanized steel, of types and sizes indicated; construct with 9/16" dia. holes, 8" o.c. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:
 - a. Fixture hangers
 - b. Channel hangers
 - c. End caps
 - d. Beam clamps
 - e. Wiring studs
 - f. Thin wall conduit clamps
 - g. Rigid conduit clamps
 - h. Conduit hangers
 - i. U-bolts
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering channel systems which may be incorporated in the work include, but are not limited to, the following:
 - a. Allied Tube and Conduit Corp.
 - b. B-Line Systems, Inc.
 - c. Elcen Metal Products Co.
 - d. Greenfield Mfg Co., Inc.
 - e. Midland-Ross Corp.

2.2 FABRICATED SUPPORTING DEVICES

- A. Pipe Sleeves: Provide pipe sleeves of one of the following:
1. Sheet-Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate sleeves from the following gage metal: 3" and smaller, 20-gage; 4" to 6", 16-gage; over 6", 14-gage.
 2. Steel-Pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.
 3. Iron-Pipe: Fabricate from cast-iron or ductile-iron pipe; remove burrs.
 4. Plastic-Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.

- B. Sleeve Seals: Provide sleeve seals for piping which penetrates foundation walls below grade, or exterior walls. Calk between sleeve and pipe with non-toxic, UL-classified caulking material to ensure watertight seal.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES:

- A. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installation of supporting devices.
- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with spacings indicated and in compliance with NEC requirements.
- D. Torque sleeve seal nuts, complying with manufacturer's recommended values. Ensure that sealing grommets expand to form watertight seal.

END OF SECTION 260529

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The materials used in the fabrication of the raceway and outlet box systems shall be products of a manufacturer regularly engaged in the manufacturing of the specified material. Where a manufacturer is named for a particular material, the material of other manufacturers shall be acceptable provided the material meets requirements of the Specification.

2.2 CONDUIT

- A. Rigid Galvanized Steel Conduit: Full weight, threaded, rigid steel conduit, galvanized inside and out by hot-dip or electro-galvanizing process. Provide thread protective caps and coupling plugs to prevent injury to threads during handling. Use rigid galvanized steel conduit in interior spaces where exposed and subject to physical damage such as vertical and horizontal runs installed within 10 feet of finished floor, and for all conduit applications regardless of size where installed in earth fill or in poured concrete walls, columns, floors or other concrete structures.
- B. Flexible Metal Conduit (1/2" min. size, 36" max. length except for light fixture connections which may be up to 72" long): Formed of one continuous length of spirally wound electro-galvanized steel strip. Use for: Final connections to motor operated equipment such as unit heaters, fans, air handling units, pumps and connections to dry type transformer connections from junction boxes to power pole junction boxes, connections from junction boxes to lighting fixtures and for wiring within casework and millwork. The use of "Super Flex" metal conduit is prohibited.
- C. Liquid tight Flexible Metal Conduit (1/2" min. size, 36" max. length): Formed of one continuous length of spirally wound steel strip, with water and oil tight neoprene jacket. Use for final connections to equipment located in wet areas and at all exterior locations.

- D. PVC Conduit: Schedule 40, 90.C conduit shall be composed of polyvinyl chloride and shall conform to NEMA Standards. Conduit fittings and cement shall be by the same manufacturer. PVC conduit may be used for installations where buried outside of the building, encased in concrete or below slabs on grade. Rigid conduit shall be used in all areas of high stress.
- E. Electrical metallic tubing (EMT) may be used for lighting and receptacle branch circuit wiring, auxiliary systems wiring, and HVAC control wiring concealed above furred ceilings and in partitions within finished areas. EMT may also be used for feeders run through the building where not exposed to physical damage. EMT shall be zinc-coated steel conforming to ANSI "Specification for Electrical Metallic Tubing, Zinc-Coated"; Triangle, Youngstown, or as approved by Architect.

2.3 CONDUIT FITTINGS

- A. Rigid Galvanized Steel Conduit Fittings: Threaded, galvanized malleable iron or heavy steel, water and concrete tight. Grounding type nylon insulated bushings for connectors at cabinets, boxes and gutters.
- B. Electrical Metallic Tubing Fittings: Set screw type galvanized malleable iron or steel. Connectors with nylon insulated throats at cabinets, boxes and gutters.
- C. Flexible Metal Conduit Fittings: Squeeze, screw, or set screw type galvanized malleable iron or steel with nylon insulated throats.
- D. Liquid-tight Flexible Conduit Fittings: Galvanized malleable iron or steel with watertight gaskets, "O" ring and retainer, and nylon insulated throats.
- E. Conduit Fittings: Exposed conduit fittings shall be conduit type for sharp turns and tees. Minimum radius shall be compatible with the cable to be installed.

2.4 AUXILIARY GUTTERS

- A. Construction, sizes and installation of auxiliary gutters shall comply with NEC, Article 374.

2.5 EXPANSION JOINTS

- A. Conduits 3" and larger, rigidly secured to building construction on opposite sides of a building expansion joint, shall be provided with expansion and deflection couplings. The couplings shall be installed in accordance with the manufacturer's written instructions.
- B. Conduits smaller than 3" shall be provided with junction boxes on both sides of the expansion joint, and connected by 15" of slack flexible conduit. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above may be installed.
- C. Expansion and deflection couplings shall also be installed where shown on the drawings.

2.6 BOXES AND FITTINGS

- A. **Outlet Boxes:** Provide galvanized flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities and sizes, including box depths as indicated, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
- B. **Outlet Box Accessories:** Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
- C. **Device Boxes:** Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with cable-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide cable clamps and corrosion-resistant screws for fastening cable clamps, and for equipment type grounding.
- D. **Device Box Accessories:** Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster board expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.
- E. **Raintight Outlet Boxes:** Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.
- F. **Junction and Pull Boxes:** Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.
- G. **Floor Boxes:** Provide cast-iron watertight adjustable floor boxes as indicated, with threaded-conduit-entrance ends, and vertical adjusting rings, gaskets, brushed aluminum floor plates and flush screw-on covers with ground flange and stainless steel cover screws.
 - 1. **Floor Box Accessories:** Provide flush type two-pole, three-wire, grounded-pole, 125 volts, 20-amperes, floor-type receptacles with flanges.
- H. **Bushings, Knockout Closures and Locknuts:** Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.
- I. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering

outlet boxes which may be incorporated in the work include, but are not limited to, the following

:

1. Adalet-PLM Div, Scott Fetzer Co.
2. Appleton Electric
3. Square D Company.
4. Midland-Ross Corp.
5. OZ/Gedney; General Signal Co.
6. RACO Div; Harvey Hubbell Inc.
7. Thomas & Betts Co.

PART 3 - EXECUTION

3.1 CONDUIT INSTALLATION

- A. In general, horizontal runs of conduit shall be installed in ceiling plenum. Conduit for convenience outlets, wall mounted fixtures and other wall outlets shall be routed overhead and dropped through wall to the outlet. Conduit shall not be installed in concrete floor slabs except where conditions will not permit the conduit to be routed overhead. Where the installation of concealed conduit is not possible due to the existing building's construction, a finished surface mounted raceway "Wiremold" shall be installed. Surface raceway shall be installed perpendicular to and/or parallel to walls and ceilings. Finished surface raceways shall, where possible, be run low on the wall. Where this is not possible due to door openings, mechanical fan coil units, and air conditioning units, the surface raceway shall be installed on the wall at the intersection of the ceiling and wall.
- B. Generally, conduit shall be concealed, except in parking garage, crawl spaces, tunnels, shafts, mechanical equipment rooms, and at connections to surface panels and free standing equipment, and as otherwise noted.
- C. Prior to the installation of any finished surface mounted raceway "Wiremold" (or approved equal), the routing shall be reviewed with and approved by the Architect. Failure to gain written approval will cause the Electrical Contractor, at his own expense, to remove and reinstall the finished raceway as directed by the project Architect.
- D. Conduit installed above corridor ceilings, in tunnels or chases and exposed shall be routed in lines parallel to building construction.
- E. No conduit shall be installed less than 6" from piping installed by other trades.
- F. Certain conduits are permitted to be embedded in structural concrete work. Contractor shall cooperate with other Contractors of their respective trades to effect the following:
 1. Reinforcing steel shall be securely anchored in place before installing conduit.
 2. No steel reinforcing shall be displaced from plan dimensions without approval of Architect.
 3. Conduit shall not be placed over top of reinforcing or under bottom of reinforcing.
 4. Conduit and fittings shall not displace concrete in columns in excess of 4% of total cross-

- section area of column without approval of Architect.
5. Conduit shall not be placed closer than three diameters on center.
 6. Maximum size of embedded conduit or pipe shall not exceed 1/3 thickness of structural slab; 2/3 thickness of topping slab.
- G. Minimum size conduit shall be 1/2" for power, control and lighting and 3/4" for communications applications. Where specific sizes required by Drawings or Specifications are larger than Code requirements, the larger size shall be provided. (Size conduit for THW wire.)
- H. Install the conduit system mechanically and electrically, continuous from outlet to outlet and to cabinets, junction or pull boxes. Conduit shall enter and be secured to cabinets and boxes in such a manner that all parts of the system will have electrical continuity.
- I. Rigid galvanized steel metal conduit buried in earth fill shall be coated with an Architect approved corrosion resistant material.
- J. In all exterior work, provide rigid galvanized steel conduit work with corrosion
- K. Where cable trays are installed for communications cables, conduit shall be installed from the equipment junction box to the cable tray.
- L. Communications conduit bends shall be made so that the radius of the curve of the inner edge is not less than ten times the conduit outside diameter.
- M. Install a nylon braided polyester or propylene pull cord with 12" minimum slack at the ends for each empty telephone/data communications conduit.
- N. All conduit shall be concealed in all finished areas. All corridors, supply rooms, storage rooms, locker and shower rooms, etc., shall be considered as finished spaces.

3.2 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

- A. General: Install electrical boxes and fittings where indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.
- C. Outlets installed indoors and outdoors in wet locations shall have an enclosure which is weatherproof whether or not the attachment cap is inserted.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Install electrical boxes in those locations to ensure ready accessibility to enclosed electrical wiring.
- F. Avoid installing boxes back-to-back in walls. Provide not less than 6" (150 mm) separation.

- G. Under no circumstances shall aluminum products be installed in concrete.
- H. Position recessed outlet boxes accurately to allow for surface finish thickness.
- I. Set floor boxes level and flush with finish flooring material.
- J. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.
- K. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry.
- L. Provide electrical connections for installed boxes.
- M. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.3 GROUNDING

- A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

END OF SECTION 260533

SECTION 260553 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code .
- B. Materials shall be UL and NEC approved for the application.
- C. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to electrical identification systems.
- D. ANSI Compliance: Comply with applicable requirements of ANSI Std A13.1, "Scheme for the Identification of Piping Systems".
- E. NEMA Compliance: Comply with applicable requirements of NEMA Std No's. WC-1 and WC-2 pertaining to identification of power and control conductors.

1.3 DESCRIPTION OF WORK

- A. Types of electrical identification work specified in this section include the following:
 - 1. Buried cable warnings.
 - 2. Electrical power, control and communication conductors.
 - 3. Operational instructions and warnings.
 - 4. Danger signs.
 - 5. Equipment/system identification signs.
 - 6. Electrical devices.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's data on electrical identification materials and products.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering

electrical identification products which may be incorporated in the work include, but not limited to, the following:

1. Brady, W.H. Co.
2. Calpico Inc..
3. Direct Safety Co.
4. George-Ingraham Corp.
5. Ideal Industries, Inc.
6. Markal Company.
7. National Band and Tag Co.
8. Panduit Corp.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

- A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.
- B. Color-Coded Conduit Markers:
 1. General: Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, plastic-sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive, adhesive lap joint of marker, matching adhesive plastic tape at each end of marker, or pre-tensioned snap-on. Except as otherwise indicated, provide lettering which indicates voltage of conductor(s) in conduit. Provide 8" minimum length for 2" and smaller conduit, 12" length for larger conduit.
 2. Colors: Unless otherwise indicated or required by governing regulations, provide white markers with black letters.
 3. Color-Coded Plastic Tape:
 - a. General: Provide manufacturer's standard self-adhesive vinyl tape not less than 3 mils thick by 1-1/2" wide.
 - b. Colors: Unless otherwise indicated or required by governing regulations, provide orange tape.
 4. Underground-Type Plastic Line Marker:
 - a. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates type of service of buried cable.
 5. Cable/Conductor Identification Bands:
 - a. General: Provide manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers of wrap-around type; either pre-numbered plastic coated type, or write-on type with clear plastic self-adhesive cover flap; numbered to show circuit identification.

6. Plasticized Tags:

- a. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention and operational tags, of plasticized card stock with matt finish suitable for writing, approximately 3-1/4" x 5-5/8", with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary working, e.g., DANGER, CAUTION, DO NOT OPERATE.

7. Self-Adhesive Plastic Signs:

- a. General: Provide manufacturer's standard, self-adhesive or pressure-sensitive, pre-printed, flexible vinyl signs for operational instructions or warnings; of sizes suitable for application areas and adequate for visibility, with proper wording for each application, e.g., 208V, EXHAUST FAN, RECTIFIER.
- b. Colors: Unless otherwise indicated, or required by governing regulations, provide white signs with black lettering.

8. Baked Enamel Danger Signs:

- a. General: Provide manufacturer's standard "DANGER" signs of baked enamel finish on 20-gage steel; of standard red, black and white graphics; 14" x 10" size except where 10" x 7" is the largest size which can be applied where needed, and except where larger size is needed for adequate vision; with recognized standard explanation wording, e.g., HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH.

9. Engraved Plastic-Laminate Signs:

- a. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- b. Thickness: 1/16", for units up to 20 sq. in or 8" length; 1/8" for larger units.
- c. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.3 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturer or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions, and requirements of NEC.
2. Coordination: Where identification is to be applied to surfaces which require finish, install identification after completion of painting.
3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:

1. General: Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on electrical conduit in manner similar to piping identification. Except as otherwise indicated, use white as coded color for conduit.

C. Underground Cable Identification:

1. General: During back-filling/top-soiling of each exterior underground electrical, signal or communication cable, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
2. Limit use of line markers to direct-burial cables.
3. Install line marker for every buried cable, regardless of whether direct-buried or protected in conduit.

D. Cable/Conductor Identification:

1. General: Apply cable/conductor identification, including voltage, phase and feeder number, on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present, except where another form of identification (such as color-coded conductors) is provided. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project's electrical work.

E. Operational Identification and Warnings:

1. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on switches, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

F. Danger Signs:

1. General: In addition to installation of danger signs required by governing regulations and authorities, install appropriate danger signs at locations indicated and at locations subsequently identified by Installer of electrical work as constituting similar dangers for persons in or about project.
2. High Voltage: Install danger signs wherever it is possible, under any circumstances, for persons to come into contact with electrical power of voltages higher than 110-120 volts.
3. Critical Switches/Controls: Install danger signs on switches and similar controls, regardless of whether concealed or locked up, where untimely or inadvertent operation (by anyone) could result in significant danger to persons, or damage to or loss of property.

G. Equipment/System Identification:

1. General: Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems, unless unit is specified with its own self-explanatory identification or signal system. Except as otherwise indicated, provide single line of text, ½" high lettering on 1-1/2" high sign (2" high where 2 lines are required), white lettering in black field. Provide text matching terminology and numbering of the contract documents and shop drawings. Provide signs for each unit of the following categories of electrical work:
2.
 - a. Panelboards, electrical cabinets and enclosures.
 - b. Access panel/doors to electrical facilities.
 - c. Major electrical switchgear.
 - d. Automatic transfer equipment.
 - e. Fire alarm master station.
2. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate the substrate.

G. Electrical Device Branch Circuit Identification:

1. The branch circuit supplying each receptacle shall be identified on the inside of the device cover plate with a "Dymo" label. Identification shall include the panel serving the device and the branch circuit number.

END OF SECTION 26 05 53

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.
- C. Requirement of ANSI/ASHRAE/IES Standard 90.1 – 2019, Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.3 MICHIGAN UNIFORM ENERGY CODE COMPLIANCE

- A. DRAWINGS: Within 30 days after the date of system acceptance, the electrical contractor shall submit record drawings of the actual electrical installation to the building owner, including:
 - 1. A single line diagram of the building electrical distribution system and;
 - 2. Floor plans indicating location and area served for all distribution.
- B. MANUALS: An operating and maintenance manual shall be provided to the building owner. The manuals shall include, at a minimum, the following:
 - 1. Submittal Data stating equipment rating and selected options for each piece of equipment requiring maintenance.
 - 2. Operation manuals and maintenance manuals for each piece of equipment requiring maintenance required routine maintenance actions shall be clearly identified.
 - 3. Names and address of at least one qualified service agency.
 - 4. A complete narrative of how each system is intended to operate.

1.4 SUMMARY

- A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated, energy saving, lighting control system including Programmable Lighting Controller, and Occupancy Sensor Controls from a single supplier.

- B. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.5 SUBMITTALS

- A. Submit manufacturer's data on lighting control system and components including shop drawings, detailed point to point wiring diagrams, and floor plans showing occupancy and daylighting sensor locations. Provide typical mounting details for occupancy and daylighting sensors for this application.

1.6 MANUFACTURERS

- A. Subject to compliance with requirements, provide lighting controls of one of the following manufacturers:
 - 1. Watt Stopper
 - 2. Acuity Controls
 - 3. Leviton
 - 4. Greengate
 - 5. Lutron
- B. Prior approval does not guarantee final approval by the electrical engineer. The contractor shall be completely responsible for providing a system meeting this specification in its entirety. All deviations from this specification must be listed and individually signed off by the consultant.

PART 2 - PRODUCTS

2.1. OCCUPANCY SENSORS AND POWER PACKS

- .A. Occupancy Sensors:
 - 1. Passive infrared sensors shall:
 - a. Utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.
 - b. Provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
 - c. Have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
 - 2. Dual technology sensors shall:
 - a. Be either corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
 - b. Use passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

3. Ultrasonic sensors shall:
 - a. Utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and airflow throughout controlled space.
 - b. Have an ultrasonic operating frequency that is crystal controlled at 25 kHz within 0.005% tolerance, 32 kHz within 0.002% tolerance, or 40 kHz within 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
4. General Requirements:
 - a. All sensors shall be capable of operating normally with Light Emitting Diode Drivers.
 - b. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
 - c. Where specified, sensors shall utilize technology for automatically adjustable time delay and sensitivity settings.
 - d. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
 - e. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
 - f. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
 - g. Where specified, sensors shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

B. Relay Modules – Power Packs:

1. For ease of mounting, installation and future service, the relay module – power pack unit(s) shall be able to externally mount through a 1/2" knock-out on a standard electrical outlet box or enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control units shall provide power to a minimum of two (2) sensors.
2. For applications where dimming is required, the relay module shall include a 0-10V

dimming output.

3. Where lighting fixtures operated through the emergency generator system are indicated, a power pack – relay module with 0-10V dimming and a means to transfer to emergency power shall be provided.
4. Relay Contacts shall have ratings of:
 - a. 20A - 120 VAC Ballast
 - b. 20A - 277 VAC Ballast
5. Control wiring between sensors and relay module – power pack units shall be Class II, 18-20 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.
 - a. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

C. Photocell Sensors:

1. Each photo sensor shall be mounted in the appropriate location for measuring the available daylight. Each sensor shall have a control/calibration module. Settings shall be located on the sensor and shall be recessed to limit tampering.

D Manual Lighting Control Stations:

1. Manual control lighting control stations shall provide On/Off, or On/Off & Raise/Lower lighting control.
 - a. Lighting control stations shall mount in a single gang wall outlet box or low-voltage ring.
 - b. Control stations shall enable local control of a lighting zone.
 - c. Control stations shall provide 0-10V low-voltage dimming.

2.2 WALLBOX DIMMERS

A. General Requirements:

1. Utilize air gap off, activated when user selects "off" to disconnect the load from line supply.
2. Provide air gap service switch accessible without removing faceplate.
3. Operates at the rated capacity across the full ambient temperature range including modified capacities for ganged configurations which require removal of fins.
4. Provide radio frequency interference suppression.

5. Surge Tolerance: Designed and tested to withstand surges of 6,000 V, 200 amps according to IEEE C62.41.2 without impairment to performance.
 6. Dimmers: Provide full range, continuously variable control of light intensity.
- B. Preset Wall Dimmers:
1. Dimmer Control: Paddle switch for on/off operation with small, discrete, captive linear slide for dimmer adjustment.
 2. 3-Way Dimmers: Provides multi-location capability using standard 3-way and 4-way mechanical switches.
 3. Dimmers:
 - a. Dimmers for Electronic Low Voltage (ELV) Transformers: Minimum of 90 percent of line voltage.
 - b. 0-10V control for 0-10V LED drivers (50 mA max control current); no power pack required to switch line voltage load (8 A, 120-277 V); adjustable high-end and low-end trim.
 - c. Preset Dimmer; 0-10V control for 0-10V LED drivers (30 mA max control current); 24 V, requires power pack to switch line voltage load; adjustable high-end and low-end trim;
4. Dimmer Control:
- a. LED bar for on/off operation.
 - b. Dimmer Control: Single touch LED bar with one portion of bar for on/off operation and one portion for dimmer adjustment.
 - c. Single touch of light level adjustment control portion of LED bar raises/lowers lights, with new level becoming the current preset level.
 - d. Single touch of on/off control portion of LED bar raises lights to preset level or fades lights to off.
 - e. Provide audible feedback for touch control confirmation.
 - f. LED bar indicates on/off status and current light level, and functions as locator light when dimmer is off.
 - g. Advanced Programming Mode: Provide for customized adjustment of dimmer functions.
 - 1) High/low end trims.
 - 2) LED brightness.
 - 3) Sound on/off.
 - 4) Off fade time.
 - 5) On fade time.
 - 6) Forward/reverse phase dimming (phase selectable dimmers only).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lighting control system components and ancillary equipment as indicated, in Accordance with equipment manufacturer's written instructions, and with recognized industry practices. Comply with requirements of National Electrical Code, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices.
- B. Coordinate with other electrical work, including raceways, and electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- C. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B.

3.2 GROUNDING

- A. Provide equipment grounding connections for lighting control equipment as indicated. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure **permanent and effective grounding**.

3.3 PROGRAMMING

- A. Manufacturer shall provide system programming of all components for the lighting control systems.

3.4 SYSTEMS START UP

- A. Manufacturer shall provide a factory authorized technician to confirm proper installation and operation of all system components. The Startup requirement is intended to verify that the lighting controls interact as a complete and operational system to meet the design intent.
- B. Manufacturer to provide a written statement verifying that the system meets the design intent.
- C. Training: Manufacturer shall provide factory authorized application engineer to train owner personnel in the operation, programming and maintenance of the lighting control systems including the proper care and adjustment of all occupancy sensor types and controls.
- D. Documentation:
 - 1. Manufacturer shall provide system documentation including:
 - a. Reflected ceiling plans showing each occupancy and daylighting sensor and manual

control station locations.

- b. Typical wiring diagrams for each component.
- c. The manufacturer will certify that the products will meet the product specifications and Michigan Energy Code. If any additional equipment is required to meet the required coverage patterns, the manufacturer shall provide the additional equipment at no cost to the owner.

3.5 TESTING

- A. Test capability of lighting system, after installation work is complete, to demonstrate compliance with requirements. Where possible, correct mal-functioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- B. Instruct Owner's building personnel in procedures for starting-up, testing, maintaining and operating lighting control system equipment, including both the system's software and hardware.

3.6 EXTENDED WARRANTY

- A. Manufacturer shall provide a 4-year extended warranty in addition to a required one-year warranty for all system components.

END OF SECTION 260923

SECTION 262213 – DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.
- C. Comply with NEC as applicable to installation and construction of electrical power/distribution transformers.
- D. Comply with applicable portions of NEMA Standard Publication No.'s TR 1 and TR 27 pertaining to power/distribution transformers.
- E. Comply with applicable requirements of ANSI Standards C57-Series pertaining to power/distribution transformers.
- F. Comply with requirements of NEMA Std Pub/No.'s St 20; "Dry-Type Transformers for General Applications", TR 1, and TR 27.
- G. Comply with applicable requirements of ANSI/UL 506; "Safety Standard for Specialty Transformers". Provide power/distribution transformers and components which are UL-listed and labeled
- H. Comply with applicable requirements of National Electrical Safety Code (ANSI Std C2) pertaining to indoor and outdoor installation of transformers

1.3 SUBMITTALS

- A. Submit product data of manufacturer's technical product data including rated kVA, frequency, primary and secondary voltages, percent taps, polarity, impedance and certification of transformer performance efficiency at indicated loads, percentage regulation at 100% and 80% percent power factor, no-load and full-load losses in watts, % impedance at 75 deg. C, hot-spot and average temperature rise above 40 deg. C ambient temperature, sound level in decibels, and standard published data.
- B. Submit manufacturer's shop drawings indicating dimension, and weight loadings for transformer installations, showing layouts, mountings and supports, spatial relationship to

panelboards and associated equipment, include transformer connections to electrical equipment.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Square D Electric Co.
2. Eaton Cutler-Hammer.
3. General Electric
4. Siemens Energy and Automation

2.2 POWER/DISTRIBUTION TRANSFORMERS

- A. General: Except as otherwise indicated, provide manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by manufacturer, and as required for complete installation.
- B. Dry-Type Distribution Transformers (45 kVA or less) shall be factory-assembled, general purpose, air-cooled, dry-type distribution transformers where shown; of sizes, characteristics, and rated capacities indicated; single-phase; 60-hertz, 30 kV BIL, 4.0% impedance, with 480 volts primary and 208/120 volts secondary, or three-phase; 60 hertz, 30 kV BIL, 4.0% impedance with 480 volts delta connection primary and 208/120 volts secondary wye connected. Provide primary winding with 2 taps; both 5% increments below full rated voltage for de-energized tap-changing operation. Insulate with Class 150 insulation and rate for continuous operation at kVA rating. Limit transformer surface temperature rise to maximum of 65 deg. C. Provide terminal enclosure, with hinged cover, to accommodate primary and secondary coil wiring connections and electrical supply raceway terminal connector. Equip terminal leads with connectors installed. Limit terminal compartment temperature to 75 deg. C when transformer at rated load with ambient temperature of 40 deg. C. Provide wiring connectors suitable for copper or aluminum wiring. Cushion-mount transformers with external vibration isolation supports; sound-level ratings not to exceed 45 db as determined in accordance with ANSI/NEMA standards. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Provide transformers with standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for wall mounting.
- C. Dry-Type Distribution Transformers (above 45 kVA) shall be factory-assembled, general purpose, air-cooled, dry-type distribution transformers where shown; of sizes, characteristics, and rated capacities indicated; three-phase; 60 hertz, 30 kV BIL, 5.75% impedance with 480 volts delta connection primary and 208/120 volts secondary wye connected. Provide primary winding with 6 taps; 2, 2-1/2% increments above full- rated voltage, and 4, 2-1/2% increments below full-rated voltage for de-energized tap-changing operation. Insulate with Class 220 insulation and rate for continuous operation at kVA rating. Limit transformer surface temperature rise to maximum of 65 deg. C. Provide terminal enclosure, with hinged cover, to

accommodate primary and secondary coil wiring connections and electrical supply raceway terminal connector. Equip terminal leads with connectors installed. Limit terminal compartment temperature to 75 deg. C when transformer at rated load with ambient temperature of 40 deg. C. Provide wiring connectors suitable for copper or aluminum wiring. Integrally mount vibration isolation supports between core and coil assembly and transformer enclosure; sound-level ratings not to exceed 50 db as determined in accordance with ANSI/NEMA standards. Electrically ground core and coils to transformer enclosure by means of flexible metal grounding strap. Provide transformers with standard light gray indoor enamel over cleaned and phosphatized steel enclosure. Provide transformers suitable for floor mounting.

3. Transformers installed at exterior of building shall include a NEMA 3R rating utilizing a factory fabricated rain-hood. Transformers shall be mounted on a 4-inch-thick concrete pad.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Arrange equipment to provide adequate spacing for cooling air circulation.
- B. Identify transformers in accordance with Division 16.
- C. Tighten electrical connectors and terminals in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 GROUNDING

- A. Ground transformers and tighten connections to comply with tightening torques specified in UL Standard 486A.

3.3 FIELD QUALITY CONTROL

- A. Tests shall conform to InterNational Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems", and the following:
 1. Independent Testing Organization: Arrange and pay for the services of an independent electrical testing organization in accordance with the requirements of Division 1 Section "Quality Control Services" to perform tests on transformers.
 2. Test Objectives: To assure transformer installation is operational within industry and manufacturer's tolerances, is installed in accordance with Contract Documents, and is suitable for energizing.
 3. Procedures: Upon satisfactory completion of tests, attach a label to tested components.
 4. Schedule tests and notify Architect at least one week in advance of schedule and of test commencement.
 5. Reports: The testing organization shall make a written report of observations and tests. Report defective materials and workmanship and retest corrected defective items.

6. Testing organization shall submit written test reports to the Architect and Contractor.
7. Testing for transformers shall include insulation resistance test, taps verification and excitation test.
8. Test Failures: Correct deficiencies identified by tests and make ready for retest. Verify that equipment meets the specified requirements.

3.4 ADJUSTING AND CLEANING

- A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt, and construction debris. Touch up scratches and marks of finish to match original finish.
- B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.5 PROTECTION

- A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which equipment is not in a space that is continuously under normal control of temperature and humidity.

END OF SECTION 262213

SECTION 262413 – MAIN SWITCHBOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 20237 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 QUALITY ASSURANCE

- A. Equipment submitted shall be the product of firms regularly engaged in manufacture of switchboards, enclosures, of the types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than five years.
- B. The products shall comply with applicable UL publications pertaining to switchboards, enclosures, and accessories; units shall be listed and labeled by Underwriters Laboratories.
 - 1. UL Standard 891 Dead Front Switchboards
- C. Product shall meet the applicable standards of National Electrical Manufacturers Association Standards, Publication No. PB-2, "Deadfront Distribution Switchboards".

1.4 SUBMITTALS

- A. Submit manufacturer's data on switchboards, enclosures, and accessories.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Design is based on equipment by Cutler Hammer.
- B. The following manufacturers are accepted:
 - 1. Schneider Square D
 - 2. Siemens Energy and Equipment
 - 3. General Electric Co.

2.2 CONSTRUCTION

- A. The switchboard shall be dead front only, and shall be mounted in a NEMA 3R enclosure with front only accessibility. The framework is to be of code gauge steel, rigidly welded and gasketed, and bolted together to support all cover plates and component devices during shipment and installation. The switchboard shall be provided with lifting angles and steel base channels for ease in moving or rolling the switchboard into its installation position. All exterior and interior metal surfaces of the switchboard framework shall be cleaned and finished with acrylic baked enamel over an iron phosphate pretreatment. The enamel finish shall be medium light gray.

2.3 BUSSING

- A. The switchboard through bussing shall be of plated aluminum. This through bus shall run horizontally at the rear of each section with the bus bars stacked edge-to-edge. Switchboard bus sizing shall be based on ANSI standard temperature rise criteria of 65 degrees C over a 40 degree C ambient outside of the enclosure.
- B. The switchboard assembly shall be rated to withstand mechanical forces exerted during short circuit conditions when connected directly to a power source having an available fault of 65,000 amperes symmetrical at rated voltage.
- C. Provide a full capacity neutral bus.
- D. A ground bus shall be furnished firmly secured to each vertical section of structure and shall extend the entire length of the switchboard.

2.4 SURGE SUPPRESSION DEVICE

- A. The Main Service Switchboard shall include a Surge Suppression Device (SPD).
 - 1. The SPD shall be parallel configured and shall provide all mode protection.
 - 2. Protection Modes shall be: Dedicated L-N, L-L, (normal mode), Dedicated L-G, N-G (common mode).
 - 3. Response time of less than 1 nanosecond.
 - 4. EMI/RFI Attenuation of up to 50 dB normal mode, up to 50 dB common mode.
 - 5. Capacitance up to 15 nanofarads per mode.
 - 6. Direct bus connected with over current protection.
 - 7. LED indicators, 1 per phase, normally on.
 - 8. 125 kA per mode minimum surge current with 250 kA surge current per phase.
- B. UL 1449, UL 1283 CUL Listed.
- C. Manufacturers Qualifications: ISO 9001 Quality System Certification BSI FM 30833.
- D. Unit shall be factory mounted by assembly manufacturer during assembly.
- E. SPD shall be as manufactured by Eaton Cutler Hammer, Square D, Siemens, or General

2.5 Main Molded Case Circuit Breaker

- A. Main circuit breaker shall be bolt-on molded-case circuit breaker and shall be 100% rated.
- B. Main circuit breaker shall have a minimum symmetrical interruption capacity of 65,000 RMS symmetrical at 480 volts.
- C. Main circuit breakers shall be Type LSIG (Long Time, Short Time, Instantaneous and Ground Fault) functions, equal to be Eaton Cutler Hammer Magnum SB breaker SBS-630, Digitrip 20MC LSIG 100% rated with ground-fault protection and an arc-flash reduction maintenance system.
- D. Circuit breaker shall be operated by toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinguishing shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local means of manually exercising the trip mechanism.

2.6 Feeder Molded Case Circuit Breakers

- A. Distribution section shall be equipped with bolt-on molded-Case circuit breakers and shall have a fully rated interrupting rating indicated on the drawings. Switchboard shall be Cutler-Hammer Pow-R Line Xpert with molded case circuit breakers as specified below.
- B. Circuit breakers shall have a minimum symmetrical Interruption capacity as indicated on the drawings or 65,000 RMS symmetrical at 240 volts.
- C. Circuit breakers 225 ampere frame and below shall be equal To Eaton Cutler-Hammer Frame 2, current limiting, with thermal-Magnetic trip units and inverse time-current characteristic.
- D. 400 A. circuit breakers shall be equal to Eaton Cutler-Hammer Frame 3, current limiting, with microprocessor-based RMS sensing trip units.
- E. 800 A. circuit breakers shall be equal to Eaton Cutler-Hammer Frame 4, PXR20 LSI, current limiting, with microprocessor-based RMS sensing trip units.
- F. 1200 A. circuit breakers shall be 100% rated and shall be equal to Eaton Cutler-Hammer Frame 5, PXR20 LSIG/A w/ ARMS with microprocessor-based RMS sensing trip unit with ground-fault protection and arc-flash reduction maintenance system.
- H. Circuit breakers shall be operated by toggle-type handle and shall have a quick- make, quick-break over-center switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy, and arc extinguishing shall be accomplished by means of DE-ION arc chutes. A

push-to-trip button on the front of the circuit breaker shall provide a local means of manually exercising the trip mechanism.

PART 3 – EXECUTION

3.1 STORAGE AND HANDLING

- A. Store the switchboard indoors and protect from weather. When necessary to store outdoors, elevate well above grade and enclose with durable, waterproof wrapping.
- B. Handle switchboard carefully to prevent breakage, denting, and scoring finish.

3.2 INSPECTION

- A. Examine area and conditions under which switchboard is to be installed. Do not proceed with the work until all unsatisfactory conditions have been corrected in a manner acceptable for proper installation.

3.3 INSTALLATION

- A. Install switchboard in accordance with manufacturer's written instructions, applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended purposes.
- B. Coordinate installation of switchboard with cable and raceway installation work.
- C. Anchor switchboard firmly to its equipment pad to ensure that it is permanently and mechanically secure.
- D. Provide electrical connections within the switchboard.
- E. Furnish and install equipment identification for the switchboard and each device in the switchboard.

3.4 CONCRETE WORK

- A. Provide concrete bases and housekeeping pads for all slab mounted electrical equipment. Concrete bases and housekeeping pads shall be 4" high having a 3000 PSI compressive strength after a 28 day cure. Reinforcement shall be 6" x 6" x W1.4/W1.4 wire mesh covering the plan view dimension of the base and centered vertically within the base pad.
- B. Provide equipment anchor bolts and coordinate installation and accurate location.

3.5 FIELD QUALITY CONTROL

- A. Independent Testing Organization: The Owner will contract, and pay directly, all required testing during construction by an independent electrical testing organization to perform tests on low-voltage power switchboards and accessories.
- B. Pretesting: Upon completing installation of the system, perform the following preparations for independent tests:
- C. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.
- D. Make continuity tests of circuits.
- E. Provide set of Contract Documents to test organization. Include full updating on final system configuration and parameters where they supplement or differ from those indicated in original Contract Documents.
- F. Quality Control Program: Conform to the following:
 - 1. Procedures: Make field tests and inspections and prepare switchboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
 - 2. Schedule tests with at least one week advance notification.
 - 3. Reports by Testing Organization: Report written reports of tests and observations. Report defective materials and workmanship and unsatisfactory test results. Include records or repairs and adjustments made.
 - 4. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person, and date.
 - 5. Protective Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system configuration and parameters. Where discrepancies are found, recommend final protective device ratings and settings. Use accepted ratings or settings to make the final system adjustments.
 - 6. Visual and Mechanical Inspection: Include the following inspections and related work:
 - a. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and switchboard schedules.
 - b. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 - c. Check alignment of switchboard and mounting, area clearances, and fit of components.
 - d. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 - e. Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 16 Section "Overcurrent Protective Devices".
- G. Electrical Tests: The following items shall be performed in accordance with manufacturer's instruction:

1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.
2. Ground resistance test on system and equipment ground connections.
3. Test main and subfeed overcurrent protective devices in accordance with Section A Overcurrent Protective Devices".
4. Retest: Correct deficiencies identified by tests and observations and provide retesting of switchboard by testing organization. Verify by the system tests that the total assembly meets specified requirements.

3.6 CLEANING

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.7 COMMISSIONING

- A. Infrared Scanning: After Substantial Completion, but not more than two months after Final Acceptance, perform an infrared scan of switchboard. Remove fronts to make joints and connections accessible to a portable scanner.
- B. Follow-up Infrared Scanning: Perform one additional follow-up infrared scan of each switchboard 11 months after the date of Substantial Completion.
- C. Instrument: Use an approved infrared scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for devices used.
- D. Record of Infrared Scanning: Prepare a certified report identifying switchboard checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

PART 2 – PRODUCTS

2.1 DESCRIPTION

- A. Panelboards for power distribution shall be dead-front, safety type furnished with fusible type QMQB switches or thermal-magnetic molded case circuit breakers as indicated on the drawings.
- B. Panelboards for lighting, receptacle and applicable branch circuit and power distribution applications shall have circuit breakers with ratings as scheduled on Drawings.

2.2 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers are acceptable:
 - 1. Eaton Cutler-Hammer
 - 2. Siemens Energy and Automation
 - 3. Square D Company
 - 4. General Electric

2.3 PANELBOARDS

- A. Bussing Assembly and Temperature Rise:
 - 1. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector to bus bar not to exceed 50°C. rise above ambient.

2. Heat rise test shall be conducted in accordance with Underwriters' Laboratories Standard UL 67.
 3. The use of conductor dimensions will not be accepted in lieu of actual heat tests.
 4. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Single-phase, three-wire panelboard bussing shall be such that any two adjacent single-pole breakers are connected to opposite polarities in such a manner that two-pole breakers can be installed in any location.
 5. Three-phase, four-wire bussing shall be such that any three adjacent single-pole breakers are individually connected to each of the three different phases in such a manner that two or three-pole breakers can be installed at any location.
 6. Current-carrying parts of the bus assembly shall be plated. Main's ratings shall be as scheduled on the plans. Equipment ground bus shall be provided for panels. All bus shall be tin-plated aluminum.
- B. Safety Barriers:
1. The panelboard interior assembly shall be dead front with panelboard front removed.
- C. Cabinets and Fronts:
1. Panelboard assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. Wiring gutters shall be in accordance with UL Standard 67 for panelboards. Minimum gutter 6" each side, 5" top and bottom.
 2. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler-type locks with catches and spring-loaded door pulls.
 3. The flush lock shall not protrude beyond the front of the door. All panelboard locks shall be keyed alike.
 4. Front shall have adjustable indicating trim clamps which shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. Fronts shall not be removable with door in the locked position.
 5. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door.
 6. The directory card shall provide a space at least 1/4" high x 3" long or equivalent for each circuit. The directory shall be typed to identify the load type fed by each circuit and room area(s) served.
 7. Fronts and cabinets shall be of code gauge, full finished steel with rust-inhibiting primer and baked enamel finish.
- D. Wiring Terminals:
1. Terminals for feeder conductors to the panelboard mains and neutral shall be UL listed as suitable for the type of conductor specified.
 2. Terminals for branch circuit wiring, both breaker and neutral, shall be UL listed as suitable for the type of conductor specified.
- E. Circuit Breaker Type Panelboards

1. Circuit breakers shall be quick-make, quick-break, thermal magnetic, trip indicating, and have common trip on all multi-pole breakers.
 2. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. Circuit breakers shall be plug-on type. The ampere rating of all circuit breakers shall be visible on the circuit breaker handle.
 3. The front faces of circuit breakers shall be flush with each other. Large permanent individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit).
 4. Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF.
 5. Provisions for additional breakers shall be such that no additional connectors will be required to add breaker.
- F. Fusible Switch Type Panelboards:
1. Fusible interrupter switches, manually operated; equipped with current limiting fuses providing 200,000 RMS symmetrical ampere interrupting rating.
 2. Switches shall be quick-make, quick-break type with interlocked cover and shall be equipped with rejection type current limiting fuse clips.
 3. Switches shall be complete with fuses.
 4. Provisions for additional switches shall be such that no additional structures or bussing will be required to add switches.
- G. Surge Protective Devices:
1. Provide integral Surge Protective Devices (SPD) IN ALL PANELBOARDS, unless noted otherwise. (Refer to QSCP panelboards specification below)
 - a. Power Panels and Distribution Panels shall include a Category B, 160 kA per phase, 80 kA per mode Surge Protective Device.
 - b. Lighting and receptacle circuit breaker panelboards shall include a Category A. 120 kA per phase, 60 kA per mode Surge Protective Device.
 2. Surge Protective Devices shall be equal to Eaton Cutler-Hammer SPD Series.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Securely anchor panelboards to structure and make feeder and branch circuit connections.
- B. Provide ½" air gap between panel enclosure and wall surface for surface mounted panelboards using shallow channel-strut members.
- C. Provide 4" high concrete housekeeping pad for each free-standing Panelboard.

- D. All recessed panelboards shall have a minimum of five 3/4" empty conduit stubs, from the panelboard to the ceiling space above, and two 3/4" empty conduit stubs from the panelboard to the ceiling space below for future use.

END OF SECTION 262416

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SECTION 262417 - LOAD CENTERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 DEFINITIONS

- A. Load center: An electrical distribution panel with thermal magnetic circuit-breaker branches, primarily of the plug-on type, designed for residential projects, operating at 250 V and below, single phase, and equipped with combination flush mounting trim.
- B. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data for each type of load center, accessory item, and component specified.
- B. Shop drawings from manufacturers of load centers including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. include the following:
 - 1. Enclosure type with details for types other than NEMA Type 1.
 - 2. Bus configuration and current ratings.
 - 3. Short-circuit current rating of load center.
 - 4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
 - 5. Wiring diagrams detailing schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.
 - 6. Qualification data for field-testing organization certificates, signed by the Contractor, certifying that the organization complies with the requirements specified in Quality Assurance below. Include list of completed projects with project names, addresses, and

- names of Architect and Owner plus basic organization qualifications data.
- 7. Report of field tests and observations certified by the testing organization.
- 8. Panel schedules for installation in load centers.
- 9. Maintenance data for load centers components, for inclusion in Operating and Maintenance Manual specified in Division 1 and in Division 16 Section "Basic Electrical Requirements". Include instructions for testing circuit breakers.

1.5 QUALITY ASSURANCE

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
- B. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- C. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- D. Field-Testing Organization Qualifications: To qualify for acceptance, the independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.
- E. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code".
- F. NEMA Standard: NEMA PB1, "Panelboards".
- G. UL Standards: Listed under UL file E8741.

1.6 EXTRA MATERIALS

- A. Touch-up Paint for load centers: One half-pint container.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers: Load center shall be equal to Square D type 'QO' or:
 - 1. Eaton-Cutler Hammer
 - 2. General Electric Co.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Schneider Square D

2.2 LOADCENTERS, GENERAL REQUIREMENTS (Residence Panels)

- A. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated.

Comply with Division 16 Section, "Overcurrent Protective Devices", with OCPDs adapted to load center installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

- B. Enclosures: Cabinets, flush mounted. NEMA Type 1 enclosure with hinged and latched door.
- C. Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box except as otherwise specified.
- D. Directory Frame: Metal, mounted inside each panel door.
- E. Bus: Tin-plated aluminum bus.
- F. Short Circuit Rating: 10,000 AIC, series rated.
- G. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.
- H. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

2.3 BRANCH CIRCUIT BREAKERS (Load Centers require all 15-20A, 120V. OCPD to be Arc Fault type)

- A. Branch OCPDs: Arc Fault type, Quick-make, quick-break switch mechanism with inverse time -element tripping operation. Plug-on circuit breakers shall meet UL Standard 489, NEMA standards, and Federal Spec Classification W-C 375 b/Gen.
- B. Arc Fault Circuit Breakers: AFCI circuit breakers shall be listed to UL 1699. The AFCI shall include an integrated processor to interrupt the circuit due to an arcing fault, and conventional thermal and magnetic overloads.

2.4 IDENTIFICATION

- A. General: All circuit directories shall be typed and shall indicate the load being supplied.
- B. Load center Nameplates: Engraved laminated plastic or metal nameplate for each load center mounted with epoxy or industrial cement or industrial adhesive. Mount nameplate on inside front cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install load centers and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Load centers Rated 600

Volts or Less" and manufacturer's written installation instructions.

- B. Arc Fault Circuit Protection: Install load center arc fault circuit interrupter devices in accordance with manufacturer's installation guidelines.
- C. Mounting Heights: Load centers shall be mounted with the centerline of the top most circuit breaker device at +48" A.F.F. per ICC 309.3/ANSI 117.1.
- D. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.
- E. Circuit Directory: Typed and reflective of final "Engineer Approved" circuit changes.
- F. Install filler plates in unused spaces.
- G. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.
- H. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties after completion of load balancing.

3.2 IDENTIFICATION

- A. Identify field-installed wiring and components and provide warning signs in accordance with Division 16 Section "Electrical Identification".

3.3 GROUNDING

- A. Connections: Make equipment grounding connections for loadcenters as indicated.
- B. Provide ground continuity to main electrical ground bus indicated.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

- A. Quality Control Program: Conform to the following:
 - 1. Procedures: Make field tests and inspections and prepare load center for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
- B. Labeling: Upon satisfactory completion of tests and related effort, apply a label to tested components indicating results of tests and inspections, responsible organization and person,

and date.

- C. Visual and Mechanical Inspection: Include the following inspections and related work:
- D. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and load center schedules.
- E. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
- F. Check load center mounting, area clearances, and alignment and fit of components.
- G. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
- H. Perform visual and mechanical inspection and related work for overcurrent protective devices as specified in Division 16 Section "Overcurrent Protective Devices".
- I. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:
 - 1. Ground resistance test on system and equipment ground connections.
- J. Retest: Correct deficiencies identified by tests and observations and provide retesting of load centers. Verify by the system tests that the total assembly meets specified requirements.

3.6 CLEANING

- A. Upon completion of installation, inspect interior and exterior of load centers. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 26 24 17

SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 SUBMITTALS

- A. Submit catalog cuts and data for switches and receptacles necessary to evaluate the proposed devices.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Quality Assurance:
 - 1. Manufacturers: Firms regularly engaged in manufacture of electrical wiring devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than three years.
 - 2. Installer Qualifications: Firm with at least 5 years of successful installation experience on projects utilizing wiring devices similar to those required for this project.
 - 3. NEC Compliance: Comply with 2017 NEC as applicable to installation and wiring of electrical wiring devices.
 - 4. UL Compliance: Comply with applicable requirements UL20, 486A, 498, and 943 pertaining to installation of wiring devices.
 - 5. Provide wiring devices which are UL-listed and labeled.
 - 6. IEEE Compliance: Comply with applicable requirements of IEEE Std 241, "Recommended Practice for Electric Power Systems in Commercial Buildings", pertaining to electrical wiring systems.
 - 7. NEMA Compliance: Comply with applicable portions of NEMA Stds Pub/No. WD 1, "General-Purpose Wiring Devices", WD 2, "Semiconductor Dimmers for Incandescent Lamps" and WD 5, "Specific-Purpose Wiring Devices".
- B. Submittals:
 - 1. Product Data: Submit manufacturer's data on electrical wiring devices.
- C. Acceptable Manufacturers:

1. Manufacturers: Subject to compliance with requirements, provide wiring devices of one of the following (for each type and rating of wiring device):
 - a. Arrow-Hart Div, Crouse-Hinds Co.
 - b. Leviton
 - c. Harvey Hubbell Inc.
 - d. Pass and Seymour Inc.
 - e. Sierra

2.2 SWITCHES

A. Wall switches shall be as follows:

1. Snap: Provide general-duty flush single-pole toggle switches, 20-amperes, 120/277 volts AC, with mounting yoke insulated from mechanism, equip with plaster ears, switch handles, and side-wired screw terminals.
3. Three-way: Provide general-duty duplex flush 3-way AC switches, 20-amperes, 120/277 volts, with mounting yoke insulated from mechanism, equip with plaster ears, lock type switch handles, and side-wired screw terminals, with break-off tab features, which permits wiring for separate or common feed
2. Residential Apartments: Provide single-pole or three-way switches with flush rocker, decorator type, with internal LED illumination, 20-amperes, 120 volts, AC, with mounting yoke insulated from mechanism, equip with plaster ears and side wired terminals.
4. Color to be as selected by Architect.

2.3 RECEPTACLES

- A. General-Duty Duplex: Provide, duplex specification grade receptacles, 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 20-amperes, 125-volts, with metal plaster ears; design for side and back wiring with NEMA configuration 5-20R, brown color, unless otherwise indicated.
- B. Tamper-Resistant Duplex: In all residential apartments, provide, Tamper-resistant, duplex specification grade receptacles per NEC Art. 406.12. Receptacles shall be 2-pole, 3-wire, grounding, with green hexagonal equipment ground screw, ground terminals and poles internally connected to mounting yoke, 15 or 20-amperes, 125-volts, with metal plaster ears; design for side and back wiring with NEMA configuration 5-20R.
 1. Where an equipment grounding conductor does not exist in the existing apartment receptacle enclosure(s), the installation shall include grounding type receptacles. The receptacle(s) shall be supplied through a GFCI/AFCI branch circuit breaker in the apartment load center. The receptacle or cover plate shall be marked "GFCI Protected" and "No Equipment Ground", visible after installation.
- C. Ground-Fault Interrupter Receptacles: Provide "feed-thru" type ground-fault circuit interrupters, with heavy-duty duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and of being installed in a 2-3/4" deep outlet box without adapter, grounding type UL-rated Class A, Group 1, rated 20-amperes, 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5 mili-amperes ground-fault trip level; equip with NEMA configuration 5-20R.

1. Where an equipment grounding conductor does not exist in the existing apartment GFCI receptacle enclosure(s), the installation shall include a new GFCI grounding type receptacle. The receptacle or cover plate shall be marked "No Equipment Ground", visible after installation.
- D. In general, color of receptacles to be as selected by Architect.
- F. All receptacles shall be labeled with the panelboard and the circuit supplying them with a DYMO label mounted on the inside applied of the cover plate.

2.4 COVER PLATES

- A. Cover plates shall be thermoplastic type, finish as selected by the Architect or Owner.
- B. Provide plates for all switches, receptacles, other outlets and blank plates for unused outlets.
- C. Plates for outlets in mechanical spaces shall be galvanized steel, 1/2" raised cover type.
- D. Provide while-in-use cover constructed of polycarbonate and fully gasketed for devices located in wet locations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Switches and receptacles shall be installed and located as follows:
 1. Switches: See electrical plans.
 2. Receptacles: See electrical plans.
- B. In masonry walls, switches and receptacle heights shall be adjusted as required so outlets are at nearest mortar joint to indicated height.
- C. Where light switches are located adjacent to doors, they shall be installed on "knob" side of door, unless indicated otherwise.
- D. Where walls have wainscot finish, switch height shall be adjusted as required, so switch is either all in wainscot or all in wall above wainscot.
- E. Prior to roughing-in outlet boxes, verify door swings, type of wall finishes and locations for counters.

END OF SECTION 262726

SECTION 262813 – FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.
- B. Section 26 05 10 Common Work Results for Electrical Systems apply to work specified in this section.

1.2 SUMMARY

- A. Work of this Section:

- 1. Fuses

1.3 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Fuses shall be of standard ratings, in accordance with 20123NEC, Article 240 and shall be UL listed for the application intended.

PART 2 - PRODUCTS

2.1 FUSES

- A. Fuses shall be of types and ratings as follows:
 - 1. UL Class L, Hi-Cap Time Delay Current Limiting, Type KRP-C 200,000 ampere interrupting rating; use for main service and circuits over 600 amperes.
 - 2. UL Class R, Low-Peak Dual Element Current Limiting, Type LPN-R and LPS-R, 200,000 ampere interrupting rating; use for circuits 600 ampere or less, and motors above one-half horsepower.
 - 3. UL Class S, Fustat Dual element, 10,000 ampere interrupting rating; use for general purpose circuits up to 30 ampere, and fractional horsepower motors, 125 volt or less.
- B. Fuses for feeders, branch circuits, motors and other equipment shall be selected in types and ratings in accordance with 2017 NEC to provide a coordinated system of over-current protection, thus in case of a fault or harmful overload, only the fuses nearest the fault or overload will open.

2.2 ACCEPTABLE MANUFACTURERS

- A. Bussmann
- B. Gould-Shawmut
- C. General Electric
- D. G&W Electric Co.
- E. Littlefuse, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide fuses in all fused switches.
- B. Provide one spare set of three of each size and type of fuses.

END OF SECTION 262813

SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 SUBMITTALS

- A. Submit catalog cuts and data necessary to evaluate the proposed equipment. Submittal shall include starter sizes, disconnecting device ratings, lug ratings, fabrication details and fuse sizes as a minimum.

1.4 SUMMARY

- A. This Section includes overcurrent protective devices (OCPDs) rated 600 V and below and switching devices commonly used with them.
- B. Panelboards, Load Centers, Switchboards: Application, installation, and other related requirements for overcurrent protective device installations in distribution equipment are specified in other sections of this specification.

1.5 DEFINITIONS

- A. Overcurrent Protective Device (OCPD): A device operative on excessive current that causes and maintains the interruption of power in the circuit it protects.
- B. Ampere-Squared-Seconds: An expression of available thermal energy resulting from current flow. With regard to current-limiting fuses and circuit breakers, the ampere-squared-seconds during fault current interruption represents the energy allowed to flow before the fuse or breaker interrupts the fault current within its current limiting range.

1.6 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

1. Product data for fuses, fusible switches, circuit breakers, and OCPD accessories specified in this Section, including descriptive data and time-current curves for all protective devices and let-through current curves for those with current limiting characteristics. Include coordination charts and tables and related data.

1.7 QUALITY ASSURANCE

- A. Electrical Component Standard: Component and installation shall comply with NFPA 70 "National Electrical Code."
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
- C. The terms "listed" and "labeled" shall be defined as they are in the National Electrical Code, Article 100.
- D. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- E. Single-Source Responsibility: Obtain similar OCPDs from a single manufacturer.

1.8 EXTRA MATERIALS

- A. Maintenance Stock, Fuses: For types and ratings required, furnish spare fuses, amounting to one unit for every 5 installed units, but not less than one set of 3 of each kind.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the Following:
 1. Cartridge Fuses:
 - a. Bussman Div., Cooper Industries, Inc.
 - b. General Electric Co.
 - c. Littelfuse Inc.
 2. Fusible Switches:
 - a. Allen-Bradley co.
 - b. Crouse-Hinds Distribution Equipment.
 - c. Siemens Energy & Automation, Inc.
 - d. Square D Co.
 - e. Cutler-Hammer
 - f. General Electric Co.
 3. Fused Power Circuit Devices:

- a. Pringle Electrical Mfg. Co.
- b. Square D Co.
- 4. Molded-Case Circuit Breakers:
 - a. Crouse-Hinds Distribution Equipment.
 - b. Siemens Energy & Automation, Inc.
 - c. Square D Co.
 - d. Cutler-Hammer
 - e. General Electric Co.

2.2 OVERCURRENT PROTECTIVE DEVICES (OCPDs), GENERAL

- A. General: Provide OCPDs in indicated types, as integral components of panelboards, switchboards, and motor control centers; and also, as individually enclosed and mounted single units.
- B. Enclosures: NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)."

2.3 CARTRIDGE FUSES

- A. General: NEMA Standard FU1, "Low-Voltage Cartridge Fuses," Unless indicated otherwise, provide nonrenewable cartridge fuses of indicated types, classes, and current ratings that have voltage ratings consistent with the circuits on which used.
- B. Class J Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- C. Class L Fuses: UL 198C, "High-Interrupting Capacity Fuses, Current-Limiting Type."
- D. Class RK1 Dual Element Time-Delay Fuses: UL 198E, "Class R Fuses, Current-Limiting Type."

2.4 FUSIBLE SWITCHES

- A. General: UL 98 "Enclosed and Dead Front Switches" and NEMA KS 1 "Enclosed Switches," quick-make, quick-break heavy-duty units.
- B. Rating: Load-breaking capacity in excess of the normal horsepower rating for the switch.
- C. Withstand Capability: In excess of the let-through current permitted by its fuse when subject to faults up to 200,000 RMS symmetrical amperes.
- D. Operation: By means of external handle.
- E. Interlock: Prevents access to switch interior except when in "off" position.
- F. Fuse Clips: Rejection type.
- G. Padlocking Provisions: For 2 padlocks, whether open or closed.

- H. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting where indicated.
- I. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.
- J. Enclosure for Independent Mounting: NEMA Type 1 enclosure except as otherwise indicated or required to suit environment where located.

2.5 FUSED POWER CIRCUIT DEVICES

- A. General: UL 977, "Fused Power Circuit Devices", with either bolted-pressure-type or high-pressure contact-type switch.
- B. Operation: Manually closed, electrically tripped.
- C. Ground Fault Protection: Integral, self-powered type with mechanical ground fault indicator, test function, adjustable pick-up current and delay time with inverse and constant time characteristics, internal memory arranged to integrate intermittent arcing ground faults, and ground fault current sensor located as indicated. Set ground fault pick-up in accordance with coordination study recommendations and engineer's approval.
- D. Enclosure for Switchboard Mounting: Suitable for individual mounting.
- E. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as indicated or except as required to suit environment where located.
- F. Minimum Fault Current Rating: 200,000 rms symmetrical amperes.

2.6 MOLDED-CASE CIRCUIT BREAKERS

- A. General: UL 489, "Molded Case Circuit Breakers and Circuit Breaker Enclosures," and NEMA AB 1, "Molded Case Circuit Breakers."
- B. Construction: Bolt-in type, except breakers in load-center-type panelboards and breakers 225-ampere frame size and larger may be plug-in type if held in place by positive locking device requiring mechanical release for removal.
- C. Characteristics: Indicated frame size, trip rating, number of poles, and a short-circuit interrupting capacity rating of 10,000 ampere symmetrical, unless a greater rating is indicated.
- D. Tripping Device: Quick-make, quick-break toggle mechanism with inverse-time delay and instantaneous overcurrent trip protection for each pole.
- E. Adjustable Instantaneous Trip Devices: Factory adjusted to low-trip-setting current values.
- F. Enclosure for Switchboard or Panelboard Mounting: Suitable for panel mounting in

switchboard or panelboards where indicated.

- G. Enclosure for Switchboard or Motor Control Center Mounting: Provide individual mounting where indicated.
- H. Enclosure for Independent Mounting: NEMA Type 1 enclosure, except as otherwise indicated or required to suit environment where located.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Independently Mounted OCPDs: Locate as indicated and install in accordance with manufacturer's written installation instructions.
- B. OCPDs in distribution equipment shall be factory installed.

3.2 IDENTIFICATION

- A. Identify components in accordance with Division 16 Section "Electrical Identification."

3.3 CONNECTIONS

- A. Check connectors, terminals, bus joints, and mountings for tightness. Tighten field-connected connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.

3.4 GROUNDING

- A. Provide equipment grounding connection for individually mounted OCPD units as indicated and as required by NEC. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.5 FIELD QUALITY CONTROL

- A. Visual and mechanical inspection: Include the following inspections and related work.
 - 1. Overcurrent-Protective-Device Ratings and Settings: Verify indicated ratings and settings to be appropriate for final system arrangement and parameters. Where discrepancies are found, test organization shall recommend final protective device ratings and settings. Use accepted revised ratings or settings to make the final system adjustments.
 - 2. Inspect for defects and physical damage, NRTL labeling, and nameplate compliance with current single line diagram.

3. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
 4. Check tightness of electrical connections of OCPs with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
 5. Clean OCPDs using manufacturer's approved methods and materials.
 6. Verify installation of proper fuse types and ratings in fusible OCPDs.
- B. Retest: Correct deficiencies identified by tests and observations and provide retesting of OCPDs. Verify by the system tests that specified requirements are met.

3.6 CLEANING

- A. Upon completion of installation, inspect OCPDs. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 SUBMITTALS

- A. Submit catalog cuts and data necessary to evaluate the proposed equipment. Submittal shall include starter sizes, disconnecting device ratings, lug ratings, fabrication details and fuse sizes as a minimum.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Combination starters shall be:
 - 1. Square D
 - 2. Cutler-Hammer
 - 3. Allen-Bradley
 - 4. General Electric Co.

2.2 GENERAL

- A. Combination starters shall be of the fusible type.
- B. At interior locations the enclosures shall be NEMA Type 1 rated and at exterior locations the enclosures shall be NEMA Type 4 rated.
- C. Combination starters shall be installed for motors with ratings of one-half horsepower or larger, and rated 200 volts or higher.
- D. Starters shall be NEMA sizes as scheduled or as selected by the Contractor as required for the motor horsepower ratings. No starter shall be smaller than NEMA Size 1.

- E. Starters of NEMA size 4 and larger shall be reduced voltage, closed transition, auto transformer type.

2.3 DISCONNECTS

- A. Disconnect shall be visible blade disconnect switch.
- B. The disconnect handle shall always be in control of the disconnect device with the door open or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "ON" or "OFF", and shall include a two-color handle grip, the black side visible in the "OFF" position indicating a safe condition, and the red side visible in the "ON" position indicating or danger condition.
- C. The handle shall have provision for padlocking in the "OFF" position.

2.4 STARTERS

- A. Fusible combination starters shall be 3 pole, 3 phase furnished with the following devices in addition to those scheduled:
 - 1. 120 volt control transformer with primary and secondary fuses.
 - 2. Three ambient compensated, bimetallic, manual reset, thermal over load relays.
 - 3. The starter shall be inoperative if any thermal unit is removed.
 - 4. Minimum of two N.O. and two N.C. electrical auxiliary contacts.
 - 5. Push-to-test type pilot lights.
 - 6. Phase failure protective devices.

2.5 POWER FACTOR CORRECTION CAPACITORS

- A. Provide three phase indoor dustproof capacitors for all motors 3 HP and above.
- B. The capacitors shall be dry metallized dielectric type which consists of a number of capacitor elements wound from metallized polypropylene film dielectric. The dry elements are encapsulated in a thermal setting resin inside a plastic container. The capacitor element assembly is mounted in a steel container which is filled with a non-flammable non-toxic natural mineral material such as vermiculite.
- C. Total losses in the capacitor, including discharge resistors shall be .5 watts per KVAR or less.
- D. The capacitors shall meet or exceed all applicable NEMA CP-1 and ANSI/IEEE-18 design and production test requirements.
- E. Capacitors shall be equipped with line fuse kits, blown fuse indicator lights, and wall mounting brackets.
- F. Capacitors shall be a manufactured by WESTINGHOUSE "Dri-Var II" or Architect

approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install combination motor starters for motors. Combination motor starters shall be installed within 25'-0" and line-of-sight of the motor served. For cases where these placement criteria are not satisfied then provide a non-fused, heavy duty disconnect switch in accordance with Section 26 28 16 at the motor location.
- B. Provide and install properly sized thermal overload relays for all motor starters.
- C. Provide and install fuses for all fuses disconnect switches.
- D. Complete the service to all motors as required.

END OF SECTION 26 29 13

SECTION 263213 - PACKAGE ENGINE GENERATOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this Section.
- B. Division 26 05 10 "Common Work Results for Electrical" section applies to work specified in this Section.

1.2 WORK OF THIS SECTION

- A. Package Engine Generators

1.3 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.4 GENERAL REQUIREMENTS

- A. Provide, install, and acceptance test a complete and operable Emergency/Standby electric generating system, including all devices and equipment specified herein, as shown on the drawings, or required for the service. Equipment shall be new, factory tested, and delivered ready for installation.

1.5 APPROVED MANUFACTURERS

- A. Equipment, documentation, and services described in this specification and shown on the plans are as provided by Cummins/Onan Corporation, Caterpillar, Generac or Kohler.
- B. Proposed substitutions shall include complete submittal data, as specified herein, clearly denoting any and all deviations and/or exceptions to the equipment specified. The complete proposal must be submitted to the engineer or architect for approval/disapproval not less than 10 days prior to the scheduled bid date. If approved, the Contractor is responsible for the charges for all necessary revisions.

1.6 SUBMITTALS

- A. Submit the following information with the proposal package for review and evaluation 10

days prior to scheduled bid date:

1. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
 2. Dimensions of the generator sets, transfer switches, paralleling equipment and accessory hardware, including plan and elevation drawings.
 3. Sequence of operation if required to enhance the description included in this Specification.
 4. Indication of the nearest field service office staffed with factory trained technicians. Provide service organization data and manpower. Indicate typical response time for emergency calls. Provide typical scenario for an emergency service call.
 5. After award of contract, provide ten sets of the following information for review:
- B. Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.
1. A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.
 2. Manufacturer's certification of prototype testing.
 3. Manufacturer's published warranty documents.
 4. Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.
 5. Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
 6. Manufacturer's installation instructions.

1.7 WARRANTY

- A. Shall be provided for all products against defects in materials and workmanship for two year period from the start-up date.

1.8 SINGLE SUPPLIER

- A. The supplier shall be the manufacturer's authorized distributor, who shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier shall have 24-hour service availability and factory-trained service technicians authorized to perform warranty service on all products provided.

1.9 MANUAL

- A. Operators and spare parts manuals shall be provided for all system equipment. The manuals shall include outline, interconnection, wiring, and control drawings accurately describing the equipment provided. Provide ladder logic for all programmable logic controllers in the system.

PART 2 - PRODUCTS

2.1 DIESEL ENGINE-GENERATOR SET

- A. 4-cycle, 1800 rpm, diesel engine generator set. Generator set ratings: kVA and kW rating as indicated on the drawings, at 0.8 PF based on site conditions noted below. System voltage of: 277/480 Volts AC, Three phase, Four-wire, 60 hertz. Site Conditions: Altitude 700 ft., ambient temperatures up to 122 degrees F.
- B. Prototype Tests and Evaluation: Prototype tests shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement. Prototype testing shall comply with the requirements of NFPA 110 for level 1 systems.
- C. Performance:
 - 1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.
 - 2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
 - 3. The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
 - 4. Motor starting kVA capability shall be a minimum of 3.5 times rated kVA. Gross engine power output to be equal to 1.5 times rated kW. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
- D. Engine
 - 1. The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:
 - a. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.
 - b. An electric starter(s) capable of three complete cranking cycles without overheating.
 - c. Positive displacement, mechanical, full pressure, lubrication oil pump.

- d. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
- e. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element.
- f. Replaceable dry element air cleaner with restriction indicator.
- g. Flexible supply and return fuel lines.
- h. Engine mounted battery charging alternator, 45 ampere minimum, and solid-state voltage regulator.
- i. Stairs for access to generator interior.

E. AC Generator

1. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.
2. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
3. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds

F. Engine-Generator Set Control

1. The generator set shall be provided with a microprocessor-based control system which is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.
2. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.
3. The control shall be UL508 listed, CSA282-M1989 certified, and meet IEC8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C part 9, and IEC Std 801.2, 801.3., and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance.
4. The generator set mounted control shall include the following features and functions:
 - a. Three position control switch labeled RUN/OFF/AUTO. In the RUN position

- the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
- b. Red "mushroom-head" push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - c. Push-button RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - d. Push-button PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
 - e. Generator Set AC Output Metering: The generator set shall be provided with a metering set including the following features and functions:
 - f. 2.5-inch, 90 degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters.
 - g. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - h. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:
 - 1) low oil pressure (alarm)
 - 2) low oil pressure (shutdown)
 - 3) oil pressure sender failure (alarm)
 - 4) low coolant temperature (alarm)
 - 5) high coolant temperature (alarm)
 - 6) high coolant temperature (shutdown)
 - 7) engine temperature sender failure (alarm)
 - 8) low coolant level (alarm or shutdown--selectable)
 - 9) fail to crank (shutdown)
 - 10) overcrank (shutdown)
 - 11) overspeed (shutdown)
 - 12) low DC voltage (alarm)
 - 13) high DC voltage (alarm)
 - 14) weak battery (alarm)
 - 15) low fuel-daytank (alarm)

- 16) high AC voltage (shutdown)
 - 17) low AC voltage (shutdown)
 - 18) under frequency (shutdown)
 - 19) over current (warning)
 - 20) over current (shutdown)
 - 21) short circuit (shutdown)
 - 22) ground fault (alarm)
 - 23) over load (alarm)
 - 24) emergency stop (shutdown)
- i. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.
- j. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
- 1) engine oil pressure (psi or kPA)
 - 2) engine coolant temperature (degrees F or C)
 - 3) engine oil temperature (degrees F or C)
 - 4) engine speed (rpm)
 - 5) number of hours of operation (hours)
 - 6) number of start attempts
 - 7) battery voltage (DC volts)
- k. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.
- l. Control Functions: The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
- m. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
- n. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.
- o. The control system shall include all interfaces necessary for proper operation with the paralleling equipment provided under this contract. The generator set

- supplier shall be responsible for complete compliance to all specification requirements for both the generator set and the paralleling equipment.
- p. Alternator Control Functions: The generator set shall include an automatic voltage regulation system which is matched and prototype tested with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level. The voltage regulation system shall include provisions for reactive load sharing and electronic voltage matching for paralleling applications. Motorized voltage adjust pot is not acceptable for voltage matching.
 - q. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
 - r. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
 - s. An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - t. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.
 - u. The Control System shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps, and include adjustable time delay of 0-1.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay which will function correctly in system as installed.
 - v. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:

- 1) Form "C" dry common alarm contact set rated 2A @ 30VDC to indicate existence of any alarm or shutdown condition on the generator set.
- 2) One set of contacts rated 2A @ 30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
- 3) A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
- 4) A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
- 5) The control shall be provided with a direct serial communication link for the LonWorks communication network interface as described elsewhere in this specification and shown on the drawings.

G. Base

1. The engine-generator set shall be mounted on a heavy duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

H. Generator Set Auxiliary Equipment and Accessories:

1. Coolant heater:
 - a. Engine mounted, thermostatically controlled, coolant heater for the engine. Heater voltage shall be 240 volts, single phase.
 - b. The coolant heater shall be installed on the engine with silicone hose connections. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
 - c. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
 - d. The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient, in compliance with NFPA110 requirements.
2. Vibration Isolators, spring type, quantity as recommended by the generator set manufacturer.
3. Starting and Control Batteries: Starting battery bank, calcium/lead antimony type, 24 volt DC, sized as recommended by the generator set manufacturer, shall be supplied

- for each generator set with battery cables and connectors.
4. Exhaust Silencer(s): Exhaust muffler(s), with exhaust pipe, shall be provided for the engine, size and type as recommended by the generator set manufacturer. The muffler(s) shall be critical grade and be a dual inlet style single outlet style for the configured engine. Stainless Steel exhaust flex for mounting between the engine and silencer shall be provided by the generator set manufacturer.
 5. Remote Annunciator: Provide and install a 20-light LED remote alarm annunciator with horn, located as shown on the drawings or in a location which can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems; and in addition shall provide indications for high battery voltage, low battery voltage, loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2.
 6. Battery Charger: A UL listed 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be wall mounted. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:
 - a. Loss of AC power - red light
 - b. Low battery voltage - red light
 - c. High battery voltage - red light
 - d. Power ON - green light (no relay contact)
 - e. Analog DC voltmeter and ammeter, 12 hour equalize charge timer, AC and DC fuses shall also be provided on the charger.
 7. Dual Wall Sub-Base Fuel Tank: The fuel tank shall be a standard product of the manufacturer of the engine-generator set. The tank shall be UL 2085 listed, made of aluminized steel with welded construction, and pressure tested to 25 PSI hydrostatic and 4 times maximum recommended set weight load testing required by UL and U.L.C. Capacity of the fuel tank shall be sufficient for 24 hours of operation minimum at full load.
 - a. Manual over fill protection.
 - b. Fuel level gauge.
 - c. Lockable fill cap.
 - d. Load bearing vertical AC@ channel at generator set mounting points.
 - e. Vertically accessible primary vent.

- f. Venting to UL standards in both primary and secondary containments.
 - g. Weatherproof secondary containment.
 - h. Mounts directly to generator set skid.
 - i. 8 gauge aluminized steel top.
 - j. 12 gauge aluminized steel sides and bottom.
 - k. Listed to UL142 under label #58-24-2 A Secondary Containment Generator Base Tank.
 - l. Low fuel alarm
 - m. Leak detection alarm
 - n. A reverse pump and supply pump system in combination with a solenoid and strainer mounted in the supply line shall be provided to prevent fuel spill due to overfilling of the tank. Fuel pumps shall be mounted on the tank for pumping fuel from the main tank to the sub-base fuel tank and shall utilize a heavy duty 2GPM self-priming, positive displacement rotary gear pump. UL 508 listed. Pumps to include motor control relays, manual control with On, Off and Test buttons, and secure internal test buttons for testing warning LEDs and remote annunciation of warnings.
- 8. Main Line Circuit Breaker
 - a. A unit mounted main line circuit breaker shall be supplied mounted on the side of each generator set.
 - b. The breaker shall be rated at 480 volts and be a 3 pole design with an ampere rating as recommended by the manufacturer.
- 9. Weatherproof Sound Attenuated Enclosure:
 - a. The sound attenuated housing shall enclose the complete generator set and allow ample cooling air flow in ambient temperatures as high as 122 deg. F. The sound attenuated housing shall provide level II of sound attenuation with a maximum full load sound level of 76 dB(A) at 7 meters.
 - b. The enclosure shall be attached directly to the generator subbase fuel tank by the Contractor. The enclosure shall be 14 gage formed construction, modular design, gasketed roof bolts, plus rain ledge on four sides. All bolts shall be 3/8-inch (10 mm) cadmium plated with lock washers. Hinges shall be continuous type with 1/4-inch (6 mm) brass pins.
 - c. The roof shall be flanged lap rain tight construction, complete with roof stiffeners. The doors shall be full length piano hinged with fixed open air intake louvers, and equipped with adjustable plated pad-type latches and matched keys and rubber door stops. There shall be doors on each side and one rear door for easy access. Hinged radiator fill access door and radiator core guard shall be provided. Drip flange and gasketed exhaust exit shall be provided.

- d. Enclosure shall include a radiator discharge duct which shall direct the discharge air from the radiator upward.
- e. Complete enclosure shall be primed with two coats of zinc-chromate and finished painted with two coats of enamel.

2.2 INSTALLATION OF ENGINE-GENERATOR SYSTEMS

- A. Install engine-generator units as indicated, in accordance with the equipment manufacturer's written instructions, and with recognized industry practices, to ensure that engine-generator units fulfill requirements. Comply with NFPA and NEMA standards pertaining to installation of standby engine-generator systems and accessories.
- B. Coordinate with other work, including fuel tanks, piping and accessories, as necessary to interface installation of engine-generator systems work with other work.
- C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.
- D. Install units on vibration isolators in accordance with Division-15 section; comply with manufacturer's indicated installation method if any.
- E. Connect fuel oil piping to standby generator equipment as indicated, and comply with manufacturer's instructions where not otherwise indicated.
- F. Align shafts of engine and generator within tolerances recommended by equipment manufacturer.

2.3 GROUNDING

- A. Provide equipment grounding connections for engine-generator units. Tighten connections to comply with tightening torques specified in UL Std 486A to assure permanent and effective grounds.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
- B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.2 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.3 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in installation and start-up of the equipment specified under this section for a period of 2 working days. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field start-up.

3.4 MANUFACTURER'S CERTIFICATION

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.
- C. The manufacturer shall furnish a five (5) year warranty from date of shipment.

3.5 TESTING

- A. Upon completion of installation of engine-generator system and after building circuitry has been energized with normal power source, test engine-generators to demonstrate standby capability and compliance with requirements. Where possible, field correct malfunctioning units, then retest to demonstrate compliance.
- B. Start-Up Testing:
 - 1. Engage local equipment manufacturer's representative to perform start-up and building load tests upon completion of installation, with the Architect/Engineer in attendance; provide certified test record. Tests are to include the following:
 - a. Check fuel, lubricating oil, and antifreeze in liquid cooled models for conformity to the manufacturer's recommendations under environmental conditions present.
 - b. Test prior to cranking engine for proper operation, accessories that normally function while the set is in a standby mode. Accessories include: engine heaters, battery charger, generator strip heater, remote annunciator.
 - c. Check, during start-up test mode, for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and

- stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.
- d. Test: Prior to acceptance of the installation, the equipment shall be subjected to an on site test at full load with resistive load banks for a minimum of 4 hours. All consumables necessary for this test operation shall be furnished by the Contractor. Any defects which become evident during this test shall be corrected by the bidder at his own expense.
 - e Upon completion of installation demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting. Initial testing and retesting to be at no cost to Owner.

3.6 PERSONNEL TRAINING

- A. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating diesel engine-driven generator sets. In addition, train Owner's personnel in periodic maintenance of batteries.

END OF SECTION 263213

SECTION 263600 - AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.

1.3 SCOPE

- A. Furnish and install the low voltage automatic transfer switches having the ratings, features/ accessories and enclosures as specified herein and as shown on the contract drawings.

1.4 REFERENCES

- A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:
 - 1. UL 1008 – Transfer Switches
 - 2. UL 991 - Tests for Safety-Related Controls Employing Solid-State Devices
 - 3. NFPA 70 – National Electrical Code
 - 4. NFPA 99 – Essential Electrical Systems of Health Care Facilities
 - 5. NFPA 110 – Emergency and Standby Power Systems
 - 6. NEMA ICS 10 – AC Transfer Switch Equipment
 - 7. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems

1.5 SUBMITTALS – for Review/approval

- A. The following information shall be submitted to the Engineer:
 - 1. Front view and plan view of the assembly
 - 2. Schematic diagram
 - 3. Conduit space locations within the assembly.
 - 4. Assembly ratings including:
 - a. Withstand and Closing rating
 - b. Voltage

- c. Continuous current rating
 - d. Short-Time rating if applicable
 - e. Short-circuit rating if ordered with integral protection
 - f. Cable terminal sizes
- 5. Product Data Sheets.
 - a. Where applicable, the following additional information shall be submitted to the Engineer:
 - 1) Busway connection
 - 2) Connection details between close-coupled assemblies
 - 3) Composite front view and plan view of close-coupled assemblies

1.6 SUBMITTALS – for construction

- A. The following information shall be submitted for record purposes:
 - 1. Final as-built drawings and information for items listed in section 1.04
 - 2. Wiring diagrams
 - 3. Certified production test reports
 - 4. Installation information
- B. The final (as-built) drawings shall include the same drawings as the construction drawings and shall incorporate all changes made during the manufacturing process.

1.7 QUALIFICATIONS

- A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
- C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.8 REGULATORY REQUIREMENTS

- A. Provide a certificate of compliance with UL 1008 for the transfer switches furnished under this section.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions.
- B. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

Part 2 – PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

A. General Requirements

1. Automatic transfer switch for shall be standard automatic transfer switch, open transition type. The switch shall consist of a power transfer module and a control module, interconnected to provide complete automatic operation. The automatic transfer switch shall be mechanically held and electrically operated by a single-solenoid mechanism energized from the source to which the load is to be transferred. The switch shall be rated for continuous duty and be inherently double-throw. The switch shall be mechanically interlocked to ensure only one of two possible positions--normal or emergency. The automatic transfer switch shall be suitable for use with emergency sources. (Program Transition/Neutral).
2. All main contacts shall be of silver composition. They shall be protected by arcing contacts. The operating transfer time in either direction shall not exceed one-sixth (1/6) of a second.
3. All contacts, coils, springs, and control elements shall be conveniently removable from the front of the transfer switch without major disassembly or disconnection of power conductors.
4. The control module shall be mounted separately from the transfer switch for ease of maintenance. Sensing and control logic shall be electromechanical relays. Relays shall be industrial, control-grade, plug-in type with dust covers and locking clips.
5. Automatic transfer switch shall be totally front accessible. Transfer switches requiring rear or side access shall not be acceptable.
6. The automatic transfer switch shall confirm to the requirements of NEMA Standard ICS 2-447 and Underwriters' Laboratories UL-1008, and shall be UL listed as follows:
 - a. For use in emergency systems in accordance with articles 700 of the National Electrical Code.
 - b. Rated in amperes for total system transfer including control of motors, electric-discharge lamps, electric heating and tungsten-filament lamp load.
 - c. The automatic transfer switch shall be rated to withstand the RMS symmetrical short circuit current available at the automatic transfer switch terminals.
7. The automatic transfer switch shall be mounted in a NEMA type 3R enclosure.

B. Testing

1. Certified laboratory test data on a switch of the same design and rating shall be provided to confirm overload and endurance per tables 21.2 and 23.2 of UL-1008 when enclosed.
2. Temperature rise tests after the overload and endurance tests to confirm the ability of the transfer switches to carry their rated current within the allowable temperature limits of the insulation in contact with current-carrying parts.

3. Withstand current tests per paragraph 25 of UL-1008. No welding of contacts. Transfer switch must be operable to alternate source after the withstand current tests.
4. Dielectric tests at 1960 volts, RMS, minimum after the withstand current test.
5. The complete automatic transfer switch shall be tested to ensure proper operation of the individual components and correct overall sequence of operation, and to ensure that the operating transfer time, voltage, frequency, and time delay settings are in compliance with the specification requirements.
6. The complete automatic transfer switch shall be subjected to a dielectric strength test per NEMA Standard ICS 1.109.05.
7. The control panel shall meet or exceed the voltage surge withstand capability in accordance with ANSI C37.90a-1978 and the impulse withstand voltage test in accordance with NEMA Standard ICS 1-109.

C. Performance

1. All phases of the normal service shall be monitored line-to-line. The transfer to emergency will be initiated upon reduction of normal source to 70% of nominal voltage and retransfer to normal shall occur when normal source restores to 90% of nominal.
2. A test switch shall be provided to momentarily simulate normal source failure.
3. Harnessing between transfer switch and control panel shall be built-in and shall be capable of being disconnected for routine maintenance.
4. All moveable parts of the operating mechanism shall remain in positive mechanical contact with the main contacts during the transfer operation without the use of separate mechanical interlocks. Automatic operation of the switch shall not require power from any source other than the line-to-line voltage of the source to which the switch is transferring.

D. Accessories

1. The switches shall include voltage and frequency sensing of the emergency source and shall be factory set to allow transfer to emergency when that source is approximately at rated voltage and frequency.
2. Gold plated contacts rated 10 amps, 32 volts dc which close when the normal source fails shall be provided to initiate engine starting.
3. The automatic switch shall include a 120V, 150W. heater with automatic controls to prevent condensation.

E. Certification

1. On request, the manufacturer shall provide a letter certifying compliance with all requirements of the transfer switch specification.
2. The certification shall identify equipment by serial number and shall include no exceptions to the specifications, except those stipulated with the submittal.

F. Submittal, Operator's Manual, and Warranty

1. Submittal shall include specification sheets showing all standard and optional accessories

- to be supplied; schematic wiring diagrams; dimension drawings; and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel.
2. The transfer switch shall be provided with an operator's manual providing installation and operating instructions.
 3. The automatic transfer switch shall be warranted by the generator set manufacturer.

PART 3 – EXECUTION

3.1 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section all tests shall be in accordance with the latest version of UL and NEMA standards.
 1. Insulation check to ensure the integrity of insulation and continuity of the entire system.
 2. Visual inspection to ensure that the switch matches the specification requirements and to verify that the fit and finish meet quality standards.
 3. Mechanical tests to verify that the switch's power sections are free of mechanical Hindrances.
 4. Electrical tests to verify the complete electrical operation of the switch and to set up time delays and voltage sensing settings of the logic.
- B. The manufacturer shall provide a certified copy of factory test reports.
- C. Transfer switch shall include a label indicating order number, catalog number and date.

3.2 INSTALLATION

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the contractor.

3.3 FIELD QUALITY CONTROL

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of 3 working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.

3.4 MANUFACTURER'S CERTIFICATION

1. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
2. The Contractor shall provide a copy of the manufacturer's representative's certification.

3.5 TRAINING

1. The Manufacturer's qualified representative shall conduct a training session for up to five (5) owner's representatives for one normal workday at a jobsite location determined by The owner. The training program shall consist of the instruction on the operation of the transfer switch and the major components within the assembly.

3.6 FIELD SERVICE ORGANIZATION

- A. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.

END OF SECTION 263600

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.
- B. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.

1.2 STANDARDS AND CODES

- A. Methods of installation shall comply with the provisions of applicable sections of the 2023 edition of the NEC, the 2023 State of Michigan Electrical Code with Part 8 amendments, the 2021 Michigan Building Code, NFPA 72, NFPA 99, NFPA 110, and the ICC Electrical Code.
- B. Materials shall be UL and NEC approved for the application.

1.3 SUMMARY

- A. Section Includes:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. System duct smoke detectors.
 - 5. System heat detectors.
 - 6. Notification appliances.
 - 7. Magnetic door holders.
 - 8. Remote annunciators.
 - 9. Addressable interface devices.
 - 10. Digital alarm communicator transmitter
 - 11. Single station smoke detectors with LED strobe lights.
- B. General Requirements:
 - 1. The existing fire alarm system shall be replaced with a new fire alarm system, including all new equipment. Contractor shall hire a Level 3 NICET Certified fire alarm designer to design the intelligent addressable fire alarm systems.
 - 2. All fire alarm components, shall include, but shall not be limited to; NAC panels, power supplies, initiating devices, audible alarm and visual notification appliances as appropriate, conduit, wiring, fittings, and all other accessories and auxiliaries necessary to provide a complete and operable system.

- C. The drawings indicate assumed locations of devices and suggested conduit routing diagrams on the plans. A fire alarm NICET Level 3 Certified fire alarm designer shall determine the actual device types and their locations, output levels and the routing of all raceways.

1.4 DEFINITIONS

- A. Definitions in NFPA 72 apply to fire-alarm terms used in this Section.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.

1.5 SYSTEM DESCRIPTION

- A. Non-coded, UL-certified, addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
- B. Non-coded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

1.6 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to seismic forces, and the unit will be fully operational after the seismic event."
- B. Basic Performance:
 - 1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).
 - 2. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
 - 3. Notification Appliance Circuits (NAC) shall be wired Class A (NFPA Style Z) as part of an addressable device connected by the SLC Circuit.
 - 4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
 - 5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
- C. Basic System Functional Operation
 - 1. When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

- a. The system alarm LED on the system display shall flash.
- b. A local piezo electric signal in the control panel shall sound.
- c. A backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
- d. Printing and history storage equipment shall log the information associated with each new fire alarm control panel condition, along with time and date of occurrence.
- e. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

1.7 MANUFACTURER

A. The existing system shall be replaced with new equipment.

1. Fire alarm systems shall be as manufactured by the following:
 - a. National Time and Signal
 - b. Notifier
 - c. Honeywell
 - d. Siemens
 - e. Edwards Fire Safety
2. Alternate manufacturer's equipment will be considered.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, device arrangement, complete wiring point-to-point diagrams, and conduit layouts.
3. Show annunciator layout, configurations, and terminations.

C. Manuals:

1. Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
2. Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
3. Provide a clear and concise description of operation that gives, in detail, the information required to properly operate the equipment and system.

D. Software

1. Provide the services of a factory trained and authorized technician to perform all

system software programming, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site.

E. Certifications

1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.
2. The manufacturer shall certify the fire alarm installation at each phase of construction as required by the Michigan Department of Licensing and Regulatory Affairs (LARA).

1.8. GUARANTY

- A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance. The full cost of maintenance, labor and materials required to correct any defect during this one year period shall be included in the submittal bid.

1.9 POST CONTRACT MAINTENANCE

- A. Complete maintenance and repair service for the fire alarm system shall be available from a factory trained authorized representative of the manufacturer of the major equipment for a period of five (5) years after expiration of the guaranty.
- B. As part of the bid/proposal, include a quote for a maintenance contract to provide all maintenance, tests, and repairs described below. Include also a quote for unscheduled maintenance/repairs, including hourly rates for technicians trained on this equipment, and response travel costs for each year of the maintenance period. Submittals that do not identify all post contract maintenance costs will not be accepted. Rates and costs shall be valid for the period of five (5) years after expiration of the guaranty.
- C. Maintenance and testing shall be on a semi-annual basis or as required by the AHJ. A preventive maintenance schedule shall be provided by the contractor describing the protocol for preventive maintenance. The schedule shall include:
 1. Systematic examination, adjustment and cleaning of all detectors, manual fire alarm stations, control panels, power supplies, relays, water-flow switches and all accessories of the fire alarm system.
 2. Each circuit in the fire alarm system shall be tested semi-annually.
 3. Each smoke detector shall be tested in accordance with the requirements of NFPA 72 Chapter 7.

1.10 APPLICABLE STANDARDS AND SPECIFICATIONS

- A. The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.
1. National Fire Protection Association (NFPA) - USA:
 - a. No. 72 National Fire Alarm Code
 - b. No. 101 Life Safety Code
 2. Underwriters Laboratories Inc. (UL) - USA:
 - a. No. 268 Smoke Detectors for Fire Protective Signaling Systems
 - b. No. 864 Control Units for Fire Protective Signaling Systems
 - c. No. 268A Smoke Detectors for Duct Applications
 - d. No. 521 Heat Detectors for Fire Protective Signaling Systems
 - e. No. 464 Audible Signaling Appliances
 - f. No. 38 Manually Actuated Signaling Boxes
 - g. No. 346 Water-flow Indicators for Fire Protective Signaling Systems
 - h. No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems
 - i. No. 1971 Visual Notification Appliances
 3. Local and State Building Codes.
 4. All requirements of the Authority Having Jurisdiction (AHJ).

1.11 APPROVALS

- A. The system shall have proper listing and/or approval from the following nationally recognized agencies:
1. UL Underwriters Laboratories Inc
- B. The fire alarm control panel shall meet UL Standard 864 (Control Units) and UL Standard 1076 (Proprietary Burglar Alarm Systems).

PART 2 - PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL

- A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.
- B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

- C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2. CONDUIT AND WIRE

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.
2. Where required, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.
3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.
4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.
6. Conduit shall be 1/2-inch (12.7 mm) minimum.

B. Wire:

1. All fire alarm system wiring shall be new.
2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for Initiating Device Circuits and Signaling Line Circuits, and 14 AWG (1.63 mm) for Notification Appliance Circuits.
3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.
4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).
5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.
6. All field wiring shall be electrically supervised for open circuit and ground fault.
7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

- C. Terminal Boxes, Junction Boxes and Cabinets:
 - 1. All boxes and cabinets shall be UL listed for their use and purpose.
- D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water-flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.
- E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the emergency power panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3. MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE

- A. Main FACP or network node shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.
- B. Operator Control
 - 1. Acknowledge Switch:
 - a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
 - b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
 - 2. Alarm Silence Switch:
 - a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition.
 - b. The selection of notification circuits and relays that are capable of being silenced by this switch shall be fully field programmable within the confines of all applicable standards.
 - c. The FACP software shall include silence inhibit and auto-silence timers.
 - 3. Alarm Activate (Drill) Switch:
 - a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:
 - a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.
 5. Lamp Test:
 - a. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.
- C. System Capacity and General Operation
1. The control panel or each network node shall be capable of expansion to 636 intelligent/addressable devices.
 2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable Notification Appliance Circuits.
 3. The control panel or each network node shall support up to 8 additional output modules (signal, speaker, telephone, or relay), each with 8 circuits for an additional 64 circuits. These circuits shall be either Class A (NFPA Style Z) or Class B (NFPA Style Y) per the project drawings.
 4. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
 5. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
 6. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
 7. The FACP or each network node shall provide the following features:
 - a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
 - b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.
 - c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.

- d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be .5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of .03 percent per foot to 1.0 percent per foot. The system shall also include up to nine levels of Pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.
 - e. The ability to display or print system reports.
 - f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
 - g. PAS pre-signal, meeting NFPA 72 3-8.3 requirements.
 - h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 Chapter 1 requirements for activation of notification circuits within 10 seconds of initiating device activation.
 - I. Periodic detector test, conducted automatically by the software.
 - j. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal peaks.
 - k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
 - l. Walk test, with a check for two detectors set to same address.
 - m. Control-by-time for non-fire operations, with holiday schedules.
 - n. Day/night automatic adjustment of detector sensitivity.
 - o. Device blink control for sleeping areas.
8. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), and Temporal (NFPA 72 A-2-2.2.2). The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

D. Central Microprocessor

- 1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
- 2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
- 3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
- 4. A special program check function shall be provided to detect common operator errors.
- 5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.

6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.
- E. System Display
1. The system shall support the following display mode options:
 - a. 80 character display option. The display shall include an 80-character backlit alphanumeric Liquid Crystal Display (LCD) and a full PC style QWERTY keypad.
 2. The display shall provide all the controls and indicators used by the system operator:
 - a. The 80-character display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.
 3. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
 4. The 80-character display shall provide 8 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.
 5. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.
 6. The system shall support the display of battery charging current and voltage on the 80-character LCD display.
- F. Signaling Line Circuits (SLC)
1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a loop capacity of 318 devices. The addition of the optional second loop shall double the device capacity, supporting a total of 636 devices. Each SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.
 2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each

detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

G. Serial Interfaces

1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
 - a. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.
 - b. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

H. Notification Appliance Circuit (NAC) Module

1. The Notification Appliance Circuit module shall provide four fully supervised Class A or B (NFPA Style Z or Y) notification circuits. An expansion circuit board shall allow expansion to eight circuits per module.
2. The notification circuit capacity shall be 3.0 amperes maximum per circuit and 6.0 amperes maximum per module.
3. The module shall not affect other module circuits in any way during a short circuit condition.
4. The module shall provide eight green ON/OFF LEDs and eight yellow trouble LEDs.
5. The module shall also provide a momentary switch per circuit that may be used to manually turn the particular circuit on or off or to disable the circuit.
6. Each notification circuit shall include a custom label inserted to identify each circuit's location. Labels shall be created using a standard typewriter or word processor.
7. The notification circuit module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal strips shall be UL listed for use with up to 12 AWG wire.
8. Each circuit shall be capable of, through system programming, deactivating upon depression of the signal silence switch.

I. Control Relay Module

1. The control relay module shall provide four Form-C auxiliary relay circuits rated at 5 amperes, 28 VDC. An expansion circuit board shall allow expansion to eight Form-C relays per module.
2. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.
3. The relay module shall provide 8 green ON/OFF LEDs and 8 yellow LEDs (indicates disabled status of the relay).
4. The module shall provide a momentary switch per relay circuit that may be used to manually turn the relay ON/OFF or to disable the relay.

5. Each relay circuit shall include a custom label inserted to identify its location. Labels shall be created using a standard typewriter or word processor.
 6. The control relay module shall be provided with removable wiring terminal blocks for ease of installation and service. The terminal blocks shall be UL listed for use with up to 12 AWG wire.
- J. Enclosures:
1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
 2. The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
 3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.
- K. Power Supply:
1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
 2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
 3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 60 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
 4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
 - a. Ground Fault LED
 - b. AC Power Fail LED
 - c. NAC on LED (4)
 5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
 6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 60 AH.
 7. All circuits shall be power-limited, per UL864 requirements.
- L. Field Charging Power Supply (FCPS): The FCPS is a device designed for use as either a remote 24 volt power supply or used to power Notification Appliances.
1. The FCPS shall offer up to 6.0 amps (4.0 amps continuous) of regulated 24 volt power. It shall include an integral charger designed to charge 7.0 amp hour batteries and to

support 60 hour standby.

2. The Field Charging Power Supply shall have two input triggers. The input trigger shall be a Notification Appliance Circuit (from the fire alarm control panel) or a relay. Four outputs (two Style Y or Z and two style Y) shall be available for connection to the Notification devices.
3. The FCPS shall include an attractive surface mount backbox.
4. The Field Charging Power Supply shall include the ability to delay the AC fail delay per NFPA requirements.
5. The FCPS include power limited circuitry, per 1995 UL standards.

M. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.
2. Alarm Verification: Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 5 to 30 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.
3. Point Disable: Any addressable device or conventional circuit in the system may be enabled or disabled through the system keypad.
4. Point Read: The system shall be able to display or print the following point status diagnostic functions:
 - a. Device status
 - b. Device type
 - c. Custom device label
 - d. View analog detector values
 - e. Device zone assignments
 - f. All program parameters
5. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system status.
6. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a

period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

8. Pre-Alarm Function: The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.
9. Software Zones: The FACP shall provide 100 software zones, 10 additional special function zones, 10 releasing zones, and 20 logic zones.
10. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:
 - a. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.
 - b. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.
 - c. All devices tested in walk test shall be recorded in the history buffer.
11. Water-flow Operation:
 - a. An alarm from a water-flow detection device shall activate the appropriate alarm message on the main panel display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.
12. Supervisory Operation:
 - a. An alarm from a supervisory device shall cause the appropriate indication on the system display, light a common supervisory LED, but will not cause the system to enter the trouble mode.
13. Signal Silence Operation:
 - a. The FACP shall have the ability to program each output circuit (notification, relay, speaker etc) to deactivate upon depression of the signal silence switch.
14. Non-Alarm Input Operation:
 - a. Any addressable initiating device in the system may be used as a non-alarm input to monitor normally open contact type devices. Non-alarm functions are a lower priority than fire alarm initiating devices.

2.4. SYSTEM COMPONENTS

- A. Programmable Fire Alarm Audible Devices :
 - 1. Electronic sounders shall operate on 24 VDC nominal.
 - 2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
 - 3. Shall be flush or surface mounted as shown on plans.
- B. Visual Alarm Devices: Strobe lights shall meet the requirements of the ADA, UL Standard 1971, be fully synchronized, and shall meet the following criteria:
 - 1. The maximum pulse duration shall be 2/10 of one second.
 - 2. Strobe intensity shall meet the requirements of UL 1971.
 - 3. The flash rate shall meet the requirements of UL 1971.
- C. Fire Alarm Audible/Visual Combination Devices:
 - 1. Shall meet the applicable requirements of Section A listed above for audibility.
 - 2. Shall meet the requirements of Section B listed above for visibility.
- D. All interfaces and associated equipment are to be protected so that they will not be affected by voltage surges or line transients consistent with UL standard 864.
- E. Field Wiring Terminal Blocks:
 - 1. For ease of service all panel I/O wiring terminal blocks shall be removable, plug-in types and have sufficient capacity for #18 to #12 AWG wire. Terminal blocks that are permanently fixed are not acceptable.

2.5. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

- A. Addressable Devices - General
 - 1. Addressable devices shall use simple to install and maintain decade, decimal address switches. Devices shall be capable of being set to an address in a range of 001 to 159.
 - 2. Addressable devices, which use a binary-coded address setting method, such as a DIP-switch, are not an allowable substitute.
 - 3. Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel Signaling Line Circuit.
 - 4. Addressable smoke and thermal detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash green under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady red illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.

5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. The panel on a time-of-day basis shall automatically adjust sensitivity.
 6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
 7. The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature. Bases shall include a sounder base with a built-in (local) sounder rated at 85 DBA minimum, a relay base and an isolator base designed for Style 7 applications.
 8. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
 9. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (ION, PHOTO, THERMAL).
 10. Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
 11. Addressable devices shall store an internal identifying code that the control panel shall use to identify the type of device.
 12. Addressable modules shall mount in a 4-inch square (101.6 mm square), 2-1/8 inch (54 mm) deep electrical box. An optional surface mount Lexan enclosure shall be available.
- B. Addressable Manual Fire Alarm Box (manual station)
1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
 2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.
 3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.
- C. Intelligent Photoelectric Smoke Detector
1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

2. Duct detector remote indicator shall be flush mounted to a single gang box. One required for each detector. Alarm indicators shall be mounted 60" A.F.F. or in the ceiling tile below unit when concealed.
- D. Intelligent Multi Criteria Acclimating Detector
1. The intelligent multi criteria Acclimate detector shall be an addressable device that is designed to monitor a minimum of photoelectric and thermal technologies in a single sensing device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine it's environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires and thermal properties all within a single sensing device.
 2. The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).
 3. The intelligent multi criteria detection device shall include the ability to combine the signal of the thermal sensor with the signal of the photoelectric signal in an effort to react hastily in the event of a fire situation. It shall also include the inherent ability to distinguish between a fire condition and a false alarm condition by examining the characteristics of the thermal and smoke sensing chambers and comparing them to a database of actual fire and deceptive phenomena.
- E. Intelligent Thermal Detectors
1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.
- F. Smoke Detectors in individual unit residences: (Single Station type)
1. Provide single station smoke detectors with LED strobe lights with "Fire" lettering at all new and existing apartments.
 2. The locally powered 9 VDC and 120 VAC smoke detectors shall be photoelectric type with internal 90dba at 10' horn with a temporal pattern. Ionization type detectors will not be acceptable. The detectors shall mount on any standard electrical box. It shall be listed to UL 217.
 3. All dwelling unit detectors shall be tandem connected within individual units.
 4. Single station smoke detectors shall be powered through a local 120V receptacle circuit in each apartment.
- G. Smoke and Carbon Monoxide Detectors in individual unit residences: (Single Station type)

1. Provide single station combination smoke and carbon monoxide detector with LED strobe lights with "Fire" lettering at all new and existing apartments.
 2. The locally powered 9 VDC and 120 VAC combination detectors shall detect both smoke and carbon monoxide. The smoke detector shall be photoelectric type with internal 90dba at 10' horn with a temporal pattern. Ionization type detectors will not be acceptable. The detectors shall mount on any standard electrical box. It shall be listed to UL 217.
 3. All dwelling unit detectors shall be tandem connected within individual units.
 4. Single station smoke detectors shall be powered through a local 120V receptacle circuit in each apartment.
- H. Low Frequency Temporal Horn:
1. Provide a Low frequency temporal horn audible device in each sleeping area of all apartments which shall sound upon activation of the building fire alarm system.
 2. The audible device shall emit a 520 Hz low frequency temporal tone in accordance with NFPA 72.
 3. The audible device shall be listed per UL 112E.
- I. Intelligent Duct Smoke Detector
1. The smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.
 2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.
- J. Addressable Dry Contact Monitor Module
1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLCs.
 2. The IDC zone shall be suitable for Style D or Style B operation. An LED shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.
 3. For difficult to reach areas, the monitor module shall be available in a miniature package and shall be no larger than 2-3/4 inch (70 mm) x 1-1/4 inch (31.7 mm) x 3/8 inch (12.7 mm). This version need not include Style D or an LED.
- K. Two Wire Detector Monitor Module
1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional 2-wire smoke detectors or alarm initiating devices (any N.O. dry contact device).
 2. The IDC zone may be wired for Class A or B (Style D or Style B) operation. An LED

shall be provided that shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

L. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.
4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

M. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

2.6. BATTERIES

- A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
- B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.
- C. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 - EXECUTION

3.1. INSTALLATION:

- A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.
- B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- C. All fire detection and alarm system devices, control panels and remote annunciators shall be

flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

- D. Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches (1067 mm), nor more than 48 inches (122 mm) above the finished floor.
- E. The fire alarm system shall be re-certified at each phase of construction as required by the Michigan Department of Licensing and Regulatory Affairs (LARA).

3.2. FINAL INSPECTION:

- A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

3.3. INSTRUCTION:

- A. Instruction shall be provided as required for operating the system. Provide Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions.
- B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

END OF SECTION 283111