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SECTION 00 01 15
DRAWING LIST

THE DRAWINGS LISTED BELOW ARE PART OF THIS CONTRACT AND ATTACHED BY REFERENCE.

GENERAL DRAWINGS:

A0.1	A0.2	A0.3			

ARCHITECTURAL DRAWINGS:

AD2.1	A2.1	A3.1	A7.1		

MECHANICAL DRAWINGS:

M000	M101	M111	M201	M211	M400
M600					

ELECTRICAL DRAWINGS:

E000	E001	E101	E111	E121	E201
E211	E221				

PLUMBING & FIRE PROTECTION DRAWINGS:

P000	P101	P111	P201	P211	

END OF SECTION

SECTION 01 10 00
SUMMARY

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 DEFINITIONS:

- A. Owner: Wherever the term "Owner" is used, it shall mean St. Luke's Health System, located at 901 E. 104th Street / Kansas City, MO 64131.
 - 1. Project Location: Saint Luke's East
 - 2. Address: 100 NE Saint Luke's Blvd
Saint Luke's East
Lee's Summit, MO 64086
- B. Architect: Wherever the term "Architect" is used, it shall mean ACI / Boland, Inc., located at 1710 Wyandotte / Kansas City, MO 64108. ACI / Boland, Inc. is the Design Professional of Record for the Project. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

- C. Contractor: Wherever the term "Contractor" is used, it shall mean the trade-contractor who holds a prime contract with the Owner for a portion of the Work.

SPECIFIER: SELECT FOR GC PROJECTS

- D. Contractor: Wherever the term "Contractor" is used, it shall mean the person or entity contracted with the Owner to complete the Work.
 - 1. The Contractor may also be referred to as the "General Contractor" in the Contract Documents.
- E. Subcontractor: Wherever the term "Subcontractor" is used, it shall mean the person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site.
- F. Sub-Subcontractor: Wherever the term "Sub-Subcontractor" is used, it shall mean the person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site.
- G. Consultants:
 - 1. Structural Engineer: Wherever the term "Structural Engineer" is used, it shall mean Structural Engineering Associates, Inc., who has prepared the structural design drawings and specifications for the Project.
 - 2. MEPF Consultant: IMEG Corp., who have prepared the mechanical, electrical, plumbing, and fire protection design drawings and specifications for the Project.

1.03 WORK COVERED BY CONTRACT DOCUMENTS:

- A. The Work is defined by the Contract Documents and consists of the following:
 - 1. Renovation of Existing Building: New read rooms, enlarged control and scan room, new recovery room.
- B. Categories of Work include, but not limited to, the following:
 - 1. Sitework and landscaping.
 - 2. Selective demolition.
 - 3. General construction.
 - 4. Mechanical, electrical, plumbing, and fire protection Work.
- C. Contract Type: Coordinate with Construction Manager.

- D. Contract Type: A single prime contract based on Lump Sum as described in Document 00 52 00 - Agreement Form.

1.04 DESCRIPTION OF RENOVATION WORK

- A. Scope of selective demolition work is indicated on drawings and specified in Section 02 41 00.
- B. Plumbing: Alter existing system and add new construction, keeping existing in operation.
- C. HVAC: Alter existing system and add new construction, keeping existing in operation.
- D. Electrical Power and Lighting: Alter existing system and add new construction, keeping existing in operation.
- E. Fire Suppression Systems: Alter existing system and add new construction, keeping existing in operation.
- F. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
- G. Telephone: Alter existing system and add new construction, keeping existing in operation.
- H. Security System: Alter existing system and add new construction, keeping existing in operation.

1.05 PROJECT SCHEDULE

- A. Time is of the essence in completing this project within the indicated time frames. It is imperative to approach this project in a professional manner, and plan, schedule, and execute the Work accordingly.
 - 1. Sufficient Manpower: Include premium time and/or shift work as required to comply with the project schedule.
- B. Coordinate project schedule with Contractor.
- C. Refer to Section 01 32 00 for progress schedule requirements.

1.06 WORK BY OWNER

- A. Contractor/s shall cooperate fully with the Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner.
 - 1. Coordinate the Work of this Contract with work performed by the Owner.
- B. OWNER FURNISHED / OWNER INSTALLED WORK (OFOI)
 - 1. The Owner will procure separate contracts with vendors to furnish and install furniture, fixtures, and equipment shown on the drawings.
 - 2. Items noted on Drawings as "OF/OI" will be furnished and installed by the Owner.
 - 3. Items noted on Drawings as "NIC" (Not in Contract) will be supplied and installed by others.
- C. OWNER FURNISHED / CONTRACTOR INSTALLED WORK (OFCI)
 - 1. General: Products and items indicated in the Contract Documents "OFCI" will be provided by the Owner under separate contracts for final connection or installation by the Contractor/s.
 - a. Owner's Responsibilities for Owner Furnished / Contractor Installed Work:
 - 1) Arrange for and deliver shop drawings, product data, and samples to the Contractor/s.
 - 2) Arrange and pay for product delivery to site. After delivery, inspect products jointly with Contractor/s.
 - 3) Submit claims for transportation damage and replace damaged, defective, or deficient items.
 - 4) Arrange for manufacturer's warranties, inspections and service.
 - b. Contractor's Responsibilities for Owner Furnished / Contractor Installed Work:
 - 1) The Contractor shall coordinate and schedule with the Owner the requirements and timing required for prompt and proper incorporation into the work.
 - 2) Review Owner furnished shop drawings, product data, and samples to determine if information is adequate as needed for installation.

- 3) Receive and unload products at site; inspect for completeness or damage, to the extent the Contractor is responsible for installation of Owner provided Work.
- 4) Handle, store and install Owner furnished Work.
- 5) Repair or replace items damaged by construction operations.

1.07 BUILDING OCCUPANCY

- A. The Owner intends to occupy the existing building while construction is taking place.
 1. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- B. The Owner intends to occupy the Project upon Substantial Completion.
- C. The Owner may take partial occupancy of areas as the Work is completed prior to Substantial Completion.
 1. The Contractor/shall schedule the Work to accommodate Owner occupancy.

1.08 CODES

- A. Refer to the "Life Safety" sheet in the Drawings for building code information

1.09 USE OF SITE

- A. The General Contractor shall have full use of the Project site for construction operations during construction period.
 1. Limits: Site access will be limited to the area where the Work is taking place. All other areas are off limits.
 2. Driveways, Walkways and Entrances: Keep driveways loading areas, and entrances serving premises clear and available at all times. Do not use these areas for parking or storage of materials.
- B. Arrange use of site and premises to allow:
 1. Owner occupancy.
 2. Work by Others.
 3. Work by Owner.
 4. Use of site and premises by the public.
- C. Provide access to and from Project site as required by law and by Owner:
- D. Emergency building exits during construction:
 1. Keep all exits required by code open during construction period.
 2. Provide temporary exit signs if exit routes are temporarily altered.
- E. Do not obstruct roadways, sidewalks, or other public ways without permit.

1.10 WORK RESTRICTIONS

- A. Coordinate work restrictions with Owner, including:
 1. Work hours;
 2. Utility outages and shutdowns;
 3. Noise, vibration, and odors;
 4. Limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Utility Outages and Shutdown:
 1. Prevent disruption of utility services.
 2. Do not disrupt or shut down fire sprinklers and/or fire alarm systems without 2 days notice to Owner.
 3. Prevent accidental disruption of utility services to other facilities within an existing building.
- C. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise, vibration, odors, or other disruption, that may affect the Owner's day-to-day operations.
 1. Notify Owner not less than two (2) days in advance of proposed disruptive operations.
 - a. Obtain written permission before proceeding with disruptive operations.

1.11 IDENTIFICATION OF ON-SITE PERSONNEL

- A. Employee Identification: Provide identification tags for ALL personnel working on Project site. Require personnel to use identification tags at all times.
 - 1. Coordinate with Owner

1.12 TEMPORARY PROJECT SIGNAGE

- A. Project Identification Signboard: Provide one painted sign of construction, design, and content indicated on drawings, in location designated.
- B. Project Informational Signage: Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.
- C. Refer to Section 01 58 13 - Temporary Project Signage, for requirements.

1.13 DRUG SCREENINGS

- A. If applicable, comply with Owner's requirements for drug screening of ALL personnel working on Project site.

1.14 SMOKING AND CONTROLLED SUBSTANCES

- A. Smoking is prohibited on the project site
- B. Use of controlled substances on the project site is prohibited

1.15 FIREARMS

- A. Firearms: Firearms are not permitted on the project site

1.16 BACKGROUND CHECKS

- A. Coordinate with Construction Manager
- B. Coordinate with Owner

1.17 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.

1.18 INTENT OF THE CONTRACT DOCUMENTS

- A. Intent: Drawings and specifications are intended to provide the basis for proper completion of the Work. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.
- B. The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all; performance by the Construction Manager shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results.

1.19 WORK SEQUENCE

- A. Coordinate construction schedule and operations with Construction Manager
- B. Coordinate construction schedule and operations with General Contractor

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00
CONTRACT CONSIDERATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. E-Builder Administration
- B. Cash allowances.
- C. Schedule of Values.
- D. Requests for Information - RFI's
- E. Application for Payments.
- F. Progress Payment
- G. Application for Final Payment.
- H. Change Orders.
- I. Unit Prices

1.02 E-BUILDER ADMINISTRATION

- A. Use of Owner's Project Web site ("e-builder" project management website) for purposes of hosting and managing project communication and documentation until Final Completion. Use of Project website shall include the following documents:
 - 1. Project Applications for Payment
 - 2. Project Requests for Information (RFI's)
 - 3. Project Architectural Supplemental Instructions (ASI's)
 - 4. Project Proposal Requests (PR's)
 - 5. Change Order Requests (COR's)
- B. Notify Owner with number of project website user licenses required. Owner will need to set-up and grant access for each user. Coordinate with Owner any fee payment required to set-up and maintain user licenses.

1.03 CASH ALLOWANCES

- A. No cash allowances under this contract unless otherwise provided. Unless otherwise provided, if cash allowances are to be initiated during the term of the contract, they shall be administered under the following requirements:
- B. Costs Included in Allowances: Cost of Product to Contractor or Subcontractor, less applicable trade discounts, delivery to site and applicable taxes.
- C. Costs Not Included in the Allowance: Fees for overhead and profit, product handling at the site, including unloading, uncrating, and storage; protection of Products from elements and from damage and labor for installation and finishing.
- D. Contractor Responsibilities:
 - 1. Assist Architect/Engineer in selection of Products, suppliers, and installers.
 - 2. Obtain proposals from suppliers (and installers) and other recommendations.
 - 3. On notification of selection by Architect, execute purchase agreement with designated supplier and installer.
 - 4. Arrange for and process shop drawings, product data, and samples. Arrange for delivery.
 - 5. Promptly inspect Products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
 - 6. Product handling at the site, including unloading, uncrating, and storage, protection of products from elements and from damage and labor for installation and finishing.
 - 7. The Contractor shall include in his Bid all fees for all cash allowances.
- E. Funds will be drawn from Cash Allowances only by Change Order.

1.04 SCHEDULE OF VALUES

- A. Submit to the Architect a Schedule of Values that includes all major categories of work and per building if applicable. The prices are to include all labor, material, overhead, and profit applicable to each item in the breakdown. Then as a sub-breakdown each item is to be separated into an estimated labor and materials line item. Submit an estimated total value for the projected cost of suppliers, materials, and equipment required. Submit typed schedule on AIA Form AIA G703.
 - 1. Contractor shall also submit itemized schedule of values listing all major work components separately of his Subcontractors for plumbing, HVAC, and electrical work.
- B. Submit Schedule of Values in triplicate within seven (7) calendar days after date established in Notice of Award. Schedule shall list the installed value of the component parts of the work, broken down in sufficient detail to serve as a basis for computing values for progress payments during construction.
- C. Format: At a minimum, use the Table of contents in this Project Manual to identify each line item with number and title of the major specification section.
- D. Material costs identified separately shall never exceed the total value of supplies, materials and equipment indicated.
- E. Add to the Schedule of Values approved Change Orders, with each Application for Payment. List Change Orders in numerical sequence.
- F. Identify separately by a line item the amount for each major material supplier.
- G. No progress payments will be made until the schedule of values has been received, reviewed and approved by the Architect. The costs assigned to the breakdown are to total the contract sum. The approved Schedule of Values is to be used by the General Contractor and each subcontractor on his Application for Payment.

1.05 REQUESTS FOR INFORMATION - RFI'S, CHANGES AND CLARIFICATIONS

- A. Request for Information (RFI)
 - 1. See Section 01 31 00 for additional information pertaining to the administration and procedures of RFI's.
 - 2. If during the construction of the project, clarification of the documents is required, it shall be brought to the attention of the General Contractor or Construction Manager.
 - 3. The General Contractor or Construction Manager will either provide clarification or forward a Request for Information (RFI) to the Architect. These RFI's shall be dated and sequentially numbered. The Architect shall provide his written response to the RFI and return to the Contractor for distribution to all affected contractors.
 - 4. Responses to RFI's are not authorization to proceed with work requiring additional compensation. If additional compensation is required, the General Contractor or Construction Manager will review the item with the Architect and Owner to determine if a Proposal Request will be issued.
- B. Minor Changes in the Work
 - 1. Prior to proceeding with any work described in the Architect's Supplemental Instructions, subcontractors, suppliers, etc. shall confirm that these will not impact on cost or schedule.
- C. Proposal Request (PR)
 - 1. Should the Owner, Architect, or Design Engineers contemplate making a change in the work, the Architect will issue a Proposal Request (PR) to the General Contractor or Construction Manager.
 - 2. If the described change impacts cost and/or time, prepare and submit Change Order Request (COR) to the Architect. The COR shall be broken down completely so as to identify all quantities and associated unit costs (both adds and deducts).
 - 3. Architect will review the pricing, scope of work, any time extensions requested and forward to the Owner with recommendations. If the Owner determines that the Change Order Request will be accepted, Owner will issue an approval notice through e-builder to all

project participants. The electronic signature of both the Owner and Architect will be placed on the COR before the Contractor proceeds with the change in scope work.

- D. All RFI's, PR's, and COR's will be sequentially numbered and dated and reported in the Owner's e-builder web site.

1.06 APPLICATION FOR PAYMENTS

- A. At a time consistent with the requirements of this section, the GENERAL CONDITIONS and the FORM OF AGREEMENT, for each calendar month during the progress of the work, the General Contractor or Construction Manager submit a properly notarized itemized Application for Payment to the Architect through e-builder.
1. All Applications for Payment shall include the Purchase Order number generated by the Owner for the specific project.
- B. The amount shown on the Application for Payment shall be established by the value of work completed through the last day of the application period based upon the estimate of labor and materials incorporated in the work and of materials suitably stored in accordance with the contract through the last day of the previous application, less the aggregate of previous payments, less cost of supplies, materials and equipment purchased directly by Owner, and less the retainage as specified in this Section.
- C. Application for Payment Forms:
1. General Contracting Projects: AIA G702, supported by the AIA G703, "Continuation Sheet", edition per the Form of Agreement.
 2. Construction Management Projects: AIA G702CMA, supported by the AIA G703, "Continuation Sheet", edition per the Form of Agreement.
 3. Application Form:
 - a. Fill in required information, including that for change orders executed prior to the date of submittal application.
 - b. Fill in summary of dollar values to agree with the respective totals indicated on the continuation sheet.
 - c. Execute certificate with the signature of a responsible officer of the contractor's firm.
 4. Continuation Sheets:
 - a. Fill in total list of all scheduled component items of work, with each number and the scheduled dollar value of each item.
 - b. Fill in the dollar value in each column for each scheduled line item when work has been performed or products stored. Round off values to nearest dollar, or as specified in the Schedule of Values.
 - c. List each change order executed prior to the date of submission, at the end of the continuation sheets. List by change order number, proceed order no., description, and breakdown of costs as for an original component item of work.
 5. Substantiating Data for Progress Payments:
 - a. Substantiating data is required to verify a payment request. Contractors are to include a cover letter identifying:
 - 1) Project.
 - 2) Application number and date.
 - 3) Detailed list of enclosures.
 6. For stored products: Item number and identification as shown on application, and description of specific material. Include Non-Negotiable Bailment Receipt and applicable insurance certificate.
 7. Submit one copy of the data and cover letter for each of the applications.
- D. Applications for Payment shall be accompanied by cost breakdowns from the Contractor, Subcontractors and Sub-Subcontractors; the previous billing month's affidavits, and lien waivers from the Contractor, Subcontractors, Sub-Subcontractors and Material Suppliers, as applicable.
- E. When the General Contractor finds the application properly completed and correct, they will transmit Certificates for Payment to the Architect to be certified for payment through e-builder.

- F. When the Architect finds the application properly completed and correct, he will transmit Certificate for Payment to the Owner through e-builder with a copy notification given to the General Contractor.
- G. Payment Application Documents:
 - 1. Partial Lien Waiver - Subcontractor.
 - 2. Partial Lien Waiver - in arrears - Subcontractor.
 - 3. Final Lien Waiver and Release.
 - 4. Contractor's Affidavit.
 - 5. Non-negotiable Bailment Receipt.
 - 6. Bill of Sale.
 - 7. Payment Application Forms.
 - 8. Cover Letter.

1.07 PROGRESS PAYMENTS

- A. Subject to timely submittal of proper Applications for Payment by the General Contractor or Construction Manager, the Owner agrees to pay an amount (less retainage) equal to the value of labor and materials incorporated in the work, plus material not incorporated in the work but approved by the Architect under the provisions of the Contractor Documents, up to the date of application, less the aggregate of all previous payments, the cost of all materials, supplies and equipment paid for by the Owner and deductions provided for in the Contract Documents.

1.08 APPLICATION FOR FINAL PAYMENT

- A. Submit final Application for Payment following the procedures specified above for progress payments.
- B. Before submitting final Application for Payment, forward to the Architect for submittal to the Owner the written warranties and guarantees, Record and Information Manuals and other documents required by the Contract Documents, and place properly in approved storage at the site the extra stock and spare parts specified.
- C. Properly executed "Final Lien Waiver and Release" and Contractor's "Affidavit" shall be submitted to the Architect in duplicate prior to final payment.
- D. Application for Final Payment shall be accompanied by a properly executed "Consent of Surety Company to Final Payment: AIA Document G707.
- E. In addition to the responsibilities specified for the Architect in the GENERAL CONDITIONS, the Architect will also recommend to the Owner that the Owner record the Notice of Completion within ten (10) calendar days of the date the Architect finds the Contract fully performed.

1.09 CHANGE ORDERS

- A. Regardless of methods used to determine value of changes, the estimated or actual cost shall be submitted in detailed breakdown form, giving quantity and unit costs by each trade of each item, labor cost with hourly rates, allowable overhead and profit, number of calendar days (if any) required to complete the additional work. If proposal includes the work of Subcontractors, sub-proposals similarly itemized shall be included. No additional amount will be paid for submittal in this form or for resubmittal should the breakdown be considered inadequate by the Architect. Backup data submitted with applications for payment may be used as basis for approving or rejecting costs submitted in change orders.
- B. Also reference Article 7 of the General Conditions and Supplementary General Conditions for more detail requirements and procedures.

1.10 UNIT PRICES

- A. Refer to Section 01 22 00, for requirements

END OF SECTION

SECTION 01 22 00
UNIT PRICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Administrative and procedural requirements for unit prices.
- B. Unit prices shall include all labor, materials, bailing, shoring, removal, etc., to cover the finish work of the several kinds called for
- C. Unit prices will be considered in evaluation of the bid, and are subject to review prior to the award of contract. Unit prices at the Owners discretion may or may not be used for determining the cost of additional work or deleting work.

1.03 DEFINITIONS

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.

1.04 RELATED REQUIREMENTS

- A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.05 COSTS INCLUDED

- A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased.
 - 1. **Unit Prices do not apply to Base Bid or Alternate Work as indicated in the Contract Documents.**
- B. Unit Prices shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.06 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.07 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Measurement Devices:
 - 1. Weigh Scales: Inspected, tested and certified by the applicable state Weights and Measures department within the past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate the conveying vehicle.
 - 3. Metering Devices: Inspected, tested and certified by the applicable state department within the past year.

- E. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
- F. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
- G. Measurement by Area: Measured by square dimension using mean length and width or radius.
- H. Linear Measurement: Measured by linear dimension, at the item centerline or mean chord.
- I. Stipulated Price Measurement: Items measured by weight, volume, area, or linear means or combination, as appropriate, as a completed item or unit of the Work.
- J. Perform surveys required to determine quantities, including control surveys to establish measurement reference lines. Notify Architect prior to starting work.

1.08 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected Products.

1.09 DEFECT ASSESSMENT

- A. Replace Work, or portions of the Work, not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct one of the following remedies:
 - 1. The defective Work may remain, but the unit price will be adjusted to a new unit price at the discretion of Architect.
 - 2. The defective Work will be partially repaired to the instructions of the Architect, and the unit price will be adjusted to a new unit price at the discretion of Architect.
- C. The individual specification sections may modify these options or may identify a specific formula or percentage price reduction.
- D. The authority of Architect to assess the defect and identify payment adjustment is final.

1.10 SCHEDULE OF UNIT PRICES

- A. Site Work:
 - 1. Earth Excavation - General: Per cubic yard
 - 2. Earth Excavation - Trenching: Per cubic yard
 - 3. Rock Excavation - General: Per cubic yard
 - 4. Rock Excavation - Trenching: Per cubic yard
 - 5. Controlled Fill - Fill and Backfill: Per cubic yard
 - 6. Typical Pavement Section: Per square yard
 - 7. Concrete Sidewalk Paving: Per square foot
 - 8. Seeding: Per acre
 - 9. Sod: Per square yard
- B. Walls:
 - 1. Concrete Masonry Units (CMU): 6-inch: Per square foot (SF)
 - 2. Concrete Masonry Units (CMU): 8-inch: Per square foot (SF)
 - 3. Concrete Masonry Units (CMU): 12-inch: Per square foot (SF)
 - 4. Porcelain/Ceramic Wall Tile: Per square foot (SF)

5. Patching or Infilling of Existing CMU Walls: Per square foot (SF)
- C. Flooring:
 1. Resinous Floor Coating: Per square-foot (SF)
 2. Polished Concrete Floor Finish (No Dye): Per square foot (SF)
 3. Dyed and Polished Concrete Floor Finish: Per square foot (SF)
 4. Concrete Cutting, Removal, and Replacement: Per square foot (SF)
 5. Porcelain Floor Tile: Per square foot (SF)
- D. Ceilings:
 1. Remove and Replace Existing 2X2 Ceiling Tile (Grid to remain): Per square foot (SF)
 2. Remove and Replace Existing 2X4 Ceiling Tile (Grid to remain): Per square foot (SF)
 3. New 2X2 Acoustical Ceiling System (Non-Rated): Per square foot (SF)
 4. New 2X2 Acoustical Ceiling System (1-Hr Rated): Per square foot (SF)
 5. New 2X4 Acoustical Ceiling System (Non-Rated): Per square foot (SF)
 6. New 2X4 Acoustical Ceiling System (1-Hr Rated): Per square foot (SF)
 7. Remove and Replace Existing 2X2 Acoustical Ceiling System: Per square foot (SF)
 8. Remove and Replace Existing 2X4 Acoustical Ceiling System: Per square foot (SF)

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 23 00
ALTERNATES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Administrative and procedural requirements for alternates.

1.03 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.04 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Specification sections referenced in the "Schedule of Alternates" Article contain requirements for materials necessary to achieve the work described under each alternate.

1.05 ACCEPTANCE OF ALTERNATES

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

1.06 SCHEDULE OF ALTERNATES

- A. **ALTERNATE NO. 1: NEW PAIR OF DOORS**
 - 1. Base Bid:
 - 2. Alternate: The Contractor shall state the amount to be added to or deducted from the Base Bid to remove and install new wall and pair of doors with updated hardware
- B. **ALTERNATE NO. 2: NEW MED GASES**
 - 1. Base Bid:
 - 2. Alternate: The Contractor shall state the amount to be added to or deducted from the Base Bid to install additional set of med gases in room 1C101
- C. **ALTERNATE NO. 3: NEW VITAL MONITOR, POWER AND DATA**
 - 1. Base Bid:

2. Alternate: The Contractor shall state the amount to be added to or deducted from the Base Bid to install additional vital monitor, power, data in room 1C101

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Normal Working Hours
- B. Parking for Construction Employees
- C. Security Badges - Construction Workers
- D. Contract Document Distribution
- E. Local Labor and Services
- F. Layout of Work
- G. Grades, Lines and Levels
- H. Construction Operations
- I. Concrete Pads, Curbs and Structural Supports
- J. Hoisting and Scaffolding

1.03 NORMAL WORKING HOURS ON THE PROJECT

- A. Monday through Friday, 7:00 a.m. to 3:30 p.m. Contractor has the right to amend work hours as required or necessary to maintain project schedule or as seasonal conditions warrant.

1.04 PARKING FOR CONSTRUCTION EMPLOYEES

- A. On-site parking will NOT be available for all subcontractors working on site. Unauthorized vehicles parking on site will be subject to towing at the vehicle owner's expense. Contractor will coordinate all construction vehicle parking with Owner's Facility Manager as the requirements vary based specific healthcare campuses.

1.05 SECURITY BADGES - CONSTRUCTION WORKERS

- A. Each and every construction worker working this project will be required to wear/display a Project Security Badge. Badges shall be controlled, made and distributed by the Owner's facilities office. All workers will return badges upon completion of their work, if lost, a replacement fee of \$25.00 per badge will be assessed.

1.06 CONTRACT DOCUMENT DISTRIBUTION

- A. The Architect will an electronic disk of contract documents to include drawings, project manuals, and addenda to the Contractor. The Contractor shall then distribute the documents to subcontractors and vendors.
- B. In the case of revisions and modifications issued during construction, the Architect shall furnish the Contractor copies of each supplementary drawing or drawings changed. Changes to the work during construction will be recorded on the as-built drawing set in the Contractor's filed office. These changes to the work will be recorded by the design team at the conclusion of the project and included in the as-built documents.

1.07 LOCAL LABOR AND SERVICES

- A. Wherever it is possible to do so without penalty to the Contractor, the services and materials of local merchants, contractors, local labor shall be utilized.

1.08 LAYOUT OF WORK

- A. As soon as progress of the work permits and prior to any partition work being completed, Contractor shall layout entire full-scale floor plan for each area.

- B. Layout shall be made by snapping distinct and readable chalk lines or by painting lines, indicating the accurate thickness of walls and partitions, locations and swings of doors, similar physical features, etc. Appropriate sub-contractor shall add locations of switches, outlets, sinks, etc. All markings on surfaces shall be removed prior to the installation of the finish surface finish. Any markings left that lead to exposure through finish surface finish material shall be removed and replaced at the sole expense of the Contractor.
- C. After floor layouts have been made, contractor and/or appropriate sub-contractor shall be responsible for field checking dimensions, wall thicknesses, locations, accuracy of rough-ins, locations and dimensions of built-in equipment, and similar items of critical nature.

1.09 GRADES, LINES AND LEVELS/SURVEYING

- A. The Contractor shall establish elevation bench marks; thereafter; each Sub-contractor shall set out his own work in relation thereto, each Sub-contractor shall verify all grades, lines, levels and dimensions as shown on Drawings and shall report any errors or inconsistencies to the Contractor and Architect before commencing work.
- B. Control Datum is that established by floor level in existing building at designated locations.

1.10 CONSTRUCTION OPERATIONS

- A. The permanent or temporary establishment and operation of the equipment, apparatus, or facilities for the conduct of the work is the responsibility of the Contractor. This includes storage facilities, hoists, pumps, cranes, scaffolding, mixers, conveyors and sheds, etc. Grounds shall be kept clean to avoid danger of personal injury and to minimize hazards.

1.11 CONCRETE PADS, CURBS AND STRUCTURAL SUPPORTS

- A. All concrete and steel pads, curbs, and supports for mechanical and electrical equipment detailed on architectural and structural drawings shall be furnished by the Concrete Sub-contractor, unless otherwise indicated. The Mechanical and/or Electrical Contractors, shall be responsible for furnishing to the Contractor complete information, including size, weight and location of equipment and locations of any anchor bolts, inserts, steel plates, etc., in accordance with manufacturer's recommendations. Such data shall be furnished promptly and with sufficient detail to avoid delay in the work. Pads and supports not detailed on architectural and structural drawings but required, shall be provided by the respective Mechanical and Electrical Contractor.

1.12 HOISTING AND SCAFFOLDING

- A. The Contractor will provide hoisting depending on crane availability, unless otherwise noted by Scope of Work. The cranes on site will primarily support concrete and masonry operations but will be available if scheduled in advance with the job site superintendent. Hoisting for steel erection, or hoisting required for any materials which exceed the capacity of normal joisting facilities in either size or weight, or demand excessive time, shall be provided by the individual contractor or subcontractor.

1.13 USE OF ELEVATORS

- A. The Contractors use of elevators for handling materials and personnel shall be limited.
- B. The Contractors will be permitted to use elevators for handling materials and personnel with the following restrictions:
 - 1. The Contractor is responsible for protecting elevator cab interior, corridor doors, and frames from damage in a manner satisfactory to the Owner and Architect. At the completion of the work, all damage to elevators shall be repaired in a satisfactory manner.
 - 2. Care shall be taken that material or debris is not allowed to fall into hoistway.
 - 3. Posted load limits of elevators shall be adhered to at all times.
- C. The Contractor shall coordinate the details with the Owner for usage of the existing elevators, scheduling, etc. Any cost associated with (re-)programming of the elevators as a result of the work completed by the Contractor shall be at the cost to the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT & COORDINATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. BIM Coordination drawings.
 - 3. Requests for Information (RFIs).
 - 4. Project meetings.

1.03 DEFINITIONS

- A. Request for Information: The "Request for Information" or RFI is a request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.04 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 15 calendar of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.05 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Per-installation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.
- E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

1.06 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1.07 3D BIM MODELS

- A. BIM Models will be prepared by each individual trade for the coordination process. All drawings will be imported into one file using Navisworks, and reviewed during the coordination meetings. The BIM Coordination models will be used to locate conflicts with traces when they must route their systems outside the assigned zones or areas.
- B. Modeling Procedures (BIM Coordination Models)
 1. All files will be in a 3-D solid object format using modeling software compatible with AutoCAD 2010 or later. No wire frame objects or file formats prior to 2010 will be accepted.
 2. All items above ceilings, and items listed in the trade specific requirements for items below ceiling, shall be included in the electronic files.
 3. The general contractor's BIM Model Manager will execute coordination using Navisworks. All directly imported into Navisworks.
 4. Elevations of object must be true accurate elevations per plans and specifications.
 5. Include locations of all hangers associated with piping, ductwork, and conduits.
 6. Show seismic anchor points for all items needing cabling and bracing.
 7. Include insulation thickness in overall dimensions and clearances on drawings.
 8. All models will use an insertion point as mutually determined by the team.
 9. Access and clearances around FP Box control panels and anything needing clearance by code must be maintained. Clearance requirements by code, or equipment manufacturer,

must be modeled using solid objects. The fire alarm subcontractor will note clearances on coordination drawings.

- C. Model Creators
 - 1. Architectural - Architect or Record
 - 2. Cast-in-place Concrete - Structural Engineer of Record
 - 3. Structural Steel - Structural Engineer of Record
 - 4. Mech/Plum - Mechanical Engineer
 - 5. Electrical - Electrical Engineer
 - 6. Fire Protection - Fire Protection Subcontractor
- D. Extent of Final Model: The BIM model shall extend to five feet beyond the exterior walls of the building in plan. Vertically, the model shall extend from the lowest extent of the foundations or lowest underground utility up through and including the roof of the top-most structure. The building systems will be included to the full horizontal and vertical extent of the model including underground utilities and roof-top mounted items. If site utility coordination is required, the horizontal extent of the model will be expanded as needed.
- E. As-Built Model: The extent of the as-built model will match the extent of the final model. It is the responsibility for the model creators to update their trade specific models to reflect as-built conditions. Any and all changes that occur during construction, that deviate from the final model, will be updated in the as-built model to reflect actual conditions.
- F. In the event equipment is provided by one entity and installed by another, it will be the responsibility of the installing contractor to show required equipment in their model. Equipment modeled shall include required access and clearance zones as prescribed by the governing building code or equivalent requirement.
- G. Systems Modeled and Level of Detail: The level of detail defined in each section below is the minimum level of detail required in the model.
 - 1. Architectural
 - a. All interior walls.
 - b. All interior and exterior doors and windows.
 - c. All fixed casework.
 - d. All ceilings and soffits will be modeled.
 - 1) Ceilings and soffits will be modeled as the overall thickness including elevation changes and termination points.
 - e. Fire extinguisher cabinets.
 - 2. Structural
 - a. All cast-in-place concrete, including all penetrations and openings identified in the construction documents, will be modeled. Chamfers at corners will not be modeled.
 - b. Edges of all slabs and penetrations of structural systems will be accurately located in the model.
 - c. All primary and secondary structural steel members will be modeled, including standard steel member sizes, gusset plates, braces and kickers. Any systems requiring embeds to be placed in CIP concrete will show connections in the model. Reinforcing steel will not be modeled for MEP coordination.
 - d. Metal, wood and concrete decks will be modeled as the overall thickness of the slab. Ribs in metal deck will not be modeled.
 - 3. HVAC
 - a. All ducts and air handling equipment will be modeled. If flanges are not modeled, ducts will be modeled to the outside face dimension of the flanges or overall dimension including insulation (if required). Duct joints do not have to be modeled, but all rigid hangers will be modeled to ensure conflicts are reduced.
 - b. Equipment will be modeled to its overall height, width and depth. Equipment will be modeled as separate objects. Equipment access zones will be modeled as solids.
 - c. Any piping associated with the mechanical equipment will be modeled. Pipes will be modeled to the outside diameter of the pipe or pipe insulation, whichever is greater. Pipe hangers must be shown extending to structure.

- d. The intent of this model is to show the ductwork and piping as accurately as possible to the actual condition at completion of construction. Specific dimensional location of these items may not be included in the construction documents. To the extent that location can be determined from the construction documents, the model will reflect that location.
- 4. Electrical
 - a. Conduits, 1" or greater or smaller conduits of in ganged runs of 4 or more will be modeled.
 - b. Cable tray, access zones, and equipment to be included in the model.
 - c. Light fixture locations and space requirements to be included in the model.
 - d. All power feeds to equipment and all switch gear will be modeled. Also consider switches and outlets a coordination with architectural FFE or interior elevations is a concern.
- 5. Plumbing
 - a. All plumbing piping and gas piping, including specialty gas, access zones, and equipment will be modeled. Pipes will be modeled to the outside diameter for the pipe or pipe insulation, whichever is greater. Pipe slope will be incorporated in the model.
 - b. All plumbing equipment will be modeled to its overall height, width and depth. Equipment will be modeled as separate objects.
 - c. All valves and clean outs will be modeled along with all access to valves/cleanouts.
- 6. Fire Protection Sprinkler and Alarm
 - a. All components of the fire protection system will be modeled. This includes all piping, valves, fire pump and sprinkler heads.
 - b. Any access zone requirements will be modeled.

1.08 TRADE CLASH DETECTION / COORDINATION / RESOLUTION

- A. Changes to the Contract Documents during Coordination
 - 1. When time allows, changes will be made to BIM models and re-coordinated.
 - 2. When time does not allow, detailers and foremen will coordinate with existing field conditions.
 - 3. If field coordination is required, as-builts will reflect the new field condition.
 - 4. All changes to the construction documents (IE: ASI's, PR's, RFI's, etc.) will be included in the as-builts and verified in the final BIM model.

1.09 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
 - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of Subcontractors.
 - 3. RFIs shall, in good faith, wherever possible, a request for confirmation by the General Contractor. The Contractor shall submit a solution, wherever possible, as an understanding of the issue for the Architect to confirm in writing. An RFI that revises the construction documents will be reflective in the final as-built documents.
- B. Content of the non-confirming RFI: Include a detailed, legible description of item needing information or interpretation and the following:
 - 1. Project name.
 - 2. Project number.
 - 3. Date.
 - 4. Name of Contractor.
 - 5. Name of Architect.
 - 6. RFI number, numbered sequentially.
 - 7. RFI subject.
 - 8. Specification Section number and title and related paragraphs, as appropriate.

9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 010200 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Architect.
 4. RFI number including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Architect's response was received.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.
1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 2. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

1.10 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within two days of the meeting.
- B. Pre-construction conference: General Contractor will schedule and conduct a pre-construction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Conduct the conference to review responsibilities and personnel assignments.
 2. Mandatory Attendees: Authorized representative of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress, including the following: (Key procedures are indicated in bold)
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Lines of communications.
 - f. Procedures for processing field decisions and Change Orders.
 - g. Procedures for RFIs.
 - h. Procedures for testing and inspecting.
 - i. Procedures for processing Applications for Payment.
 - j. Distribution of the Contract Documents.
 - k. Submittal procedures.
 - l. Preparation of record documents.
 - m. Use of the premises and existing building.
 - n. Work restrictions.
 - o. Working hours.
 - p. Owner's occupancy requirements.
 - q. Responsibility for temporary facilities and controls.
 - r. Procedures for use of e-builder.
 - s. Procedures for disruptions and shutdowns.
 - t. Construction waste management and recycling.
 - u. Parking availability.
 - v. Office, work, and storage areas.
 - w. Equipment deliveries and priorities.
 - x. First aid.
 - y. Security.
 - z. Progress cleaning.
 - aa. Project Close-Out and As-built Record Documents
 4. Minutes: Entity Responsible for conducting meeting will record and distribute meeting minutes.
- C. Pre-installation Conferences: Conduct a pre-installation conference at Project site before each construction activity that requires coordination with other construction.
 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. Contract Documents.
 - b. Options.
 - c. Related RFIs.
 - d. Related Change Orders.

- e. Purchases.
- f. Deliveries.
- g. Submittals.
- h. Review of mockups.
- i. Possible conflicts.
- j. Compatibility requirements.
- k. Time schedules.
- l. Weather limitations.
- m. Manufacturer's written instructions.
- n. Warranty requirements.
- o. Compatibility of materials.
- p. Acceptability of substrates.
- q. Temporary facilities and controls.
- r. Space and access limitations.
- s. Regulations of authorities having jurisdiction.
- t. Testing and inspecting requirements.
- u. Installation procedures.
- v. Coordination with other work.
- w. Required performance results.
- x. Protection of adjacent work.
- y. Protection of construction and personnel.
- 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
- 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
- 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
 - 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Mandatory Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents / Final BIM model / and coordination with Owner Facility Maintenance Management System
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing operations and maintenance data.
 - e. Requirements for delivery of material samples, attic stock, and spare parts.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.
 - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.

- m. Responsibility for removing temporary facilities and controls.
- 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at mutually agreed to time intervals.
 - 1. Coordinate dates of meetings with preparation of payment requests.
 - 2. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period. General Contractor shall be proactive in scheduling updates and have identified any field concerns that will impact schedule and/or design in advance of need. A need for emergency responses by the Owner or Design team based on a lack of proactive activity by the General Contractor will not be tolerated or subject to a request for additional time and/or compensation.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of outstanding submittals.
 - 5) Site utilization.
 - 6) Temporary facilities and controls.
 - 7) Progress cleaning.
 - 8) Quality and work standards.
 - 9) Status of correction of deficient items.
 - 10) Field observations.
 - 11) Status of any outstanding RFIs.
 - 12) Status of proposal requests.
 - 13) Pending changes.
 - 14) Status of Change Orders.
 - 15) Pending claims and disputes.
 - 4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- F. Coordination Meetings: Conduct Project coordination meetings at intervals as necessary for coordination of the project. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and pre-installation conferences.
 - 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access to/from Site.
 - 8) Site Utilization.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks. See Owner related documents.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
PROGRESS SCHEDULE AND SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Submittal Procedures.
- B. List of Material Suppliers and Sub-Contractors.
- C. Construction Progress Schedules.
- D. Construction Schedule Scope.
- E. Weather Delays.
- F. Shop Drawing and Product Data.
- G. Samples.
- H. Manufacturer's Instructions.
- I. Manufacturer's Certificates.
- J. Record Drawings.

1.02 SUBMITTAL PROCEDURES

- A. Subcontractor shall forward submittals to Contractor in a timely fashion, maintaining project schedule as a priority. Subcontractor to allow for Contractor and Architect's review. If submittal required expediting to maintain project schedule, a return date shall be so noted on transmittal.
- B. Each submittal shall be accompanied with a letter of transmittal. Deliver to Architect at business address. Coordinate submission of related items.
- C. Sequentially number the transmittal forms. Resubmittals to have original number with an alphabetic suffix.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate.
- E. Each submitting Subcontractor and then the Contractor shall apply "Contractor's stamp", signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and contract documents.
- F. Contractor will prepare a schedule for submission of all shop drawings specified necessary for the equipment and materials proposed for and incorporated in the work or erection drawings needed for proper installation, operation or maintenance. The schedule shall accompany the work progress schedule submitted to Architect".
- G. Sub-contractor, in establishing his schedule for submittals, shall allow fourteen (14) calendar days in Architect's office for reviewing original submittals and seven (7) calendar days in Architect's office for reviewing re-submittals.
- H. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed work.
- I. Provide space for Contractor and Architect review stamps.
- J. Revise and resubmit submittals as required, identify all changes made since previous submittal.
- K. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

1.03 LIST OF MATERIAL SUPPLIERS AND SUBCONTRACTORS

- A. Within fourteen (14) days after signing of Contracts, the Contractor shall furnish to the Architect a complete list of all materials, material suppliers and Subcontractors he intends to use on this project. The listing shall be made in such a manner to show brand names, referenced section of the work, Subcontractor's name, address, and telephone number.

- B. If this is not received by the Architect within the time frame, the Architect will make all decisions and choices from specified materials for preparation of Color Schedules, etc., and the Contractor shall abide by such choices.

1.04 CONSTRUCTION PROGRESS SCHEDULES

- A. The Construction Manager is to prepare a critical path schedule for construction, including actual construction activities, submittals for major components, procurement of materials and equipment, and testing of major building systems.
- B. Contractor is to submit after Notice to Proceed and prior to the Preconstruction meeting, a schedule indicating durations for submittals, fabrication, delivery and installation of the components for said scope of work. This information will be utilized in the completion of the progress schedule presented at the Preconstruction meeting.
- C. As changes occur in the schedule information provided by the Contractor, updated schedule information will be forwarded to the Construction Manager immediately. The Construction Manager will utilize this information in issuing updates to the progress schedule.
- D. The Construction Manager shall initiate progress schedules in duplicate within fourteen (14) calendar days after date established in Notice to Proceed for Architect review. Revise and resubmit as required.
- E. The Construction Manager shall revise schedules with each Application for Payment, identifying changes since previous version. If any activity varies by more than 14 days from the initial schedule, revise and resubmit.
- F. The minimum number of line items shall not be less than the number of sections in the Project Manual.
- G. Show complete sequence of construction by activity, identifying work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- H. Indicate submittal dates required for shop drawings, product data, samples, color selections and product delivery dates, including those furnished by Owner and under Allowances.
- I. Major Subcontractors shall submit itemized progress schedules for mechanical and electrical work, to accompany their substantiating requests for payment.

1.05 SCHEDULE SCOPE

- A. The construction schedule, at a minimum, shall provide for:
 - 1. Long lead time procurement activities.
 - 2. Contract phasing activities.
 - 3. Activation and testing activities.
 - 4. Milestone dates for contract phasing requirements.
 - 5. Utility tie-in activities.
 - 6. Clean-up and punch list activities and Owner move-in activities.
 - 7. Activity durations in working days.

1.06 WEATHER DELAYS

- A. Weather Delays. The following are considered reasonable anticipated days of adverse weather on a monthly basis and shall be included in the Contract Time, if applicable:

January: 10 days	July: 5 days
February: 9 days	August: 4 days
March: 7 days	September: 3 days
April: 6 days	October: 2 days
May: 4 days	November: 4 days
June: 5 days	December: 7 days
- B. Adverse weather days beyond the above total will be allowed only to the extent authorized by the Architect and the Owner and established by the Contractor as actually causing a delay in

critical path work. Adverse weather days shall be recorded and submitted, in writing, for the Owner's and Architect's review and approval on a monthly basis.

1.07 SHOP DRAWINGS AND PRODUCT DATA

- A. Contractors shall submit electronic Shop Drawings, erection drawings, and setting drawings:
 - 1. Shop drawings shall be submitted in a format that is compatible with the Owner's Facility Maintenance Management System. Coordination with the Owner will be required to confirm compliance.
- B. Submittals shall include the following:
 - 1. Manufacturer's specifications.
 - 2. Fabrication and erection drawings
 - 3. Bills of materials and spare parts lists.
 - 4. Instruction Books.
 - 5. Samples, color charts and similar items.
 - 6. All drawings, catalogs, or parts thereof, manufacturer's specification and data, samples, instruction, written guarantees and other information specified or necessary for the Architect to determine that the equipment and materials conform with the design concept and comply with the intent of the Contract Documents.
 - 7. For Architect to determine that the equipment and materials conform with the design concept and comply with the intent of the Contract Documents.
 - 8. For the proper erection, installation, operation and maintenance of the equipment and materials which Architect will review for general content but not for substance.
 - 9. For Architect to determine the effect on contiguous or related structures, equipment, and materials.
 - 10. Data submitted shall be complete with respect to dimensions, design criteria, materials of construction and the like to enable Architect to review the information effectively. Where standard drawings are furnished which cover a number of variations of the general class of equipment, each such drawing shall be individually annotated to describe exactly which parts of the drawings apply to the equipment being furnished. Such annotation shall also include proper identification of the submittal permanently attached to the drawing. Reproduction of copies of Contract Drawings or portions thereof will not be accepted as fabrication or erection drawings.
 - 11. General outline drawings of equipment showing overall dimensions, location of major components, weights, and locations of required building openings and floor plates.
 - 12. General outline drawings of equipment showing overall dimensions, location of major components, weights, and locations of required building openings and floor plates.
 - 13. Detailed equipment installation drawings showing foundation details, anchor bolt sizes and locations, base plate sizes, location of Owner's connections; and all clearances required for erection, operations and disassembly for maintenance.
 - 14. Schematic diagrams for electrical items showing external connections, terminal block numbers, internal wiring diagrams, and one-line diagrams.
- C. Each shop drawing submitted shall bear the stamp of the submitting Contractor and signed by their representative indicating he/she has reviewed and approved the submittal prior to transmittal to the Architect and Owner. Contractor shall identify each submittal by project title and the Specification division and article number marked thereon.
- D. Contractor shall submit the designated quantity of drawings to the Architect for review and processing and carbon copy the Owner. Owner's concerns/comments will be issued to the Architect during the review period. Architect shall incorporate owner comments agreed upon and indicate reviewed items on reviewed submittal returned to the Contractor. Drawings requiring review of Structural or Mechanical/Electrical/Plumbing Design Consultants shall be submitted directly to the respective Consultants and a copy of the transmittal forwarded to Architect.
- E. The Architect shall pass upon these drawings with reasonable promptness, making necessary corrections, including any necessary corrections relating to artistic effect. Drawings will be

reviewed on a first-come basis. The Contractor shall make any revisions required by the Architect and re-submit when so noted and marked by the Architect.

- F. Architect's review action stamp, appropriately completed, will appear on all shop drawings of Contractor when returned by Architect.
- G. Architect's review of drawings is performed to assist subcontractor/s and supplier/s in proper application and/or installation of material and product only and is not either a warranty that all information pertaining to the submitted drawings are accurate and/or complete, nor does it relieve contractor, subcontractor or supplier's responsibility for proper installation, selection, or application of product/material. It remains the responsibility of the subcontractor and/or supplier to bring any discrepancy or inaccuracy to the immediate attention of the Architect prior to production and/or installation.
- H. A complete set of all shop drawings shall be supplied to the Owner at the completion of the project as a part of the close-out documents. These shop drawings shall be formatted such that they can easily be uploaded into the Owner's Facility Maintenance Management System.
- I. Copies of Shop Drawings for Owner furnished equipment will be transmitted to Contractor after drawings are reviewed.

1.08 SAMPLES

- A. Submit samples to illustrate functional and aesthetic characteristics of the Product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work. Samples are not required if the product submitted matches the specification without exception. Saint Luke's maintains a set of product standards and if sample matches that exact standard, a submittal is not required. If submitted, the Architect will return without review.
- B. Submit samples of finishes from the full range of manufacturers' standard colors (custom colors where specified), textures, and patterns for Architect's selection, where applicable.
- C. Include identification on each sample, with full project information.
- D. Subcontractors shall submit:
 - 1. Two (2) each of each differing type.
 - 2. Contractor will retain 1 of each differing type.

1.09 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, (start-up), adjusting, and finishing, in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and contract documents.
- C. All manufacturer articles, materials and equipment shall be applied, installed, connected, erected, used, cleaned and conditioned as directed by the manufacturer unless specified otherwise.

1.10 MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification Sections, submit manufacturer's certificate to Architect for review, in quantities specified for Product Data.
- B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or Product but must be acceptable to Architect.

1.11 RECORD DRAWINGS

- A. Each Contractor shall provide, and keep up-to-date, a complete record set of prints which shall be corrected on a daily basis to show all changes in layouts and details from original drawings and specifications. Prints for this purpose shall be provided by the Owner, through the Architect. The Contractor and Owner's Representative will monitor the updating of the as-built conditions. Compliance for updating as-built conditions will be strictly enforced.

- B. At the completion of the work or a phase, the Contractor shall date and mark the prints "as-built" then return them to the Architect for record. Architect/Engineer will modify original drawing CADD files to "As-Built" conditions.
- C. Structural and MEP "as-builts" will be provided to the respective Design Consultants in CADD format on 2 sets of CD's along with the hard copy construction document set of record. Structural and MEP Design Consultants will review submitted "as-built" CADD files, coordinate any corrections/additions, and submit 2 final CD "as-built" sets to Architect (1 for Architect and 1 for Owner) along with the respective construction document set of record.
- D. Reference Project Record Documents - Section 01 70 00 - Contract Closeout.

END OF SECTION

SECTION 01 32 33
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Procedural requirements for cutting and patching.

1.03 DESCRIPTION OF WORK

- A. This specification covers the furnishing and installation of materials for cutting and patching. Installation procedures shall be in accordance with the product manufacturer's recommendations. Demolition and removal of materials shall be as required to support the work.

1.04 DEFINITION

- A. Cutting: Removal of in-place construction (i.e. concrete, steel, wood, piping, etc.) necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.05 REQUIREMENTS OF STRUCTURAL WORK

- A. Structural Work shall not be cut and patched in a manner that results in a reduction of load-carrying capacity or load/deflection ratio.
- B. Prior to cutting and patching the following categories of Work, the Contractor shall obtain the Engineer's approval to proceed with:
 - 1. Miscellaneous structural metals, including equipment supports, stair systems and similar categories of Work.
 - 2. Structural concrete
 - 3. Structural decking

1.06 OPERATIONAL AND SAFETY LIMITATIONS

- A. The Contractor shall not cut and patch operational elements and safety-related components in a manner resulting in a reduction of capacities to perform in the manner intended or resulting in decreased operational life, increased maintenance or decreased safety.

1.07 VISUAL REQUIREMENT

- A. The Contractor shall not cut and patch Work which is exposed on the exterior or exposed in occupied spaces, in a manner resulting in a reduction of visual qualities or resulting in substantial evidence of the cut and patch Work, both as judged solely by the Engineer. The Contractor shall remove and replace Work judged by the Engineer to have been cut and patched in a visually unsatisfactory manner.

1.08 APPROVALS

- A. When prior approval for cutting and patching is required, the Contractor shall submit the request and obtain approval prior to performing the Work. The request should include a description of why cutting and patching cannot reasonably be avoided; how it will be performed; how structural elements (if any) will be reinforced; products to be used; firms and tradespeople who will perform the Work; approximate dates of the Work; and anticipated results in terms of structural, operational, and visual variations from the original Work.

1.09 SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.

1.10 QUALITY ASSURANCE

- A. LEED Requirements for Building Reuse:
 1. Credit MR 1.1 and 1.2, as directed: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be removed; do not cut such existing construction beyond indicated limits.
 2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be removed; do not cut such existing construction beyond indicated limits.
 3. Credit MR 1.2 and 1.3, as directed: Maintain existing non-shell, non-structural components (walls, flooring, and ceilings) not indicated to be removed; do not cut such existing construction beyond indicated limits.
- B. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
 1. Refer to NJPA Member for list of elements that might otherwise be overlooked as structural elements and that require Architect's or Construction Manager's approval of a cutting and patching proposal.
- C. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operating elements include the following:
 1. Primary operational systems and equipment.
 2. Air or smoke barriers.
 3. Fire-suppression systems.
 4. Mechanical systems piping and ducts.
 5. Control systems.
 6. Communication systems.
 7. Conveying systems.
 8. Electrical wiring systems.
- D. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Miscellaneous elements include the following:
 1. Equipment supports.
 2. Piping, ductwork, vessels, and equipment.
 3. Noise- and vibration-control elements and systems.
 4. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.11 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize OR prevent, as directed, interruption to occupied areas.

3.02 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
- B. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- C. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 5. Proceed with patching after construction operations requiring cutting are complete.
- D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 1) Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - 2) Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 3) Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
- E. Cleaning:
1. Clean areas and spaces where cutting and patching are performed.
 2. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

SECTION 01 40 00
QUALITY CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Safety
- B. Quality Assurance/General Requirements for Workmanship
- C. Quality Control and Inspections
- D. References
- E. Field Samples
- F. Mock-Up
- G. Inspection and Testing Laboratory Services
- H. Manufacturer's Field Services and Reports

1.03 SAFETY

- A. Contractors who perform any work under this Contract will fully comply with the provisions of the Federal Occupational Safety and Health Act of 1970 and/or the Construction Safety Act of 1969 (which ever is applicable) to the rules and regulations promulgated pursuant to this Act.
- B. Hazardous Material. In the event the Contractor encounters on the site, material reasonably believed to be asbestos or polychlorinated biphenyl (PCB) which has not been rendered harmless, the Contractor shall immediately stop work and notify the Architect and Owner. Such notification shall be documented in writing.
- C. Contractors shall keep MSDS sheets on file at the jobsite office and make available to the Hospitals' Representative for all hazardous materials brought onto the job site.
- D. Provide any and all measures of protection required by the local authorities, for the protection of the public and employees during excavation operations and at completion of work. Measures taken shall include but not be limited to; sidewalks, barricades, warning lights, and signs; and shall comply with American Standard Safety Code and all local laws and ordinances. Maintain in good condition during operations.

1.04 QUALITY ASSURANCE / GENERAL REQUIREMENTS FOR WORKMANSHIP

- A. Maintain quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Manufacturer's requirements shall be strictly followed for storage, preparation, installation, cleaning, protecting and testing of all products and materials except where specific requirements included in appropriate Sections in Division 1 through Division 16 exceed those requirements. Where conflicts between manufacturer's requirements and Contract Documents occur, Contractor shall notify Construction Manager and request resolution prior to proceeding. Construction Manager shall request clarification from Architect before proceeding.
- C. Perform work by persons qualified to produce workmanship of specified quality. Work which properly should be done by skilled labor shall not be attempted with common laborers. The Contractor shall have on the job, at all times, ample equipment to carry on the work properly, including such tools as may be necessary to meet emergency requirements.
- D. Each Contractor is to inspect jobsite, coordinate with other trades and field verify dimensions where applicable prior to fabricating product or material.
- E. Manufacturer's requirements and industry standards are to be followed in regards to the effect of temperature, moisture and humidity on products and materials.

- F. Materials and equipment are to be installed plumb, level and true, with uniform joints and edge conditions, tight seams and neatly fitting adjoining materials, unless specifically shown otherwise.
- G. Install materials and equipment as dimensioned on the drawings. If dimensions or height are not dimensioned on the drawings, Construction Manager is to issue a Request for Information to Architect requesting location of item in question.
- H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- I. Cleaning of materials and equipment shall be completed in a manner as not to damage finish.
- J. Equipment and material shall be protected by installing Contractor following installation with labels intact until final cleaning.

1.05 QUALITY CONTROL AND INSPECTIONS - RESPONSIBILITIES

- A. Each Contractor shall advise the Construction Manager's on-site field superintendent of all scheduled tests three working days in advance. Contractor's quality control representative shall review his drawings, procurement documents and contracts to ensure that technical information provided, and all work performed, is in accordance with latest revision of Contract Documents. Contractor shall maintain a complete set of original Contract Documents, including contract drawings and specifications, on site for work performed under his contract. These documents shall be updated to reflect all changes made through Addenda, Change Orders and Requests for Information.
- B. Contractor's quality control representative shall perform an inspection upon receipt at the site, of all materials, equipment and supplies. Items which are damaged or not in conformance with respective submittals, quality standards, contract documents, contract drawings and specifications, shall be identified and segregated from accepted items. Items thus identified will not be incorporated into the work until corrective action, acceptable to the Construction Manager and Architect is completed.
- C. Each Contractor is responsible for quality of the work performed by his work force and sub-Subcontractors, as well as quality of the material, equipment and supplies furnished by Subcontractor to be incorporated into the work. Subcontractor shall designate a quality control representative who will be on site at all times when work is in progress.

1.06 REFERENCES

- A. Conform to reference standard by date of issue current on date of contract documents.
- B. Obtain copies of standards when required by contract documents.
- C. Should specified reference standards conflict with contract documents, request clarification from Architect before proceeding.
- D. The contractual relationship of the parties to the contract shall not be altered from the contract documents by mention or inference otherwise in any reference document.

1.07 FIELD SAMPLES

- A. Install field samples at the site as required by individual specifications sections for review.
- B. Acceptable samples represent a quality level for the work.
- C. Where field sample is specified to be removed in individual sections, clear the area when directed by Architect.

1.08 MOCK-UPS

- A. Refer to Section 01 43 39 - Mockup Requirements

1.09 INSPECTION AND TESTING LABORATORY SERVICES

- A. Owner will appoint, employ, and pay for services of an independent firm to perform inspections and testing, except when a specification section specifically states that testing work be provided for by the Contractor. Testing will include, but not be limited to, the following:

1. Special Inspections as required by the 2018 International Building Code.
 2. Earthwork-, Structural-, and Fireproofing-Testing, will be by Owner-furnished independent laboratory or Structural Engineer.
- B. Mechanical and Electrical Testing will be furnished by the respective Contractor.
- C. The HVAC air and water balance and plumbing water balance shall be performed the Mechanical Contractor.
- D. The independent firm will perform inspections, tests, and other services specified in individual specification sections and as required by the Architect.
- E. Reports will be submitted by the independent firm to the Architect, indicating observations and results of tests and indicating compliance or noncompliance with contract documents. Provide copies to the Architect (1), Structural Engineer (1), Contractor (1), The Concrete Subcontractor and Consulting Geotechnical Engineer shall each receive (1) when applicable.
- F. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage and assistance as requested.
1. Notify Architect and independent firm 48 hours prior to expected time for operations requiring services.
 2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.
- G. Retesting required because of nonconformance to specified requirements shall be performed by the same independent firm on instructions by the Architect. Payment for retesting will be charged to the Contractor by deducting inspection or testing charges from the contract sum.

1.10 MANUFACTURER'S FIELD SERVICES AND REPORTS

- A. Submit qualifications of observer to Architect (30) days in advance of required observations. Observer subject to approval of Architect and Owner.
- B. When specified in individual specifications sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance of equipment, as applicable, and to initiate instructions when necessary.
- C. Individuals are to report observations and on-site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers written instructions.
- D. Submit report within (30) days of observation to Architect / Engineer for review.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 43 39
MOCKUP REQUIREMENTS

PART 1 –GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Composite exterior envelope mockups for visual and preconstruction testing
- B. Interior full-size room mockups
- C. Other composite mockups
- D. Product mockups for materials and systems indicated in individual specification Sections

1.03 DEFINITIONS

- A. Mock-ups (General): Full-size physical assemblies that are constructed on-site. Mock-ups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances.
 - 1. Mock-ups are not Samples.
 - 2. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1.04 PERFORMANCE REQUIREMENTS

- A. General Performance: Refer to individual specification sections for performance requirements of components and assemblies incorporated into mockups.
- B. Delegated Design: Design temporary supports for composite mockups, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

1.05 MOCKUP GENERAL REQUIREMENTS

- A. The drawings and specifications are the primary instruments used to convey design intent. Mock-ups are supplementary. The mockup shall not replace or supplement the drawings.
 - 1. Mockups shall demonstrate the proposed range of aesthetic effects and workmanship.
- B. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required, using materials indicated for the completed Work.
 - 1. Contractor shall employ supervisory personnel who will oversee mockup construction.
 - 2. Include mockup costs in the Contract Sum.
 - 3. Mockup design and construction shall be completed in a timely manner to ensure that there will be no delays in performance and completion of the Work. Contractor shall schedule and construct mockup(s) to allow for review(s), possible rejection(s), and corrective work, without interfering with the progress of the Work or delaying the project schedule.
- C. All mockups specified in this Section, other Sections of the Specifications, or shown on the drawings will be reviewed and approved by the Architect before starting fabrication or installation of the Work specified.
 - 1. Correct, replace, or reconstruct unacceptable mockups. Contractor shall carry forth mockup replacement /reconstruction until obtaining acceptance by Architect.
 - 2. Approval, acceptance, observation, or review of mockups does not constitute approval of deviation from the Contract Documents contained in mockups, unless such deviation is specifically identified in writing by Contractor, and thereafter approved by Architect in writing.

- D. Coordinate Work of trades and schedule elements to expedite the fabricating, furnishing and installation of multiple component mockups specified in this Section, in other Sections of the Specifications, and as shown on the Drawings.
- E. Composite Exterior Envelope Mock-ups: Mock-ups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
 - 1. Design and provide standard framework assemblies necessary to support and display mockups.
 - 2. Locate exterior visual mockups to simulate actual conditions of solar direction, solar angle, and shading. Coordinate with Architect.
- F. Interior Full-Size Room Mock-ups: Mock-ups of interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting as indicated in the Drawings.
- G. Mock-ups shall not be fabricated until after acceptance of required submittals for all finish materials to be incorporated into the mockups. Project schedule shall take into account early submittal of these components to the Architect.
- H. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- I. Demolish and remove mockups when directed unless otherwise indicated.

1.06 ACTION SUBMITTALS

- A. Product Data: Submit applicable product data prior to or with mockup shop drawings.
 - 1. Initial approval of applicable product data and other submittals applicable to mockups is preliminary approval only and for purpose of mockup only. Final approval of previously reviewed product data and other submittals is subject to approval of mockup.
 - 2. For pre-fabrication mockups, products and materials are subject to change at the discretion of the Owner and after evaluation of Architect recommendations.
- B. Mockup Shop Drawings: For composite exterior envelope mockups, and other composite mockups, provide plans, sections, elevations, and details indicating materials and size of mockup construction.
 - 1. Submit shop drawings for the mockup that integrate shop drawings of each finish material and footings and bracing. Clearly identify components and materials to be integrated into the assembly.
- C. Samples: Prior to construction of mockups, provide material samples as specified in the respective Specification Sections included as part of the mockups.
- D. For installed products indicated to comply with design loads, include Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Submit structural calculations as required to ensure the structural integrity of the mock-u

1.07 INFORMATIONAL SUBMITTALS

- A. Mockup Schedule: Submit copies of schedule indicating coordination with overall construction schedule. Indicate the following:
 - 1. Milestones for fabrication of mockup materials, mockup installation start, mockup installation completion, and mockup acceptance.
 - a. Include time periods for Architect and Owner reviews.
 - b. Include time periods for testing.
 - c. Include time periods required by testing agency for scheduling, setup, and testing.
 - d. Submit schedule a minimum of 30 days prior to start of mockup fabrication.
- B. Mockup Preconstruction Testing Program (if applicable): Developed specifically for Project and to comply with indicated testing requirements.
 - 1. Upon completion of testing, provide "as built" mockup shop drawings showing modifications or additions required to meet the performance requirements and submit within 15 days of mockup testing completion.

- C. Mockup Field Quality Control Reports: Submit reports indicating completion of correction items noted on Architect's mockup review(s). Include field quality control reports for testing associated with mockups.
- D. Delegated-Design Submittal: For composite mockup support systems indicated to comply with performance requirements and design criteria.
 - 1. Submit complete design, structural analysis, calculations, testing and other data demonstrating that the work of this Section will conform to accepted engineering practice, and conform to the design requirements indicated.
 - a. The submittal shall be certified, stamped and signed by a registered Professional Engineer responsible for the information contained in the submittal.
 - 2. Shop drawings shall indicate the location and configuration for each assembly, support, member, connection, anchor, etc.
 - 3. Certificate of Compliance: Submit a signed letter certifying that the system is designed to comply with the specified design requirements.
 - a. Provide certification that analysis methodology, as referenced in SEI/ASCE 7, has been satisfactorily performed and can demonstrate system compliance with specified design performance requirements.
 - 4. Design Calculations: Calculate requirements for system. Coordinate transferred loads with work of other Sections.

1.08 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: As specified in Section 01 40 00 - Quality Requirements.
- B. Preconstruction Testing Agency Qualifications (if applicable): Qualified according to ISO/IEC 17025 and accredited by ICC-ES for preconstruction testing indicated.
- C. Inspection Agency Qualifications:
- D. Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to, using materials indicated for the completed Work.
- E. Performance Testing Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

1.09 COMPOSITE EXTERIOR ENVELOPE MOCKUPS

- A. Construct full thickness exterior mockup/s of size and configuration indicated on Drawings to verify selections made for color and textural characteristics, and to represent completed work for qualities of appearance, materials and construction. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.
- B. Construct exterior envelope mockups early in construction sequence, as required to allow sufficient time for testing, review, and approval of mockup. Approval of mockup is required prior to fabrication of materials for actual building construction.
- C. Provide all components and materials required for a complete weather-tight assembly as indicated and specified for the full building construction.
- D. Mockup shall include engineering, design, and construction of required temporary supports including but not limited to concrete footings, concrete slabs, structural steel framing, reinforced masonry, cold-formed metal framing, miscellaneous metal supports, anchors, and other temporary support construction.
- E. Furnish labor and materials to build composite mockup unit(s) of sufficient size and configuration to adequately demonstrate the performance capabilities of the various types of work and support systems of the work. The exact configuration of mockup(s) shall be based on approved mockup Shop Drawings and as a function of the work as finally designed, but shall in no case be smaller than the size and configuration shown on the Drawings.
 - 1. Mockup(s) shall include exterior envelope assemblies and other Work as indicated on the Drawings. The Contractor may at their option include other portions of the Work as part of mockup(s).

2. Chamber preparation shall include simulated floors, roofs, structural frames, and similar support elements. Surrounding work of trades other than those indicated on Drawings shall, if so directed by the Contractor, be provided by those trades who perform the work for the project, and coordinated accordingly.
3. Mockup(s) shall be complete with corners, splice joints, sealants, glass and glazing, anchors, flashings, complete finishes, and with details complete and identical to those proposed for use in the building. Do not use excessive amounts of sealant or other special measures or techniques that are not representative of those to be used in the building.
4. Mockup(s) shall be fabricated, assembled and glazed (if shop glazed for the project) at the locations where and by the same persons as will do this work for the project. Mockup installation and field glazing and demonstration field glazing procedures shall be performed by the same personnel for the mockup as will do this work on the site.
5. Set up and make complete installation of mockup(s) at the designated location on the project site campus. Mockup(s) shall be used to demonstrate quality of materials, finish and workmanship as well as to show compliance with performance criteria.
6. Design Concept: Engineer and construct mockup, including required shoring, bracing, foundations, power, etc., making required additions and modifications to details as required.
 - a. Comply with performance requirements specified in the individual Specification Sections while maintaining basic design concept, member profiles, and alignment of components.
7. Unless directed otherwise by Architect, locate exterior mockups to simulate actual conditions of solar direction, solar angle, and shading.

1.10 INTERIOR FULL-SIZE ROOM MOCKUPS

- A. Provide full-size room mockups within the building. The rooms to serve as the mockups shall be as indicated on the Drawings. Room mockup shall include all required floor, wall, and ceilings finishes, casework, light fixtures, door(s) and frame(s), glazing, mechanical diffusers, and other required materials and finishes.
 1. Make necessary modifications until room mockup is accepted by the Owner.
 2. Mock-up shall be constructed out of sequence.
 3. Upon acceptance, the room mockup will be incorporated into the final completed Project.
- B. Materials: As specified in the respective Sections of the Specifications.
- C. Provide the following interior full-size room mockups:
 1. Typical Patient Room, in location indicated in the Drawings.
- D. Mock-ups will be used to test color and material alternatives and to accept final colors, textures and workmanship. Multiple colors may be tested for each component as part of the mockup until the Owner is satisfied.

1.11 SPECIAL FINISHES MOCKUPS

- A. Provide special finish mockups of the types specified in this Section, other Sections of the Specifications, or shown on the Drawings.
 1. Mock-ups shall show materials and workmanship to be expected in the completed work.
- B. Make necessary revisions as required until each special finishes mockup is accepted by the Owner.
- C. Accepted mockups may be allowed to remain in place.
- D. Provide special finishes mockups of the following:
 1. To be Determined

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PREPARATION

- A. Pre-Construction Conference for Exterior Mockup: Prior to commencement of Work, schedule meeting/s at mutually agreeable time to include Owner, Architect, Engineer/s, Contractor,

Subcontractor/s, Manufacturer representative/s, and other interested parties to review methods and procedure to be used to achieve design and Performance Requirements.

3.02 INSTALLATION

- A. Installers proposed for use on the actual work shall install the mockups. Personnel representing manufacturers, fabricators, and installers of exterior wall components shall be present during mock-up construction and testing as appropriate for efficient evaluation and revision if required.

3.03 SEQUENCE OF INSPECTION

- A. Notify the Architect at the start of construction of mockups.
- B. After approximately 50-percent of each mockup has been built, request the Architect's and Owner's preliminary review before completion.
 - 1. Should the mockups fail to meet the requirements, it shall be taken down or dismantled, and reconstructed to the extent necessary, until acceptance has been obtained.
 - 2. Incorporate visual and technical changes, or variations, into mockups as directed by Architect.
 - 3. Time the completion and reworking of mockups necessary to obtain acceptance to avoid delay in the construction schedule of the Project. Update the Construction Schedule to reflect required revisions to mockups.
- C. Final Completion and Acceptance: Obtain the Architect's acceptance of visual and technical qualities of mockups before commencing the corresponding work for the Project.
- D. Maintain and protect mockups during construction to serve as a standard for judging work incorporated into the Project. Do not alter, remove, or destroy remote mockups until authorized by the Architect.

3.04 TESTING PROCEDURES

- A. Conduct tests of mockups in the presence of the Inspection Agency. Proceed with each test only after acceptance of the detailed outline of test procedure.
 - 1. Test protocol requires that air infiltration testing precede water tests. Should it be necessary for a water test to be performed in advance of the air test, the specimen must be allowed to completely dry before air test.
 - 2. The wind machine used for the dynamic water test shall generate wind speeds equivalent to 10 psf.
 - 3. Center deflection readings shall be taken for glass during testing.
- B. Refer to "Performance Testing Mockup" Article this Section for additional requirements.

3.05 CORRECTION OF MOCKUPS

- A. Correct any deficiencies in the mockup observed during testing and repeat tests as may be required to show compliance with the specified performance standards and the Contract Documents. Resubmit any submittals affected by these corrections. Resubmit Shop Drawings with changes made to assemblies to successfully complete preconstruction testing.
- B. Deficiencies requiring repair or modification to the mockup shall mandate a complete retesting of the mockup beginning with the specified Preliminary Test unless otherwise requested by the Owner. If compliance with the performance standards is not achieved after 2 complete retests the Contractor shall replace mockup completely with revised construction and start testing from the beginning.
- C. Incorporate corrective measures indicated by the test report into the final exterior wall assemblies after review by the Owner.

3.06 DISPOSAL

- A. When authorized by Owner, demolish and remove all components of composite mockups from project site.

END OF SECTION

SECTION 01 45 33
CODE-REQUIRED SPECIAL INSPECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Code-required special inspections.
- B. Manufacturers' field services.
- C. Fabricators' field services.

1.02 DEFINITIONS

- A. Building Code: ICC (IBC)-2018 Edition of the International Building Code and specifically, Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
 - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
 - 2. Special inspections are separate from and independent of tests and inspections conducted by the Owner for the purposes of quality assurance and contract administration.

1.03 REFERENCES

- A. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; 2014 (Errata 2016).
- B. ICC (IBC)-2018 - International Building Code; 2018.
- C. SDI (QA/QC) - Standard for Quality Control and Quality Assurance for Installation of Steel Deck; 2017.
- D. AISC 341 - Seismic Provisions for Structural Steel Buildings; 2016.
- E. AISC 360 - Specification for Structural Steel Buildings; 2010.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- G. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2015ae1.
- H. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2014a.
- I. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2012a.
- J. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2014a.
- K. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2015.
- L. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestops; 2014b.
- M. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2010a (Reapproved 2015).
- N. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007, with Editorial Revision (2014).
- O. AWCI 117 - Technical Manual 12-B; Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials; an Annotated Guide; 2014.

- P. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; 2011.
- Q. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2010.
- R. IAS AC291 - Accreditation Criteria for Special Inspection Agencies; 2017.

1.04 SUBMITTALS

- A. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency shall:
 - 1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
 - 4. Submit documentation that Special Inspection Agency is accredited by IAS according to IAS AC291.
- B. Testing Agency Qualifications: Prior to the start of work, the Testing Agency shall:
 - 1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 - 3. Submit certification that Testing Agency is acceptable to AHJ.
 - 4. Submit documentation that Testing Agency is accredited by IAS according to IAS AC89.
- C. Manufacturer's Qualification Statement: Manufacturer shall submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.
- D. Fabricator's Qualification Statement: Fabricator shall submit documentation of fabrication facilities and methods as well as quality control procedures. Include documentation of AHJ approval.
- E. Special Inspection Reports: After each special inspection, Special Inspector shall promptly submit two copies of report; one to Architect and one to the AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.
 - i. Results of special inspection.
 - j. Compliance with Contract Documents.
 - 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- F. Test Reports: After each test or inspection, promptly submit two copies of report; one to Architect and one to AHJ.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.

- g. Type of test or inspection.
 - h. Date of test or inspection.
 - i. Results of test or inspection.
 - j. Compliance with Contract Documents.
- G. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and AHJ.
- H. Manufacturer's Field Reports: Submit reports to Architect and AHJ.
 - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the contract documents.

1.05 SPECIAL INSPECTION AGENCY

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

1.06 TESTING AND INSPECTION AGENCIES

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

1.07 QUALITY ASSURANCE

- A. Special Inspection Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
 - 2. Accredited by IAS according to IAS AC291.
- B. Testing Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
 - 2. Accredited by IAS according to IAS AC89.
- C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS - GENERAL

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections during construction on the types of work listed in Section 1705 of the 2015 International Building Code (IBC), including:
 - 1. Steel construction (Section 1705.2)
 - 2. Concrete construction (Section 1705.3)
 - 3. Soils (Section 1705.6)
 - 4. Fire-resistant penetrations and joints (Section 1705.16)

5. Smoke control (Section 1705.17)

3.02 SPECIAL INSPECTIONS - FREQUENCY

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

3.03 SPECIAL INSPECTIONS - STEEL CONSTRUCTION

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections of steel construction in accordance with the requirements of Section 1705.2 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1. Structural Steel: Special Inspections and nondestructive testing of structural steel elements on this Project shall be in accordance with the requirements of AISC 360.
 - 2. Cold-formed steel floor and/or roof deck: In accordance with the quality assurance inspection requirements of SDI (QA/QC)
 - 3. Open-Web Steel Joists and Joist Girders (Table 1705.2.3):
 - a. End connections - welded or bolted; periodic.
 - b. Bridging - horizontal or diagonal; periodic.
 - 4. Inspection of welding:
 - a. Inspection of welds at the base of cantilevered rail posts.

3.04 SPECIAL INSPECTION OF CONCRETE CONSTRUCTION (BY OWNER)

- A. Perform inspections and associated testing and sampling in accordance with the requirements of Section 1705.3, and Table 1705.3, of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1. Inspect reinforcing steel, including prestressing of tendons, and verify placement; periodic.
 - a. Reinforcing bar welding; periodic or continuous.
 - b. Inspect anchors in concrete; periodic.
 - c. Inspect anchors post-installed in hardened concrete; periodic or continuous.
 - d. Verify use of required design mix; periodic.
 - e. Inspect concrete and shotcrete placement; continuous.
 - f. Verify maintenance of specified curing temperature and techniques; periodic.
 - g. Inspect prestressed concrete; continuous.
 - h. Inspect erection of precast concrete members; periodic.
 - i. Verify in-situ concrete strength; periodic.
 - j. Inspect formwork shape, location and dimensions; periodic.

3.05 SPECIAL INSPECTION OF CONCRETE CONSTRUCTION (BY CONTRACTOR)

- A. The Concrete Contractor will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with the requirements of Section 1705.3, and Table 1705.3, of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1. Concrete sampling concurrent with strength test sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M and ACI 318; continuous. Record the following:
 - a. Slump.
 - b. Air content.
 - c. Temperature of concrete.

3.06 SPECIAL INSPECTION OF MASONRY CONSTRUCTION

- A. Masonry construction shall be inspected and verified in accordance with the quality assurance requirements of TMS 402 / ACI 530 / ASCE 5 and TMS 602 / ACI 530.1 / ASCE 6.

1. Exceptions:
 - a. Empirically designed masonry and masonry veneer in structures classified as Risk Category I, II, or III.
- B. Occupancy (Risk) Category: II, per 2015 IBC, Section 1604.5

3.07 SPECIAL INSPECTIONS - SOILS

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling of soils, in accordance with the requirements of Section 1705.6, and Table 1705.6, of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity; periodic.
 2. Verify excavations are extended to proper depth and have reached proper materials; periodic.
 3. Perform classification and testing of compacted fill materials; periodic.
 4. Verify materials, densities, and lift thicknesses during placement and compaction of compacted fill: continuous.
 5. Verify subgrade, prior to placement of compacted fill; periodic.

3.08 SPECIAL INSPECTIONS FOR DRIVEN DEEP FOUNDATIONS

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling of driven deep foundations, in accordance with the requirements of Section 1705.7, and Table 1705.7, of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1.

3.09 SPECIAL INSPECTIONS FOR CAST-IN-PLACE DEEP FOUNDATIONS

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling of cast-in-place deep foundations, in accordance with the requirements of Section 1705.8, and Table 1705.8, of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1.

3.10 SPECIAL INSPECTIONS FOR HELICAL PILE FOUNDATIONS

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling of cast-in-place deep foundations, in accordance with the requirements of Section 1705.9 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1.

3.11 SPECIAL INSPECTIONS FOR SPRAYED FIRE-RESISTANT MATERIALS

- A. Perform inspections and associated testing and sampling of sprayed fire-resistant materials in accordance with the requirements of Section 1705.14 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 1. Condition of substrates.
 2. Thickness of application.
 3. Density.
 4. Bond strength adhesion/cohesion.
 5. Condition of finished application.

3.12 SPECIAL INSPECTIONS - MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS

- A. When applicable, perform inspections and associated testing and sampling of mastic and intumescent fire-resistive coatings, in accordance with the requirements of Section 1705.15 of the 2015 International Building Code.
 1. Verify mastic and intumescent fire resistant coatings comply with AWCI 12-B and the fire resistance rating indicated on approved contract documents.

3.13 SPECIAL INSPECTIONS - EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS)

- A. The Owner will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling of exterior insulation and finish systems, in accordance with the requirements of Section 1705.16 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1.
- B. Verify water resistive barrier coating applied over sheathing complies with ASTM E2570/E2570M.

3.14 SPECIAL INSPECTIONS FOR FIRE RESISTANT PENETRATIONS AND JOINTS

- A. Occupancy (Risk) Category: IV - Essential facilities, per 2018 IBC, Section 1604.5
 - 1. Special Inspections required per Section 1705.17 of the 2018 IBC:
 - a. Inspection of penetration firestop systems shall be conducted in accordance with ASTM E2174
 - b. Inspection of fire-resistant joint systems shall be conducted in accordance with ASTM E2393
- B. Occupancy (Risk) Category: IV - Essential facilities, per 2015 IBC, Section 1604.5
 - 1. Special Inspections not required per Section 1705.17 of the 2015 IBC.
- C. Perform inspections and associated testing and sampling of fire-resistant penetrations and Joints, in accordance with the requirements of Section 1705.17 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1. Through-penetrations, membrane penetration firestops, fire-resistant joint systems, and perimeter fire barrier systems.

3.15 SPECIAL INSPECTIONS - SMOKE CONTROL

- A. Where applicable, perform inspections and associated testing and sampling of smoke control, in accordance with the requirements of Section 1705.18 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 - 1. During erection of ductwork and prior to concealment for the purpose of leakage testing and recording of device location.
 - 2. Prior to occupancy and after sufficient completion for the purposes of pressure difference testing, flow measurements and detection and control verification.

3.16 SPECIAL INSPECTIONS - SEISMIC RESISTANCE

- A. Design Requirements:
 - 1. Building Code: 2015 IBC
 - 2. Occupancy (Risk) Category (Section 1604.5): II
 - 3. Site Classification (Section 1613.3.2): C
 - 4. Wind Speed: 115 mph
 - 5. Seismic Design Category (Section 1613.3.5): C
- B. When applicable, perform inspections and associated sampling and testing of seismic resistance, in accordance with the requirements of Section 1705.12 of the 2015 International Building Code (ICC (IBC)-2015).
 - 1. Special Inspections:
 - a. Structural Steel (Seismic Design Category B, C, D, E or F): Comply with the quality assurance requirements of AISC 341 .
 - b. Cold Formed Steel Light Frame Construction (Seismic Design Category C, D, E or F)
 - 1) Field welding; periodic.
 - 2) Screw attachment, bolting, anchoring and other fastening of components within the main seismic force-resisting system; periodic.
 - c. Mechanical and Electrical Components:
 - 1) Anchorage of electric equipment required for emergency or standby power systems (C, D, E or F); periodic.

- 2) Installation of piping systems for flammable, combustible or highly-toxic contents and associated mechanical units (C, D, E or F); periodic.
- 3) Installation of HVAC ductwork that will contain hazardous materials (C, D, E or F); periodic.
- 4) Vibration isolation systems where the approved contract documents require a nominal clearance of 1/4 inch or less between support frame and seismic restraint (C, D, E or F); periodic.
- d. Designated Seismic System Verification (C, D, E or F): Verify label, anchorage or mounting complies with certificate of compliance provided by manufacturer or fabricator.
- e. Seismic Isolation System (B, C, D, E or F):
 - 1) Fabrication and installation of isolator units; periodic.
 - 2) Fabrication and isolation of energy dissipation devices; periodic.
2. Testing for Seismic Resistance:
 - a. Steel:
 - 1) Structural Steel: Comply with the quality assurance requirements of AISC 341.
 - 2) Seismic isolation systems: Test system in accordance with ASCE 7, Section 17.8
3. Structural Observations for Seismic Resistance: Visually observe structural system for general compliance with the approved contract documents; periodic.

3.17 SPECIAL INSPECTIONS - WIND RESISTANCE

- A. Design Requirements:
 1. Building Code: 2015 IBC
 2. Occupancy (Risk) Category (Section 1604.5): II
 3. Site Classification (Section 1613.3.2): C
 4. Seismic Design Category (Section 1613.3.5): B
 5. Wind Exposure Category: B
 - a. Ultimate Design Wind Speed $V_{ult} = 115$ mph
 - b. Nominal Design Wind Speed $V_{asd} = 89$ mph
- B. The Owner will employ the services of a Special Inspection Agency to perform inspections and associated testing and sampling for wind resistance, in accordance with the requirements of Section 1705.11 of the 2015 International Building Code (ICC (IBC)-2015), including the following:
 1. Structural Wood:
 - a. Field gluing of components in the main wind force-resisting system; continuous.
 - b. Nailing, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic.
 2. Cold Formed Steel Light Frame Construction:
 - a. Field welding; periodic.
 - b. Screw attachment, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic
 3. Wind Resisting Components:
 - a. Roof cladding; periodic.
 - b. Wall cladding; periodic.
 4. Structural Observations for Wind Resistance: Visually observe structural system for general compliance with the approved contract documents; periodic.

3.18 OTHER SPECIAL INSPECTIONS

- A. Provide for special inspection of work that, in the opinion of the AHJ, is unusual in nature.
- B. For the purposes of this section, work unusual in nature includes, but is not limited to:
 1. Construction materials and systems that are alternatives to materials and systems prescribed by the building code.
 2. Unusual design applications of materials described in the building code.

3. Materials and systems required to be installed in accordance with the manufacturer's instructions when said instructions prescribe requirements not included in the building code or in standards referenced by the building code.
- C. Alternative Test Procedures: Where approved rules and standards do not exist, test materials and assemblies as required by AHJ, or provide AHJ with documentation of quality and manner in which those materials and assemblies are used.

3.19 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

- A. Special Inspection Agency shall:
 1. Verify samples submitted by Contractor or Owner comply with the referenced standards and the approved contract documents.
 2. Perform specified sampling and testing of products in accordance with specified REFERENCES.
 3. Ascertain compliance of materials and products with requirements of Contract Documents.
 4. Promptly notify Contractor or Architect of observed irregularities or non-conformance of work or products.
 5. Submit reports of all tests or inspections specified.
- B. Limits on Special Inspection Agency Authority:
 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the work.
- C. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- D. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

3.20 TESTING AGENCY DUTIES AND RESPONSIBILITIES

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

3.21 CONTRACTOR DUTIES AND RESPONSIBILITIES

- A. Contractor Responsibilities, General:
 1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
 2. Cooperate with agency and laboratory personnel; provide access to the work, to manufacturers' facilities, and to fabricators' facilities.
 3. Provide incidental labor and facilities:

- a. To provide access to work to be tested or inspected.
- b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
- c. To facilitate tests or inspections.
- d. To provide storage and curing of test samples.
4. Notify testing or inspection agency 24 hours prior to expected time for operations requiring testing or inspection services.
5. Arrange with Owner's agency and pay for additional samples, tests, and inspections required beyond specified requirements.

3.22 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES

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

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. This Section includes temporary facilities and controls for which the General Contractor or Construction Manager are responsible, including temporary utilities, support facilities, and security and protection facilities
- B. All work which is within an existing facility must be performed such that the existing facility may remain functioning with little or no interruption. Take all necessary precautions and plan all work so that there will be a minimum of interruptions to the operations of the Owner.

1.03 CONFLICTING DOCUMENTS

- A. All work included in this Section shall be governed by the Contract Documents. In Case of conflict between General Conditions and other Contract Documents with this section the more stringent requirements shall govern as determined and as directed by the Architect.

1.04 TEMPORARY TOILETS

- A. Temporary toilet facilities shall be furnished, maintained and removed as required.
- B. Toilets shall be sufficient numbers, and at various locations, to accommodate the work force.
- C. The use of these toilet facilities by all members of the work force is mandatory. NO construction personnel are permitted use of any hospital facilities or services for personal use, unless otherwise approved in advance.
- D. The plumbing contractor shall install toilet fixtures on each floor for construction personnel at such time as the temporary unit is impractical.

1.05 TEMPORARY WATER

- A. The plumbing contractor will furnish, install, and maintain temporary water for use during construction at the job site. The temporary water requirements will consist of one individual hose bib per floor.
- B. Other contractors requiring additional temporary water service will be responsible for making arrangements for this work through the plumbing contractor subject to the approval of the Construction Manager. The cost for additional temporary water service will be paid by the contractor requesting the additional service.
- C. It will be the responsibility of all contractors utilizing temporary water to protect against water damage. Contractors are required to use new materials and replace worn or broken parts. Hoses, fittings, etc. which are leaking will be required to be removed from the job. Contractors in violation of same will be responsible for the cost of correcting damage arising from violation of this policy.
- D. Temporary water service shall be drained down and reactivated as required by the plumbing contractor to prevent freezing.
- E. The Owner will pay for all water used during construction of the project.

1.06 TEMPORARY ELECTRICAL

- A. Electrical contractor will furnish, install, relocate, maintain and remove all necessary temporary wiring, lighting fixtures, protective devices, distribution panels, and transformers, etc. required for construction purposes conforming to rules and regulations of OSHA as well as other agencies having local jurisdiction.

- B. Temporary electrical service shall be 3 phase 4 wire, service with voltages and ampacities as required, provided by the electrical contractor at locations coordinated with the Construction Manager.
- C. Electrical contractor shall provide temporary lighting as required by OSHA Standard 1926.56, but not less than one lamp per 500 square feet. Additional temporary light requirements shall be the responsibility of individual contractors.
- D. All contractors will be responsible for their power extension cords from the temporary panels to their work areas. These cords shall be three wire (including ground wire) of sufficient capacity for service intended and fully approved by all governing bodies.
- E. Each contractor shall coordinate any further special temporary electrical requirements with the electrical contractor.
- F. Permanent convenience receptacles may not be utilized during construction.
- G. Each contractor shall estimate their electrical needs and timing sequence. This information shall be provided to the electrical contractor at the start of the project prior to final sizing and installation of the temporary electrical service for this project.
- H. The Owner will pay for the cost of all electrical energy used during the construction phase of the project. Should the project not be substantially complete, by no fault of the Owner, as dated in the contract, the Owner reserves the right to back charge the Contractor for all electrical energy until the project achieves substantial completion.
- I. Utility company charges associated with installation of temporary power service shall be paid by the Owner.

1.07 TEMPORARY HEAT

- A. The Contractor will provide and pay for building interior heating devices and fuel as required to maintain specified conditions for construction operations. At minimum:
 - 1. The building shall be heated to at least 55°F. for seven (7) days prior to, during, and after the application of wood trim, staining, varnishing and painting, and continued to completion and final acceptance of the Owner.
 - 2. The building shall be heated to at least 70°F for seven (7) days prior to, during, and 96 hours after installation of resilient floor coverings.
 - 3. Maintain such heat as practical to provide satisfactory working conditions of all trades.
- B. The use of open salamanders, heating devices which may smoke or damage the finish of walls, etc., and produce fumes hazardous to persons, shall not be allowed. Field equipment and method of heating shall be satisfactory to the Owner and Architect.
- C. Mechanical contractor shall be required to activate the permanent heating system for completion of the interior finishes as indicated in the Construction Schedule. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Mechanical contractor shall include extended warranties, as required, which enables the Owner to receive a full warranty at completion of the project. Mechanical contractor will clean and replace filters and provide watchmen as required.
- D. Owner will pay for utility charges incurred as a result of operating the permanent equipment.
- E. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.08 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. Ventilation shall be to the exterior and not be ventilated to adjacent occupied areas.

1.09 TEMPORARY COMMUNICATION SYSTEMS

- A. Telephones will be provided at the site office. Telephones will not be provided for tradesmen for their personal use.
- B. Radio communication will be permitted only with prior approval.
 - 1. Cellular type phones are not permitted without specific approval of the Owner due to possible medical equipment interference.

1.10 HOISTS

- A. Hoisting requirements shall be the responsibility of the individual contractors.

1.11 CONSTRUCTION FENCE

- A. The Contractor will erect and maintain a construction fence around the perimeter of the site and staging area. Fence gates shall be located to provide access/egress as determined by the Contractor. No contractor shall remove any sections of the fence without approval from the Contractor. Contractors granted approval to remove a portion of the construction fence will be responsible to replace and restore those sections to the satisfaction of the Contractor.

1.12 SITE AND AREA RESTRICTIONS

- A. Access and egress to and from the site is under the control and direction of the General Contractor or Construction Manager.
- B. All contractors will be responsible for advising the General Contractor or Construction Manager of their delivery schedules and will coordinate the work of various contractors as to minimize delays.
- C. All general access to the construction site is limited to the designated construction entrance unless arranged otherwise.
- D. On-site parking will be available for all contractors or their respective workforce.
- E. Unauthorized vehicles parking on-site will be subject to "towing" at the vehicle owner's expense.

1.13 TEMPORARY ONSITE STRUCTURES

- A. Each contractor shall make his own arrangements with the General Contractor or Construction Manager for office and storage facilities on this site. If office or storage space is required or necessary, each contractor shall provide and maintain his own offices and storage facilities.
- B. Temporary telephone and power requirements shall be the responsibility of the individual contractors.

1.14 STORAGE

- A. Unprotected, outdoor storage shall be permitted at the job site subject to prior approval of the Construction Manager.
- B. The Owner will assume any responsibility for any stored materials.
- C. Protected onsite storage shall be provided subject to availability and approval of the Owner, General Contractor, or Construction Manager.

1.15 TEMPORARY ENCLOSURES

- A. Any in progress or recently completed portions of work requiring protection from exposure to foul weather and detrimental operations will need to be protected by the contractor performing the work. Protection at a minimum will include translucent nylon reinforced laminated polyethylene sheets on a wood framing capable of containing heat for adequate drying or curing.

1.16 FIRE PROTECTION

- A. All contractors shall provide fire extinguishers of proper type and number as required to extinguish fires in all locations where performing work. contractor shall provide fire watch as required to perform the work. Notify General Contractor or Construction Manager when welding, cutting or any activity that could create a fire hazard.

- B. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
 - 1. Prohibit smoking in hazardous fire-exposure and construction areas.
 - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 - 3. Develop and supervise an overall fire-prevention and –protection program for personnel at Project site. Review needs with applicable fire department and establish procedures to follow. Instruct personnel in methods and procedures. Post warnings and information.
- C. The Fire Protection Contractor shall be responsible to maintain a fully operational wet fire sprinkler system within the renovation area throughout the duration of construction.
 - 1. In the event that the system must be taken offline, the contractor shall coordinate the scheduling of this with the Hospital and provide a firewatch during the outage.
 - 2. Existing sprinkler piping may be utilized for this protection and all sprinkler heads must be installed to comply with NFPA installation requirements.

1.17 TRASH REMOVAL

- A. Each contractor is required to remove their individual trash and place it in a dumpster at a location approved by the Owner.
- B. It is the responsibility of each Contractor to keep all areas, including scaffold platforms and lunch/break areas, clean of all debris and a safe workplace.
- C. Failure by the (sub)contractor to maintain a clean and safe workplace will not be tolerated and may be subject to a third-party cleaning engaged by the Owner and charges reduced from the contract sum.
- D. All boxes, cartons, etc., are crushed to the minimum prior to placing in the trash containers or trash collection areas. No paint cloths will be allowed in trash containers.
- E. The disposal of any material, waste, effluents, trash, garbage, or oil, grease, chemicals, etc., resulting from either demolition or new work, shall be disposed of in accordance with all applicable laws. Any materials disposed of in an unauthorized place or manner shall be removed and the area restored to its original undisturbed condition at the expense of the contractor.
- F. Should any contractor repeatedly fail or refuse to perform their own clean up after twenty-four (24) hours notice, the General Contractor or Construction Manager shall cause the clean-up work to be performed and the entire cost thereof, plus handling changes, will be assessed against the party responsible.

1.18 SNOW AND ICE REMOVAL

- A. Each contractor will be required to remove snow and ice from their work areas to the extent necessary to perform the work. The use of calcium chloride as an acid or means to remove snow or ice will not be permitted.

1.19 PROTECTION OF LIFE, SAFETY AND PROPERTY

- A. Provide necessary barricades, safety fencing, wall protection, etc. to safeguard the employees and the general public against any and all hazards which might arise from the construction operations.
- B. The Contractor/s shall be responsible for all damage caused to walks, streets, curbs, or grounds through operations under this contract.
- C. Whenever public property is damaged, it shall be restored to match surrounding surfaces to the satisfactions of cognizant local authority.
- D. The General Contractor or Construction Manager shall consult governing local agencies for anti-truck ordinances and restrictions and shall abide by them.

1.20 INTERIM LIFE SAFETY MEASURES

- A. Interim Life Safety Measures (ILSM) are a series of administrative actions required to be taken to temporarily compensate for the hazards posed by existing Life Safety Code (LSC) deficiencies or construction activities.
- B. Implementation of ILSM is required in or adjacent to all construction areas and throughout buildings with existing LSC deficiencies. ILSM apply to all personnel, including construction workers. Implementation of ILSM must begin upon project development and be continuously enforced through project completion.
- C. ILSM are intended to provide a level of life safety comparable to that described in chapters 1-11, and the applicable occupancy chapters of the 2012 edition of the LSC (NFPA 101). Each ILSM action must be documented. Except as stated below, frequencies for inspection, testing, training, and monitoring and evaluation must be established by the organization.
- D. Daily ILSM checklist shall be performed by the General Contractor or Construction Manager on Owner provided forms. Adherence to the Owner's policies and procedures concerning risk assessments and ILSM is strictly observed. Failure to comply with these regulations is subject to termination of the contract.
- E. All contractors shall comply with J.C.A.H.O. Interim Life Safety Code, current edition.

1.21 SAFETY

- A. All (sub)contractors shall abide by Federal, State and local laws and regulations concerning safety on the work site. All (sub)contractors shall be required to have a representative attend all safety meetings scheduled by the General Contractor or Construction Manager while they are present at the job site and shall abide by all other reasonable efforts and requests of the General Contractor or Construction Manager to encourage, plan and enforce a safety program.
- B. The General Contractor or Construction Manager shall supply the Owner with a list of all field and office personnel, with their respective work and home telephone numbers in case of an emergency.
- C. Each (sub)contractor shall provide the General Contractor or Construction Manager with a copy of their Hazard Communication Program and copies of all Material Safety Data Sheets for any materials used on site. This program shall remain in the General Contractor or Construction Manager's office, available for review to job site personnel, during construction activities of the contractor and will be returned to the contractor upon completion of his work.
- D. All (sub)contractors shall comply with and sign the Owner's Construction and Safety Policy and sign off, as may be amended from time to time. Current Owner's Policy Statements are attached ahead of this section under the heading of "Safety Manual".
- E. Safety on the project site is a primary concern to the Owner. Each (sub)contractor is responsible for the safety and security of their employees. OSHA and general safety regulations must be observed and maintained as a minimum standard in all cases. Failure to comply with safety requirements will be considered as non-compliance with the contract, and will result in remedial action, including but not limited to, withholding of progress payments. Contractor reserves the right to have unsafe conditions corrected by others, if contractor fails to do so when requested and backcharge contractor for costs.
- F. General Guidelines:
 - 1. Personal Protective Equipment - OSHA approved hard hats shall be worn by all personnel and visitors on the jobsite at all times. Proper clothing shall be worn, suitable for construction work. Shirts and long pants shall be worn at all times. Durable work shoes are required; canvas or leather type athletic shoes and shoes without heels or toes are not permitted. All other personal protective equipment shall be furnished by the Contractor to its employees, the Owner and Design team as required.
 - 2. Housekeeping - Good housekeeping shall be maintained at all times. All stripped lumber shall be safety stacked after nails have been removed or bent down. All stairways, scaffolds, ramps, walkways, and work areas shall be kept clear and clean of trash and material. Work areas shall be maintained free from accumulation of combustible trash.

3. Safety Representative - Each contractor will assign an individual to act as a safety representative. This individual must be on site and have the authority to immediately correct hazardous conditions. The name of the on-site representative shall be submitted to the General Contractor or Construction Manager prior to the Contractor beginning work.
4. First Aid - The General Contractor or Construction Manager will maintain a first aid center at the project office. Phone numbers of the local clinics and hospitals will be posted at all times.

1.22 SECURITY

- A. Provide security and facilities to protect work from unauthorized entry, vandalism, or theft.
- B. Coordinate with Owner's security program. Maintain all existing security during the contract period. Repair or replace all fencing and equipment damaged by construction activities.
- C. Provide Hospital Construction Master Keying System for access through temporary walls.
DOORS MUST BE ACCESSIBLE BY AUTHORIZED HOSPITAL PERSONEL AT ALL TIMES.

1.23 BARRIERS

- A. Provide barriers and signals to prevent unauthorized entry to construction areas, allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
 1. NOTE: Reinforced poly acceptable for 3 days or less, all other barriers need to be painted gypsum board or other approved temporary wall system. Owner has the right to remove or replace, as necessary.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plant life designated to remain. Replace damaged plant life. Provide barricades at drip lines at existing trees to remain.
- D. Protect stored materials, site and structures from damage.

1.24 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.25 INTERIOR ENCLOSURES

- A. Provide and maintain temporary partitions and ceilings as required to separate work areas from Owner occupied areas, to prevent penetration of dust and moisture into Owner occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces may be used if approved by the Owner. Otherwise temporary partitions shall be constructed as noted on the Construction Documents.
- C. Provide access doors in temporary protection where required for Owner, Contractor, and as required by code. Maintain proper negative air flow and monitor this condition throughout the construction of the project.

1.26 PROTECTION OF INSTALLED WORK

- A. Protect installed work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials. Use plank runways for wheeling over finished floors.

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

1.27 ACCESS ROADS

- A. Contractors shall maintain the streets and existing drives adjacent to the site clean and unobstructed from traffic and shall comply in all respects with the applicable City, State, and County laws.
- B. Provide and maintain access to fire hydrants, free of obstructions.
- C. Designated existing on-site roads may be used for construction traffic. Maintain in existing condition.

1.28 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.
- D. Remove waste materials, debris, and rubbish from site and dispose off-site.
- E. In remodel areas, clean the construction zone daily, or more often if debris or dust accumulates. Protect from dust migration and infiltration.
- F. Paved driveways on Owner's property and public streets and thoroughfares shall be kept clean, by cleaning daily or more often if necessary, of earth and debris spillage from vehicles involved in the construction operations.

1.29 PROJECT SIGNAGE

- A. Refer to Section 01 58 13 - Temporary Project Signage for requirements

1.30 REMOVAL OF TEMPORARY UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary above grade or buried utilities, equipment, facilities, materials, prior to Substantial Completion and inspection.
- B. Clean and repair damage caused by installation or use of temporary work.
- C. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to the specified condition.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 58 13
TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project identification signboard
- B. Project informational signs.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary

1.03 REFERENCE STANDARDS

- A. FHWA (SHS) - Standard Highway Signs and Markings; 2004, with Supplement (2012).

1.04 QUALITY ASSURANCE

- A. Design sign and structure to withstand 50 miles/hr wind velocity.
- B. Sign Painter: Experienced as a professional sign painter for minimum three years.
- C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.05 SUBMITTALS

- A. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing:
 - 1. Lumber is B or better Southern pine, pressure-preservative treated in accordance with AWPA C1 and AWPA C2. Nails are aluminum or galvanized steel.
- B. Sign Panel:
 - 1. Material: Grade B-B medium density overlaid exterior plywood.
 - 2. Thickness: 3/4 inch, minimum.
 - 3. Size: Minimum 4 by 8 foot (1200 by 2400 mm)
- C. Rough Hardware: Galvanized.
- D. Paint and Primers: Give one coat of exterior alkyd primer and two coats of exterior alkyd enamel paint to the entire signboard and supports.
- E. Lettering: Exterior quality paint, contrasting colors.

2.02 PROJECT IDENTIFICATION SIGN

- A. One painted sign of construction, design, and content indicated on drawings, location designated.
- B. Content:
 - 1. Project number, title, logo and name of Owner as indicated on Contract Documents.
 - 2. Names and titles of authorities.
 - 3. Names and titles of Architect and Consultants.
 - 4. Name of Prime Contractor and major Subcontractors.
- C. Graphic Design, Colors, Style of Lettering: Designated by Architect.
- D. Lettering: Standard Alphabet Series C, as specified in FHWA (SHS).

2.03 PROJECT INFORMATIONAL SIGNS

- A. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot distance.

- B. Provide at each field office, storage shed, and directional signs to direct traffic into and within site. Relocate as Work progress requires.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at designated location.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. Paint exposed surfaces of sign, supports, and framing.

3.02 MAINTENANCE

- A. Maintain signs and supports clean, repair deterioration and damage.

3.03 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area.

END OF SECTION

SECTION 01 60 00
PRODUCTS, MATERIALS, & EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. General Product Requirements
- B. Transportation and Hauling.
- C. Installation Requirements.
- D. Identifying Markings.
- E. Product Approval Standards.
- F. Installation of Products.
- G. Substitutions.

1.03 GENERAL PRODUCT REQUIREMENTS

- A. General: Provide products, materials, and equipment which comply with requirements, and which are undamaged and unused at time of installation, and which are complete with accessories, trim, finish, safety guards, and other devices and details needed for a complete installation for intended use and effect.
- B. Any product, material or piece of equipment that contains asbestos or other hazardous material is not acceptable.
- C. Standard Products: Where available, provide standard products of types which have been produced and used previously and successfully on other projects and in similar applications.
- D. Continued Availability: Where additional amounts of a product, by nature of its application, are likely to be needed by Owner at a later date for maintenance and repair or replacement work, provide a standard, domestically produced product which is likely to be available to Owner at such later date.

1.04 TRANSPORTATION AND HAULING

- A. Materials, products, and equipment shall be properly containerized, packaged, boxed and protected to prevent damage during transportation and handling.
- B. More detailed requirements for transportation and handling are specified under the technical sections.

1.05 INSTALLATION REQUIREMENTS

- A. Furnish, apply, install, connect, erect, clean and condition manufactured articles, materials, and equipment per manufacturers' printed directions, unless otherwise indicated or specified.
- B. Manufacturer's printed directions must be on job prior to and during installation of materials and equipment.
- C. Provide all attachment devices and materials necessary to secure materials together or to other materials and to secure work of other trades.
- D. Make field check of actual building dimensions before fabricating products.
- E. Where proper fit of work depends upon close tolerances of manufactured products, furnish manufacturer with necessary templates to insure proper fit of all components.
- F. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking or other disfigurement.
- G. Conduct work in a manner to avoid injury to previously placed work.

1.06 IDENTIFYING MARKINGS

- A. Name Plates: Except as otherwise indicated for required labels, and operating data, do not permanently attach or imprint manufacturer's or producer's nameplates or trademarks on exposed surfaces of products which will be exposed to view either in occupied spaces or on exterior of the work.
- B. Labels: Locate required product labels and stamps on a concealed surface or, where required for observation after installation, on an accessible surface which, in occupied spaces, is not conspicuous.
- C. Equipment Name Plates: Provide permanent nameplate on each item of service-connected or power operated equipment. Indicate manufacturer, product name, model number, serial number, capacity, speed, ratings and similar essential operating data. Locate name plates on an easily accessed surface which, in occupied spaces, is not conspicuous.

1.07 PRODUCT APPROVAL STANDARDS

- A. Definitions:
 - 1. The term product shall include materials, equipment, assembly methods, manufacturer, brand, trade name and other description.
 - 2. References to approved equal or similar items mean that approval of the Architect is required in writing.
- B. Where materials or equipment are described but not named, provide required first-quality items, adequate in every respect for the intended use; such items shall be subject to the Architect's approval prior to procurement.
- C. Proof of Compliance: Whenever the Contract Documents require that a product be in accordance with Federal Specifications, ASTM designation, ANSI Specification, or other association standard, the Contractor shall present an affidavit from the manufacturer certifying that the product complies therewith. When requested or specified, submit supporting test data to substantiate compliance.

1.08 INSTALLATION OF PRODUCTS

- A. General: Except as otherwise indicated, particularly in individual work sections of these specifications, comply with manufacturer's instructions and recommendations for installation of products in applications indicated. Anchor each product securely in place, accurately located and aligned with other work. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of acceptance.

1.09 SUBSTITUTIONS

- A. Substitutions Prior to Bid Date: For inclusion of products other than those specified, Bidders shall submit a request in writing at least ten (10) days prior to bid date. Requests received after this time will not be reviewed or considered regardless of cause. Requests shall clearly define and describe the product for which inclusion is requested. Inclusion by the Architect will be in the form of an addendum to the specifications, issued to all bidders on record.
 - 1. The burden of proof of the merit of the proposed substitution is upon the proposer and shall provide a feature by feature comparison of the specified (approved) product or material, with the proposed substitution. Submissions without a thorough comparison chart will not be considered. The substitution shall not cause the cost of the project to increase. The Owner and Architect's decision of approval or disapproval of a proposed substitution shall be final.
- B. Substitutions after Award of Contract: Substitution of products will be considered after award of contract only under one of the following conditions:
 - 1. When the specified product is not available, a proposed substitution will not be considered unless proof is submitted that firm orders were placed within ten (10) days after review by the Architect of the item listed in the specification, or the unavailability is due to a strike, lockout, bankruptcy, discontinuance of the manufacturer of a product, or natural disasters.

2. When a guarantee of performance is required and, in the judgment of the Contractor, the specified product or process will not produce the desired results.
 3. Request for such substitution shall be made in writing to the Architect within ten (10) days of the date that the contractor ascertains he cannot obtain the material or equipment specified, or that the performance cannot be guaranteed.
- C. Procedures Respecting Substitutions:
1. Materials and equipment proposed for substitution shall be equal or superior to that specified in construction, efficiency, utility, aesthetic design, and color, as determined by the Architect, whose decision shall be final and without further recourse. Physical size of substitute brand shall not be larger than the space provided for it. Requests must be accompanied by full description and technical data, in two copies, including manufacturer's name, model, catalog number, photographs or cuts, physical dimensions, operating characteristics, and any other information necessary for comparison.
 2. Permission to make any substitution after award of the contract shall be affected by a no cost Change Order. It shall not relieve the Contractor, any subcontractor, manufacturer fabricator or supplier from responsibility for any deficiency that may exist in the substituted product or for any departures or deviations from the requirements of the contract documents, as modified by such Change Order. Except as otherwise expressly specified by the contractor in his request for substitution and shall be deemed to warranty by his request that the proposed substituted product will satisfy all standards and requirements satisfied by the originally specified product and the Change Order shall not be deemed to modify the contract documents with respect thereto.
 3. If any substitution will affect a correlated function, adjacent construction, or the work of other trades or contractors, the necessary changes and modifications to the affected work shall be considered as an essential part of the proposed substitution, to be accomplished by the contractor without additional expense to the Owner, if and when accepted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 65 00
STARTING OF SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Starting systems.
- B. Demonstration and instructions.
- C. Testing, adjusting, and balancing.

1.03 STARTING SYSTEMS

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner's Representative seven days prior to start-up of each item. All start-up of systems shall be done as directed by the Owner. Owner shall notify the Architect that all systems are operating as designed before final payment will be released. A third party commissioning agent may be engaged. Mechanical contractor to coordinate with Owner and Commissioning Agent on all system start-ups, if required.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, or other conditions which may cause damage.
- D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of responsible manufacturer's representative and Contractor's personnel in accordance with manufacturer's instructions.
- G. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 014000 that equipment or system has been properly installed and is functioning correctly.

1.04 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project Equipment by a qualified Manufacturer's Representative who is knowledgeable about the project.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate start-up, operation, control, adjustment, trouble shooting, serving, maintenance, and shutdown of each item of equipment at schedule agreed on times and at designated location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. The amount of time required for instruction on each item of equipment and system is as needed or that specified in individual sections.

1.05 TESTING, ADJUSTING, AND BALANCING

- A. The mechanical contractor will appoint, employ, and pay for services of an independent firm to perform testing, adjusting, and balancing in a timely manner.
- B. Reports will be submitted by the independent firm to the Architect indicating compliance or noncompliance with specified requirements and with the requirements of the contract documents.

PART 2- PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 70 00
CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Substantial Completion.
- B. Final Cleaning.
- C. Adjusting.
- D. Project Record Documents.
- E. Operation and Maintenance Data.
- F. Warranties.
- G. Final Lien Waivers
- H. Spare Parts and Maintenance Materials.
- I. Documents required for Closeout.

1.03 RELATED REQUIREMENTS

- A. Section 00 01 35 - Project Closeout Checklist
- B. Section 01 78 10 - Asset Inventory

1.04 PROCEDURES PRIOR TO SUBSTANTIAL COMPLETION

- A. Prior to requesting an inspection for Substantial Completion, the Construction Manager or General Contractor shall complete the following:
 - 1. Punch List Inspection: Prepare and submit to Architect a comprehensive list of items to be completed and corrected (punch list), the value of each item on the list, and the reason why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Certificates of Release: Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 4. Submit completed Asset Inventory Forms. Refer to Section 01 78 10 - Asset Inventory
 - 5. Submit Record Drawings, operation and maintenance manuals, photographic documentation, and similar documents.
 - 6. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 7. Deliver tools, spare parts, extra materials, and similar items to a location determined by the Owner.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.
 - 8. Make final changeover of permanent locks and deliver keys to Owner.
 - 9. Complete startup testing of systems and equipment.
 - 10. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 11. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
 - 12. Participate with Owner in conducting inspection and walkthrough with local jurisdictions having authority.
 - 13. Remove temporary facilities and controls.

14. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
15. Complete final cleaning requirements, including touchup painting.
16. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

1.05 PROCEDURES FOR SUBSTANTIAL COMPLETION

- A. Upon completion of the items above, the Construction Manager or General Contractor shall submit a written request to the Architect for inspection for Substantial Completion. On receipt of request, Architect will proceed with inspection or advise Contractor of unfulfilled requirements.
 1. Architect will prepare the Certificate of Substantial Completion after inspection or will advise Contractor of items that must be completed or corrected before certificate will be issued.
 2. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
 3. Results of completed inspection will form the basis of requirements for final completion.

1.06 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. Use CSI Form 14.1A or other form acceptable to Architect.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect will return annotated file.
 - b. PDF electronic file. Architect will return annotated file.

1.07 FINAL CLEANING

- A. Execute final cleaning prior to final inspection. Owner will not take possession until they have approved final cleaning.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to a sanitary condition. Clean all lighting fixtures in areas affected by construction.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.08 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation. Follow scope as directed by Owner or third-party commissioning agent.

1.09 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the work:
 1. Contract Drawings.
 2. Project Manual.
 3. Addenda.
 4. Change Orders and other Modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
- B. Store Record Documents separate from documents used for construction.
- C. Record information concurrent with construction progress.

- D. Project Manual: Legibly mark and record at each product section description of actual products installed including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and Modifications.
- E. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
- F. Measured depths of foundations in relation to finish first or main floor datum.
 - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
 - 3. Field changes of dimension and detail.
 - 4. Details not on original contract drawings.
- G. Submit documents to Architect in electronic format with claim for final application for payment.

1.10 OPERATION AND MAINTENANCE DATA

- A. Submit two (2) hard copy sets prior to final inspection, bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable plastic covers or via electronic disk as deemed by Architect and Owner based on project scope. All O&M data and information shall be compatible for upload into the Owner's Facility Maintenance Management System. Confirm with Owner on requirements.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, (and subject matter of binder when multiple binders are required).
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, type on 24-pound white paper.
- E. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, major equipment suppliers.
- F. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
 - 1. Significant design criteria.
 - 2. List of equipment.
 - 3. Parts list for each component.
 - 4. Starting and operating instructions, end of season shutdown instructions.
 - 5. Maintenance instructions and schedules for equipment and systems.
 - 6. Maintenance instructions and schedule for (special) finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
- G. Part 3: Project documents and certificates, including the following:
 - 1. Shop drawings and product data.
 - 2. Air and water balance reports.
 - 3. Certificates.
 - 4. Photocopies of warranties. When warranty certificates are not available, a description of the manufacturer's standard warranty shall be acceptable.
- H. Submit one copy of completed volumes in final form two weeks prior to date of Substantial Completion. This copy will be returned (after final inspection), with Architect comments. Revise content of documents as required prior to final submittal.
- I. Submit final volumes revised, within ten days after final inspection. The final submission shall include any electronic copies as directed by the Owner.

1.11 WARRANTIES

- A. Bind in commercial quality, 8-1/2 x 11 inch three-ring side binders with hardback, cleanable, plastic covers or via electronic disk as deemed appropriate by Owner.
- B. Label cover of each binder with types or printed title WARRANTIES AND BONDS with title of project, name, address and telephone number of contractor and equipment supplier; and name of responsible individual.
- C. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of the product or work item.
- D. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, suppliers, and manufacturer, with name, address, and telephone number of responsible principals.
- E. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable time or work. Include items put into use with Owner's permission. Date of beginning of time of warranty shall be the Date of Substantial Completion.
- F. Verify that warranties are in proper form, contain full information, and are notarized.
- G. Co-execute submittals when required.
- H. Retain warranties and bonds until time specified for submittal.
- I. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
- J. For items of work when acceptance is delayed beyond date of substantial completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

1.12 FINAL LIEN WAIVER

- A. An executed Final Lien Waiver from the contractor and his subcontractors must be submitted with the contractor's final application for payment.

1.13 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification sections.
- B. Deliver to project site and place in location as directed; obtain receipt prior to final payment.

1.14 PROJECT CLOSEOUT CHECKLIST

- A. Refer to Document 00 01 35 - Project Closeout Checklist, for requirements

1.15 DOCUMENTS REQUIRED FOR CLOSE-OUT

- A. The following documents will be utilized during the closeout of all construction projects. They include:
 - 1. Project Closeout Checklist
 - 2. Certificate of Substantial Completion (AIA Document G704).
 - 3. Contractor's Partial Lien Waiver and Affidavits.
 - 4. Contractor's Final Release and Waiver of Lien.
 - 5. Consent of Surety Company to Final Payment (AIA Document G707).
 - 6. Consent of Surety to Reduction in or Partial Release of Retainage (AIA Document G707A).
 - 7. Any other documents, as notified in advance by Owner, specific to project, operations and/or policies instituted by Saint Luke's Health System.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 10
ASSET INVENTORY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Asset Inventory, including the following:
 - 1. Equipment Assets
 - 2. Doors
 - 3. Isolation Rooms
 - 4. Sleep Rooms
 - 5. Soiled Utility Rooms
 - 6. Clean Utility Rooms
 - 7. Medical Gas Zone Valves
 - 8. Exit Signs
 - 9. Smoke Detectors
 - 10. Heat Detectors
 - 11. Duct Detectors
 - 12. Smoke / Fire Dampers
 - 13. Pull Stations
 - 14. Audible Devices
 - 15. Fire Suppression Zones
 - 16. Security Cameras
 - 17. Card Readers
 - 18. TV's
 - 19. Pneumatic Tubes

1.03 RELATED REQUIREMENTS

- A. Section 01 70 00 - Contract Closeout

1.04 SUBMITTALS

- A. Asset Inventory Forms: The Contractor shall submit an asset inventory form for each of the items listed in Heading 1.02. The required forms are included after the last page of this Section.
- B. Submit one (1) electronic copy and two (2) sets of paper copies of the Asset Inventory Forms prior to final inspection

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PREPARATION

- A. Ensure entries are complete and accurate, enabling future reference by Owner.
- B. Record information concurrent with construction progress.
- C. Distribution:
 - 1. Provide two (2) paper copies of the Asset Inventory Forms for use by the Owner.
 - 2. Electronic File: Scan all documents and assemble into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

3.02 ASSET INVENTORY FORMS

- A. The Asset Inventory Forms are attached after this page. An electronic copy of the forms (Excel Spreadsheet format) will be provided upon request

END OF SECTION

SECTION 01 91 13
GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with the Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with the Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 4. Verify that the Owner's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.

1.03 SCOPE OF COMMISSIONING

- A. The following are to be commissioned:
- B. Fire Protection Systems.
- C. Plumbing Systems:
- D. HVAC System, including:
 - 1. Major and minor equipment items.
 - 2. Piping systems and equipment.
 - 3. Ductwork and accessories.
 - 4. Terminal units.
 - 5. Control system.
- E. Electrical Systems:
 - 1. Power quality.
 - 2. Emergency power systems.
 - 3. Uninterruptible power systems.
 - 4. Lighting controls other than manual switches.
- F. Electronic Safety and Security:
 - 1. Security system, including doors and hardware.
 - 2. Fire and smoke alarms.
- G. Communications:
 - 1. Voice and data systems.
 - 2. Public address/paging.
- H. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.04 RELATED REQUIREMENTS

- A. Section 01 77 00 - Closeout Procedures
- B. Section 01 78 00 - Closeout Submittals
- C. Section 01 79 00 - Demonstration and Training

D. Division 23 - Commissioning of HVAC Systems

1.05 REFERENCE STANDARDS

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority, unless they require review by Architect; in that case, submit to Architect first.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
 - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.
 - 2. Manufacturer's installation instructions.
 - 3. Startup, operating, and troubleshooting procedures.
 - 4. Fan and pump curves.
 - 5. Factory test reports.
 - 6. Warranty information, including details of Owner's responsibilities in regard to keeping warranties in force.
- C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.
- F. Commissioning Issues Log:
 - 1. Construction observations.
 - 2. Supporting photographs.

1.07 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
- B. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of Owner.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

- A. Commissioning Authority will prepare the Commissioning Plan.
 - 1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 - 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
- D. Commissioning Schedule:
 - 1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 - 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 - 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.03 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.
 - 1. No sampling of identical or near-identical items is allowed.
 - 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 - 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.
 - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
 - 1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.

2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
4. If any Checklist line item is not relevant, record reasons on the form.
5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
7. Submit completed Checklists to Commissioning Authority within two days of completion.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
 1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in the Contract Documents.
 2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in the Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
 1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.
 1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.04 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to Owner; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
 1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents or does not perform properly.
 2. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
 3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.

4. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing.
 5. Contractor shall bear the cost of Owner and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:
1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in the Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
 2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.05 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.
- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.

3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg.
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.06 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
 1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.

2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 2. Other points will be monitored by the Commissioning Authority using dataloggers.
 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
 5. Graphical output is desirable and is required for all output if the system can produce it.
 6. Monitoring may be used to augment manual testing.

3.07 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to Owner.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.

- D. Commissioning Authority will add commissioning records to manuals after submission to Owner.

END OF SECTION

SECTION 02 30 50
AVAILABLE SITE INFORMATION

PART 1 GENERAL

1.01 EXISTING SITE CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders.
- B. Neither the Owner nor the Architect guarantees the accuracy and completeness of information and data provided on the survey and geotechnical report, including that concerning type and location of underground materials and utilities.
- C. Report discrepancies between conditions shown and actual conditions to the Architect.

1.02 SITE TOPOGRAPHIC SURVEY

- A. Topographic Survey: Prepared by Insert Civil Name
 - 1. Availability:
 - a. Electronic copy will be available from Insert Civil Name
 - 2. This survey identifies grade elevations prepared primarily for the use in establishing new grades, identifying natural water shed, and other site features.
 - 3. Surveys are for Contractor's review and information only. Bidder's are responsible for verifying elevations and measurements, and for making their own determination of site conditions the survey as may be necessary to prepare their bids and perform the Work.
 - a. Variations between conditions indicated and actual conditions will not be considered reason for change in Contract amount or time.

1.03 GEOTECHNICAL REPORT

- A. Geotechnical Report: Prepared by Insert Geotech Name (Insert Geotech Address), dated mm/dd/yyyy.
 - 1. Availability:
 - a. A copy of the geotechnical report is included in the Project Manual after the last page of this Section.
- B. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
- C. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
- D. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Price accruing to Owner.
- E. Geotechnical Report is for Bidder's and Contractor's review and information only. Contractor's and Bidder's are responsible for making their own determination of site conditions as may be necessary to prepare their bids and perform the Work.
 - 1. Variations between conditions indicated and actual conditions will not be considered reason for change in Contract amount or time.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 02 41 00
SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Saint Luke's Health System - Pre-Construction Risk Assessment Form.

1.02 SECTION INCLUDES

- A. Demolition and removal of selected portions of existing building construction.
- B. Salvage of existing items to be reused or recycled.
- C. Non-profit Donations of removed materials.

1.03 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse and relocate to a storage location designated by the Owner.
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor. A demolition survey shall be completed prior to the start of construction to categorize materials schedule for removal and the proper disposal based on options described by this section.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
 - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
 - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
 - 3. Coordination for shutoff, capping, and continuation of utility services. Awareness of any utility disruptions to adjacent occupied areas shall be noted.
 - 4. Use of elevator and stairs.
 - 5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Pre-demolition Photographs or Video: Submit before Work begins.

- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition. Coordinate with the Owner.

1.06 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

1.07 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.
- B. Specialty Removal Item: If the demolition inventory lists a specialty item for removal, Contractor shall submit certifications that the entity removing the item possess the qualifications to handle and properly dispose of scheduled materials.

1.08 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before selective demolition, Owner will remove the following items:
 - a. Refer to the Drawings.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. Hazardous materials will be removed by Owner before start of the Work.
 - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

- D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
 - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
 - 1. Contractor shall identify and maintain awareness of emergency shut-offs both in and adjacent to demolition areas.
 - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.02 UTILITY SERVICES AND MECHANICAL / ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
 - 1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Administrative Requirements"
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor. Advanced pre-approval required. Strict adherence to Saint Luke's Health System guidelines shall be followed.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

3.03 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
 - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.04 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 9. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.05 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- C. Core drills in existing concrete/ masonry structure: Existing utilities tie-ins require the Contractor to x-ray the existing concrete and document reinforcement found. Approval from the design team is required before making any penetrations for utility tie-ins.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

3.06 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site.
 - 1. Do not allow demolished materials to accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Saint Luke's Health System has a goal of recycling 50% of all construction debris from projects. The Contractor shall submit a recycling plan for approval by the Owner. Track and document waste streams by quantity for each material type or provide a haul ticket and summary of haul tickets to document the waste streams as sorted at a facility if materials are commingled. All proceeds from recycled materials shall be returned to the Owner.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.07 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.08 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Construction to Be Removed: Refer to Drawings for extent.
- B. Existing Items to Be Removed and Salvaged: Refer to Drawings for extent.
- C. Existing Items to Be Removed and Reinstalled: Refer to Drawings for extent.
- D. Existing Items to Remain: Refer to Drawings for extent.

END OF SECTION

SECTION 03 05 05
UNDERSLAB VAPOR BARRIER

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

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

1.03 RELATED REQUIREMENTS

Section 03 30 00 - Cast-in-Place Concrete

1.04 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2011.

1.05 SUBMITTALS

- A. 013300 - Submittal Procedures for requirements.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Samples: Submit samples of underslab vapor barrier to be used.
- E. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Stego Industries, LLC (P: (877) 464-7834 / Email: contact@stegoindustries.com / Web: www.stegoindustries.com)
 - 1. Other Acceptable Manufacturer: Equivalent products of the manufacturer's listed below will be acceptable.
 - a. Fortifiber Corporation: Moistop Ultra.
 - b. Raven Industries Inc.: Vapor Block.
 - c. Poly-America, LP: Husky Yellow Guard.
 - d. Insulation Solutions, Inc.: Viper Vaporcheck.

2.02 MATERIALS

- A. Product: Stego® Wrap Vapor Barrier.
 - 1. Performance Criteria:
 - a. Water Vapor Permeance: Not more than 0.010 perms (maximum) when tested in accordance with ASTM E1745, Class A.
 - b. Strength: ASTM E1745, Class A.
 - c. Thickness: 15 mils minimum.
 - d. Provide third party documentation that all testing was performed on a single production roll per ASTM E1745, Section 8.1.

2.03 ACCESSORIES

- A. Seams:
 - 1. Stego Tape
- B. Sealing Penetrations of Vapor barrier:
 - 1. Stego Mastic.
 - 2. Stego Tape.

- C. Perimeter/Edge seal:
 - 1. Stego Crete Claw.
 - 2. Stego Term Bar.
 - 3. StegoTack Tape (double-sided sealant tape).
- D. Penetration Prevention:
 - 1. Beast Foot.
- E. Vapor Barrier-Safe Screed System
 - 1. Beast Screed.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade.
- C. Install vapor barrier on top of the granular fill.
- D. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
- E. Extend vapor barrier to the perimeter of the slab. Terminate it at the top of the slab.
- F. Lap joints minimum 6 inches.
- G. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- H. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- I. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

SECTION 03 30 06

CONCRETE MOISTURE VAPOR REDUCTION ADMIXTURE (MVRA)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Concrete moisture vapor reducing admixture (from here on referred to as 'MVRA'). Use for new concrete slabs-on-grade.
- B. Accessory materials.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 09 05 61 - Common Work Results for Flooring Preparation

1.04 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; 1991 (Reapproved 2009).
- B. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2016.
- C. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2016a.
- D. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2012).
- E. ASTM D5084 - Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter; 2016a.
- F. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- G. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2011.

1.05 ADMINISTRATIVE REQUIREMENTS

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

1.06 DEFINITIONS

- A. MVRA: Moisture Vapor Reduction Admixture

1.07 SUBMITTALS

- A. Product Data: Submit manufacturers' data sheets.
 - 1. Include standard slab repair details.
- B. Mix Design: Submit manufacturer approval of proposed concrete mix design.
- C. Material Certificate: Certify that products of this section meet or exceed specified requirements.
- D. Field Quality Control Submittals: Include project name and number, date of admixture application, name of testing agency, location of concrete batch in work, mix proportions, materials, and test result.
- E. Sample warranty

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm with not less than 10 years experience in manufacturing concrete water vapor reducing admixture of the type specified, capable of providing test reports indicating compliance with specified performance requirements, and able to provide on-site technical representation. Selected product must have ASTM C494 Type S Concrete Admixture approval from and independent AASHTO approved laboratory.

- B. Preinstallation Conference: Conduct conference at project site with Contractor, concrete water vapor reducing admixture manufacturer or authorized representative, concrete supplier, and concrete finisher to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements. Concrete suppliers and finishers must be certified.
- C. Concrete Supplier Qualifications: The concrete supplier must be Certified by the WVRA manufacturer prior to bid, Certificates issued by the manufacturer must be submitted with bid documents.
- D. Concrete Finishers Qualifications: The concrete finisher must be Certified by the WVRA manufacturer prior to bid, Certificates issued by the manufacturer must be submitted with bid documents
- E. Single Source Responsibility: Single source product from one manufacturer.
- F. Toxicity/Hazardous Materials: Provide products that contain no urea-formaldehyde.
- G. Repairs to slabs must be in accordance with concrete industry standards and meeting waterproofing admixture manufacturer's published details.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturers written instructions and recommendations prior to adding MVRA to concrete batch.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

1.10 PROJECT CONDITIONS

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

1.11 WARRANTY

- A. Manufacturer Warranty: Manufacturer shall warrant the products specified in this Section shall be free defects in material and workmanship for a period of ten (10) years from Date of Substantial Completion.
 - 1. During the specified warranty period, provide coverage for:
 - a. Repair or removal of failed flooring or roofing.
 - b. Placement of topical moisture remediation system.
 - c. Replacement of flooring materials to match original including material and labor.
 - 2. Submit a written warranty to the Owner, executed by the Contractor, subcontractor, and the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Specialty Products Group (SPG); P: 877-957-4626 / Email: info@spggogreen.com / Web: www.spggogreen.com.
 - 1. Other Acceptable Manufacturers: None identified. No substitutions will be considered or accepted.

2.02 MOISTURE VAPOR REDUCTION ADMIXTURE

- A. Product: SPG; Vapor Lock 20/20, ASTM C494/C494M, Type S; complex catalyzed hydrous silicate, water and vapor proofing liquid admixture.
- B. Performance characteristics:
 - 1. Waterproofing (ASTM D5084): 1 x 10⁻⁸ cm/s permeability minimum.
 - 2. Flammability: None.
 - 3. Capillary Break: Calcium silicate hydrate.
 - 4. Water Vapor Permeance: 0.03 perms, maximum, when tested in accordance with ASTM E96/E96M.
 - 5. Toxicity: None.

6. pH: 10 - 12
7. Solvent: Water.
8. Acid Resistance: Excellent.
9. Hazardous Vapors: None.
10. VOC Levels: Zero (0).
11. Inhibit mold and bacteria growth by eliminating moisture vapor emission.

- C. Location: Provide admixture in all new horizontal concrete slabs to receive adhesively applied flooring and roofing.

2.03 RELATED MATERIALS

- A. Underslab Vapor Barrier: Refer to Section 03 05 05.

2.04 CONCRETE MIX DESIGN

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

2.05 MIXES

- A. Add MVRA to concrete mix in accordance with manufacturers instructions.
- B. Add MRVA directly to freshly mixed concrete at end of the batch process with tail water.
- C. Ready-Mixed Concrete:
1. Measure, batch, mix, and deliver concrete with MVRA in accordance with ASTM C94/C94M.
 2. Furnish batch ticket information showing dosage of MVRA.
- D. Freshening on-site with held back mix water is acceptable if in accordance with ACI guidelines and if amount does not exceed original water to cementitious material ratio.
- E. Use water reducing admixtures to achieve desired slump.
- F. Use of other admixtures in same batch as MVRA is acceptable if each admixture is added separately.
- G. Do not use shrink reducing admixtures.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with requirements of Section 03 30 00 for concrete mixing, placement, and curing.
- B. Sheet Vapor Retarders for Slabs on Grade: Place, protect, and repair sheet vapor retarder under provisions of ASTM E1643 and manufacturer's written instructions.
- C. Add water vapor reducing admixture to concrete in accordance with supplier's written instructions.
- D. Obtain approval of the MVRA supplier for the mix design. MVRA supplier will provide specific testing and warranty information in accordance with application requirements.
- E. Notify MVRA supplier a minimum of 10 days prior to the placement of the first batch of treated concrete.
- F. Dispense MVRA in compliance with mix design and supplier's recommendations.
- G. The use of other admixtures with MVRA in the same concrete batch is acceptable when included in the approved mix design.

3.02 CURING

- A. Curing is typically not necessary for MVRA treated slabs except in hot, cold, rainy or windy conditions. Cure finished concrete by placing 2-mil thick polyethylene plastic on top of the concrete slab. Consult with MVRA manufacturer for additional recommendations in accordance with application requirements.

3.03 FIELD QUALITY CONTROL

- A. Contractor provide access to concrete operations at project site and cooperate with appointed testing agency.
- B. Slab Testing: Cooperate with manufacturer of specified MVRA to allow access for sampling and testing concrete for compliance with warranty requirements.
- C. Maintain four concrete cylinders for one year from date of Substantial Completion.
- D. Test cylinders as required by warranty or in accordance with supplier's recommendations.
- E. Test cylinders to demonstrate that the minimum waterproofing is 6×10^{-8} cm/s in accordance with ASTM D5084.
- F. Frequency: Test one (1) cylinder per project with the cost borne by the admixture supplier.
- G. Moisture Testing: The MVRA supplier will perform all field moisture testing using ASTM D4263 "Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method-Modified for Numerical Value". Ambient conditions shall be 70 F and 50% Relative Humidity and the moisture rise shall be no more than 0.5%. Consult with manufacturer for testing protocols.
- H. Bond Testing: Warranted moisture sensitive coatings and adhesives must be installed by each subcontractor in coordination with MVRA manufacturer. Bond test results will be evaluated by MVRA manufacturer as part of the Warranty process.
- I. Field Quality Control Reports:
 - 1. Submit test results to Architect, Contractor, and MVRA SUPPLIER, within 48 hours of testing.
 - 2. Include project name, project number, date of admixture application, name of testing agency, location of concrete in the Work, concrete mix design, and waterproofing capability.
- J. Additional Tests: Testing agency shall make additional tests of concrete when test results indicate that water vapor reducing admixture capability requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders or by other methods as directed by Architect.
- K. Additional testing, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- L. Correct deficiencies in the Work that test reports indicate do not comply with the Contract Documents.

3.04 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 48 hours of test.
- B. Defective Concrete: Concrete not complying with specified requirements.
- C. When test results indicate concrete does not comply with specified requirements, conducts additional tests as directed by Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.

3.05 REPAIRS

- A. Repair concrete slabs in accordance with other Division 03 sections and as recommended in manufacturer's written instructions.

END OF SECTION

SECTION 03 30 30
CONCRETE WORK - PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Furnishing of all necessary materials, labor and equipment, mixing, placing and furnishing of all plain and reinforced concrete for patching of existing concrete floor slabs for Work indicated on the drawings.

1.03 RELATED REQUIREMENTS

- A. Section 02 41 00 - Selective Demolition
- B. Section 03 30 00 - Cast-in-Place Concrete
- C. Section 03 81 00 - Concrete Sawcutting and Core-Drilling

1.04 SUBMITTALS

- A. Concrete Mix Designs: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and accessories.
 - 3. Joint-filler strips.
- C. Test Reports

1.05 QUALITY ASSURANCE

- A. Contractor shall be qualified / experienced in concrete patching of this type.
- B. Comply with governing codes and regulations.

1.06 CONCRETE TESTING

- A. Not required.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Portland Cement: Conforming to ASTM C150/C150M, Type I or III.
- B. Aggregates: Shall conform to the standard specifications for concrete aggregates (ASTM C33/C33M) with all subsequent amendments thereto.
 - 1. Coarse Aggregate: Clean, hard, durable, uncoated, crushed limestone conforming to the quality and gradation requirements of ASTM C33/C33M. Maximum size aggregate allowed shall be 3/4" for construction less than 6" in thickness.
 - a. Coarse Aggregate for lightweight concrete shall conform to ASTM C330/C330M.
 - 2. Fine Aggregate: Shall conform to ASTM C33/C33M.
- C. Water: Shall be clean and free from deleterious substances, oils, acids, alkalis, or organic materials.
- D. Admixtures: Not required.

2.02 GRANULAR FILL

- A. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D448, Size 57, with 100 percent passing a 1-1/2-inch (37.5-mm) sieve and 0 to 5 percent passing a No. 8 (2.36-mm) sieve placed below the vapor retarder.
 - 1. Install and compact at 4 inches minimum depth, unless otherwise indicated on the Drawings.

2.03 JOINTING PRODUCTS

- A. Slab Expansion and Isolation Joint Filler Strips: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.

2.04 REINFORCING

- A. All bars shall be billet steel conforming to ASTM A615/A615M, grade 60 steel for #5 bars and greater and grade 40 steel for #4 and under.
- B. Steel Welded Wire Fabric (WWF): Galvanized, plain type, ASTM A1064/A1064M.
 - 1. Form: Flat Sheets.
 - 2. WWF Style: 6 x 12-W12 x W5.
- C. Reinforcing Accessories;
 - 1. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.
 - 2. Bar Supports: Bolsters, spacers, chairs, ties, and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place shall be used according to the latest edition of the Concrete Reinforcing Steel Institute Manual.

PART 3 EXECUTION

3.01 CONCRETE QUALITY

- A. The Contractor shall guarantee concrete with the following minimums
 - 1. Cast-in-place structural concrete shall be 3,500 psi design strength using not less than 500 pounds of cement per cubic yard and not more than 6 gallons of water per 100 pounds of cement with aggregate specified.
- B. Normal Weight Concrete
 - 1. Shall be used throughout the project (structural and non-structural).
 - 2. Prior to placing any concrete, the Contractor shall submit for review by the Architect a mix design for each type of concrete proposed for use by each concrete supplier, substantiated by a laboratory report attesting to the concrete properties, including compressive strength and splitting strength.
 - 3. Upon approval, the Contractor shall not change suppliers except upon written authorization by the Architect.
- C. Mixing Concrete
 - 1. The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged.
 - 2. Ready-mixed concrete shall be mixed and delivered in accordance with ASTM C94/C94M with all subsequent amendments thereto.
 - 3. Maximum Slump: 4".
- D. Placing Concrete
 - 1. Placement shall be planned well in advance so that all sections of a particular area may be poured in one continuous operation.
 - 2. Before Concrete is placed, all debris and foreign material shall be removed from the area to be poured. All reinforcing and any special metal parts or shapes shall be properly set into position.
 - 3. Transporting: Concrete shall be handled from carts, buggies, or wheelbarrows. Every possible precaution shall be taken to prevent separation or loss of the ingredients while transporting the concrete.

- 4. Placing: Troughs, Pipes and Chutes
 - a. Concrete shall not be dropped freely a distance of more than five (5) feet.
 - b. Placing of any given section shall be done in a continuous operation.
- E. Extra water shall not be added to the concrete mix at the job site.
- F. Placing Time:
 - 1. The elapsed time between proportioning of materials, including cement, and placing of concrete in its final position shall never exceed 90 minutes.
 - 2. Concrete shall never remain on the job site for more than 60 minutes without being placed.

3.02 BENDING AND PLACING REINFORCING STEEL

- A. Cleaning and Bending Reinforcement:
 - 1. Metal reinforcement, at the time concrete is placed shall be free from rust, scale or other coatings that will destroy or reduce the bond.
 - 2. Bends for other bars shall be made around a pin having a diameter of not less than six times the minimum thickness of the bar except that for bars larger than 1 inch, the pin shall be not less than eight times the minimum thickness of the bar.
 - 3. All bars shall be bent cold.
- B. Placing Reinforcement:
 - 1. Metal reinforcement shall be accurately placed in accordance with the Drawings and shall be adequately secured in position by concrete or metal chairs and spacers.

3.03 FINISHING

- A. Flatwork slabs shall be poured monolithic, leveled with a straight edge screed in a sawing motion of a strike-off board.
 - 1. Finish to match existing/adjacent concrete surfaces.
 - 2. Interior slabs, shall be floated and finished with steel trowel.
 - 3. Floating shall not start until water sheen has disappeared or concrete has stiffened enough to prevent excess fine material working to the surface.

3.04 TOLERANCES:

- A. Allowable tolerance from level or grade shall be 1/4" in 10 feet measured with a straight edge in any direction.

END OF SECTION

SECTION 03 81 00
CONCRETE CUTTING AND BORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Slab Sawing: Precision sawcutting of openings in steel-reinforced concrete floor construction.
- B. Wall Sawing (Track Sawing): Precision sawcutting of openings with precisely plumb, level or beveled edges in steel-reinforce concrete walls, masonry walls, and precast concrete wall construction.
- C. Core-Drilling: Drilling of round holes in steel-reinforced concrete, precast concrete, and masonry construction.

1.03 RELATED REQUIREMENTS

- A. Section 02 41 00 - Selective Demolition
- B. Section 03 30 30 - Concrete Work - Patching

1.04 REFERENCE STANDARDS

- A. Occupational Safety and Health Administration - Safety and Health Standards Digest Construction Industry (OSHA).
- B. ANSI B-7.1 and B-7.5 Standards.

1.05 DEFINITIONS

- A. Slab Sawing: Precision sawcutting of openings in steel-reinforced concrete floor construction.
- B. Wall Sawing (Track Sawing): Precision sawcutting of openings with precisely plumb, level or beveled edges in steel-reinforce concrete walls, masonry walls, and precast concrete wall construction.
- C. Wire Sawing: Precision sawcutting of sections of steel-reinforced concrete, precast concrete, and masonry construction to virtually any size and volume; Capable of cutting complex and irregular shapes; Capable of not over-cutting at the corners.
- D. Core-Drilling: Drilling of round holes in steel-reinforced concrete, precast concrete, and masonry construction.

1.06 PRE-JOB CONFERENCE

- A. Pre-Job Conference: Conduct conference at Project site.
 - 1. Inspect and discuss condition of construction to be sawcut or core-drilled.
 - 2. Review and finalize construction schedule and verify availability of materials, personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review requirements of work performed by other trades that rely on the sawcutting or core-drilling operation.
 - 4. Review areas where existing construction is to remain that requires protection from sawcutting or core-drilling operation.

1.07 SUBMITTALS

- A. Sawcutting or core-drilling procedures and operational sequence for review and acceptance.

1.08 QUALITY ASSURANCE

- A. Contractor shall be qualified/experienced in sawcutting or core-drilling materials of this type.
- B. Comply with governing codes and regulations.
- C. Contractor shall adhere to all applicable safety guidelines in accordance with Federal, State and local ordinances.

- D. Contractor shall be responsible for the design and installation of any bracing or shoring required to make sure that the material being sawed free is supported in a safe and effective manner so that when the piece is cut free, it is retained in place, causing no damage to persons, equipment or adjacent structures.

1.09 PROJECT CONDITIONS

- A. Scaffolding required by the Contractor shall be designed, provided by and erected by competent personnel according to code requirements.
- B. Shoring:
 - 1. Shore cut material to protect personnel, adjacent structures, equipment, etc.
 - 2. Shore cut material to prevent displacement upon completion of the saw cut.
- C. Provide rigging and lifting equipment and personnel to remove cut off material from the work area as soon as practical and in the safest manner possible.

1.10 COORDINATION

- A. The Contractor must determine if there are utility lines contained within, adjacent to or secured to the structure being sawcut or core-drilled.
 - 1. If utility lines are present as described, the Contractor must take the necessary action to have all services for these utilities cut off.
 - 2. If utility lines are suspected of being buried, the Contractor must call the appropriate agency for accurate utility location as state or local regulation may require.
- B. Locate existing pipe, conduit, structure, etc. prior to any sawcutting or core-drilling; interior and exterior.
- C. If an unknown utility line is unintentionally sawcut or core-drilled though, the Contractor shall immediately notify the Architect.
- D. Locate all steel reinforcement in the structure to be sawcut or core-drilled, and verify that the location of the cut lines will not split any piece of reinforcement. Propose and receive approval of an alternative cut location if required.

1.11 SAFETY REQUIREMENTS

- A. Provide adequate safety provisions to protect the operator's work area, including below, above, and adjacent to the area being cut or drilled.
- B. Provide safe access to and from the work area.
- C. Provide barricades, cones, warning tape or other devices used to keep unauthorized people out of the work area.
- D. Provide fall protection in accordance with OSHA standard 1926.501(b)(4) for all holes and openings created by the cutting contractor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not commence work until conditions are acceptable.

3.02 SLAB & WALL SAWCUTTING

Except when the contractor determines that any of the following steps do not apply to a particular work or that other steps are appropriate:

- A. Set-Up Procedures:
 - 1. Provide adequate power and water supply for equipment at time of cutting.
 - 2. Inspect the complete saw for damage or improper functioning before cutting operations begin. Repair or replace as required.
 - 3. Clean and inspect the blade flanges and arbor for damage before mounting any blade. Repair or replace as required.

4. Inspect any air, hydraulic, electric or water lines or cords attaching to the saw for proper condition and fit. Repair or replace as required.
 5. Inspect diamond blade for the condition of the segments and core. Do not use the blade if any of the following conditions exist: core cracks, missing or broken segments, loss of tension or any other condition as mentioned in the blade manufacturer's instructions.
 6. Check to confirm that the blades are of a proper specification for the material being cut.
- B. Sawing Operation:
1. When needed, place partitions or screens between wall saw operations and the personnel area to prevent any flying objects from contacting any worksite personnel.
 2. Allow no personnel to be in-line with the blade while it is rotating.
 3. On applications requiring a bottom horizontal cut, sequence the cut or shore the work piece so that the weight of the work piece is prevented from jamming, pinching and/or crushing the diamond blade.
 4. Blades and blade guards should be properly fastened to the saw as per the saw manufacturer's specifications.
 5. The saw should be operated according to the saw manufacturer's specifications.
- C. Before commencing sawing operations, determine whether the piece being removed needs to be cut into smaller, more manageable pieces.
- D. Provide temporary enclosures and/or sufficient barricades to reasonably contain slurry. Pump slurry to a suitable container during cutting operations as required.
- E. Overcutting at Corners: A determination will be made by the Architect as to whether over cuts are allowed.
- F. Tolerances: Contractor shall verify the location, dimension and accuracy of all saw cuts. Deviation of cut line or dimension of cuts by more than 1/4-inch will be repaired entirely at the Contractor's expense.

3.03 CORE-DRILLING

Except when the contractor determines that any of the following steps do not apply to a particular work or that other steps are appropriate:

- A. Set-Up Procedures:
1. Equipment used in the drilling operations must meet all OSHA standards and specifications as to plugs, noise, wiring, and fume pollution.
 2. Specifications for minimum and maximum clearance requirements between the pipe and core hole should be determined prior to starting work.
 3. Provide labor to catch core(s) and water when the core is cut free on a suspended slab.
 4. Inspect diamond core drill bits for damage to the hub area that could cause improper seating of the back of the bit against the drill shaft.
 5. Check to confirm drill bits are of proper specification for the material being cut.
 6. Prohibit access and clear machinery or equipment directly under the area to be core drilled so that falling cores do not injure any persons or damage any property.
 7. Provide fall protection for all holes or openings created by the drilling operation.
- B. Drilling Operation:
1. If any of the core drilling operations are performed without water as a coolant then additional safety precautions may apply. Consult the diamond tool manufacturer or the core drill manufacturer for specification information.
 2. If any of the core drilling operations are performed with hand held core drilling equipment then additional safety precautions may apply. Consult the core drill manufacturer for specification information.
 3. Never operate a core drill assembly unattended unless the equipment has been designed specifically for this purpose.
 4. The core drilling equipment should be operated in accordance with the manufacturer's specifications.

5. When needed, place partitions, barricades or caution tape around the work area to prevent unauthorized personnel from having access to the work area.

3.04 CLEANUP

- A. Provide for the proper, safe, and appropriate disposal of slurry.
- B. At completion of cutting operations and removal of cut off material wash all adjacent remaining structure clean of all slurry, collect washing and pump to a suitable container.
- C. Dispose of slurry in the proper manner off site or at the direction of the Owner on site.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Formed steel stud exterior wall framing.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 061600 - Sheet Metal Flashing and Trim
- C. Section 072100 - Thermal Insulation
- D. Section 07 25 00 - Weather Barriers
- E. Section 072726 - Resilient Base and Accessories
- F. Section 079200 - Hollow Metal Doors and Frames
- G. Section 092116 - Gypsum Board Assemblies
- H. Section 092216 - Non-Structural Metal Framing

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.05 SUBMITTALS

- A. See Section 013300 - Summary
- B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, limitations.
- C. Product Data: Provide manufacturer's data on factory-made framing connectors, showing compliance with requirements.
- D. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
 - 1. Indicate stud and ceiling joist layout.
 - 2. Describe method for securing studs to tracks and for bolted framing connections.
 - 3. Delegated Design Submittal:
 - a. Submit structural calculations prepared by manufacturer for approval. Submittal shall be sealed by a professional engineer registered in the state of Missouri.
 - b. Design Criteria:
 - 1) Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
 - 2) Selection of framing components, accessories and welded connection requirements.
 - 3) Verification of attachments to structure and adjacent framing components.
- E. Manufacturer's Installation Instructions: Indicate special procedures, conditions requiring special attention, and _____.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in Insert Project State.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3/D1.3M, "Structural Welding Code--Sheet Steel."
 - 1. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure."
- E. Fire-Test-Response Characteristics: Where metal framing is part of a fire-resistance-rated assembly, provide framing identical to that of assemblies tested for fire resistance per ASTM E119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by GA File Numbers in GA-600, "Fire Resistance Design Manual," or by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 - 2. AISI Specifications: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members" for calculating structural characteristics of cold-formed metal framing:

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Protect and store materials protected from exposure to rain, snow or other harmful weather conditions. Products to be handled per AISI S202 "Code of Standard Practice for Cold-Formed Steel Structural Framing."

1.08 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.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: ClarkDietrich
 - 1. Other acceptable manufacturers with equivalent products to the specified manufacturer shall include:
 - a. CEMCO
 - b. Jaimes Industries
 - c. Marino Ware
 - d. SCAFCO Corp.
 - e. Steel Construction Systems
 - f. United Products, Inc.
 - 2. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".
- B. Framing Connectors and Accessories:
 - 1. Same manufacturer as metal framing.

2.02 FRAMING SYSTEM - DESIGN DATA

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Design Requirements: Provide completed framing system having the following characteristics:
 - 1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
 - 2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.

3. Design Loads: Includes live and dead loads on floor and roofs, snow loads, and wind loads:
 - a. In accordance with applicable codes.
 - b. As indicated on the structural drawings.
 4. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
 5. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
- C. Shop fabricate framing system to the greatest extent possible.
- D. Deliver to site in largest practical sections.

2.03 MATERIALS

- A. Cold-Formed Steel Sheet: Complying with ASTM A1003/A1003M; unless indicated otherwise.
- B. Protective Coating: CP60 coating designator minimum (G60, A60, AZ50, GF30), complying with ASTM C955 and AISI S240.

2.04 FRAMING SYSTEM - COMPONENTS

- A. Structural Studs
1. Product: ClarkDietrich; "Cold-Formed Steel C-Studs".
 2. Gage and Web Depth: As required to meet specified performance levels.
 3. Minimum Yield Strength: As required for design.
- B. Structural Track: Cold-formed steel track
1. Product: ClarkDietrich; "Cold-Formed Steel Track".
 2. Web Depth: Match stud web size.
 3. Minimum Yield Strength: As required for design.
 4. Material Thickness (Gage): Match stud/joist thickness unless design dictates heavier thickness.
- C. Slotted Deflection Track
1. Product: ClarkDietrich; "MaxTrak (SLT), MaxTrak 2D (SLT/H), or BlazeFrame DSL".
 2. Gage and Web Depth: As required to meet specified performance levels.
 3. Minimum Yield Strength: As required for design.
 4. Slotted or un-slotted.
- D. Deflection and Drift Clips
1. Material Thickness: As required for design, based on application.
- E. Clip Angles (Support Clips)
1. Product: ClarkDietrich; "EasyClip Series".
 2. Size and Material Thickness: As required for design, based on application.
- F. U-Channel
1. Product: ClarkDietrich; "U-Channel and FastBridge Clip".
 2. Size and Material Thickness: As required for design.
- G. Furring Channel
1. Product: ClarkDietrich; "Furring Channel".
 2. Size and Material Thickness: As required for design.
- H. Bridging/Spacer Bar
1. Product: ClarkDietrich; "TradeReady Spazzer 5400 Bridging and Spacing Bar".
 2. Material Thickness: As required for design.
- I. Web Stiffeners
1. Product: ClarkDietrich; "EasyClip Quick Twist Web Stiffener".
 2. Size and Material Thickness: As required for design.
- J. Load-Bearing Headers

1. Product: ClarkDietrich; "Heavy Duty Stud (HDS) or Header Bracket (HDSC), cold-formed galvanized one-piece load-bearing header.
 2. Size and Material Thickness: As required for design.
- K. Partial Height Wall Framing
1. Product: ClarkDietrich; "Pony Wall (PW)"
 2. Material Thickness: 12 gauge, 0.0966 inch (2.45mm).
 3. Size: As required for design.
- L. Framing Component Accessories: Provide the following accessories as required for a complete system.
1. Flat strapping.
 2. Angles, plates, sheets.
 3. Custom brake-formed shapes.
- M. Fasteners: Self-drilling, self-tapping screws; Steel, complying with ASTM C 1513; Galvanized coating, plated or oil-phosphate coated complying with ASTM B633 as needed for required corrosion resistance.
- N. Touch-Up Paint: Complying with ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings. Zinc rich, containing 95-percent metallic zinc.

2.05 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
1. Products:
 - a. ITW Commercial Construction North America; ITW CCNA-Buildex Tek's Select Series, or comparable product.
- B. Anchorage Devices: Powder actuated.
- C. Welding: Comply with AWS D1.1/D1.1M.

2.06 WALL SHEATHING

- A. Plywood: Refer to Section 061500 - Metal Ladders
- B. Gypsum Sheathing: Refer to Section 061600 - Sheet Metal Flashing and Trim.

2.07 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Plates, Gussets, Clips: Formed Sheet Steel, thickness determined for conditions encountered; finish to match framing components.
- C. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- D. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.08 FABRICATION

- A. General: Framing components may be pre-assembled into panels prior to erecting.
- B. Fabricate panels square, with components attached in a manner so as to prevent racking or distortion.
- C. Cut all framing components squarely for attachment to perpendicular members, or as required for an angular fit against abutting members. Hold members positively in place until properly fastened.
- D. Provide insulation as specified elsewhere in all double jamb studs and double header members, which will not be accessible to the insulation Subcontractor.
- E. Axially Loaded Studs:

1. Install studs to have full bearing against inside track web (1/8 inches (3.2 mm) maximum gap) prior to stud and track attachment.
 2. Splices in axially loaded studs are not permitted.
- F. Fasteners: Fasten components using self-tapping screws or welding.
- G. Welding: Welding is permitted on 18 gauge or heavier material only.
1. Specify welding configuration and size on the Structural Calculation submittal.
 2. Qualify welding operators in accordance with Section 6.0 of AWS D.1.3.
 3. Touch up all welds with zinc-rich paint in compliance with ASTM A780/A780M

PART 3 EXECUTION

3.01 EXAMINATION

- A. Prior to installation, inspect previous work of all other trades. Verify that all work is complete and accurate to the point where this installation may properly proceed in strict accordance with framing shop drawings.

3.02 ERECTION

- A. General Requirements:
1. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
 2. Weld in compliance with AWS D.1.3.
 3. Install in compliance with applicable sections of the AISI S240 "North American Standard for Cold-Formed Steel Structural Framing."
- B. Wall Systems:
1. Erect framing and panels plumb, level and square in strict accordance with approved shop drawings.
 2. Handle and lift prefabricated panels in a manner so as not to cause distortion in any member.
 3. Anchor track securely to the supporting structure as shown on the erection drawings. Install concrete anchors only after full compressive strength has been achieved.
 4. Butt all track joints. Securely anchor abutting pieces of track to a common structural element, or butt-weld or splice them together.
 5. Align and plumb studs, and securely attach to the flanges or webs of both upper and lower tracks except when vertical movement is specified.
 6. Install jack studs or cripples below window sills, above window and door heads, at freestanding stair rails and elsewhere to furnish support, securely attached to supporting members.
 7. Attach wall stud bridging in a manner to prevent stud rotation. Space bridging rows according to manufacturer's recommendations.
 8. Frame wall openings to include headers and supporting studs as shown in the drawings.
 9. Provide temporary bracing until erection is completed.
 10. Provide stud walls at locations indicated on plans as "shear walls" for frame stability and lateral load resistance.
 11. Where indicated in the drawings, provide for structural vertical movement using a vertical slide clip or other means in accordance with manufacturer's recommendations.

3.03 FIELD QUALITY CONTROL

- A. Inspection: Periodic special inspections are required by local code authorities.
1. Refer to Section 014533 - Flagpoles

3.04 PROTECTION

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

3.05 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using clip and tie method.
- D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- E. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
- F. Install intermediate studs above and below openings to align with wall stud spacing.
- G. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
- H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- I. Touch-up field welds and damaged galvanized surfaces with primer.

END OF SECTION

SECTION 05 43 00
SLOTTED CHANNEL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Framing shall be a strut type metal framing system (Strut System)
- B. Strut System shall be used:
 - 1. To support mechanical and electrical equipment and devices.
 - 2. For structural applications as applicable.

1.03 SUBMITTALS

- A. Structural calculations by a Registered Professional or Structural Engineer in the State of Iowa for approval by the Professional of Record. Calculations may include, but are not limited to:
 - 1. Description of design criteria
 - a. Stress and deflection analysis
 - 2. Selection of framing members, fittings, and accessories.
- B. Assembly drawings necessary to install the Strut System in compliance with the Contract Documents.
- C. Pertinent manufacturers published data

1.04

1.05 QUALITY ASSURANCE

- A. Manufacturer's qualifications:
 - 1. The manufacturer shall have at least 10 years' experience in manufacturing Strut Systems.
 - 2. The manufacturer must certify in writing all components supplied have been produced in accordance with an established quality assurance program.
- B. Work shall meet the requirements of the following standards:
 - 1. Federal, State and Local codes
 - 2. American Iron and Steel Institute (AISI) Specification for the Design of ColdFormed Steel Structural Members 2001 Edition
 - 3. American Society for Testing And Materials (ASTM)
 - 4. Metal Framing Manufacturer's Association (MFMA)

1.06 DELIVERY, STORAGE, AND HANDLING

- A. All material is to be delivered to the work site in original factory packaging to avoid damage to the finish.
- B. Store strut systems and components in original cartons and in clean dry space; protect from weather and construction traffic.

1.07 WARRANTY

- A. Installer shall warrant for 1 year from the Date of Substantial Completion that the work will be free of defects in installation. In the event of any such defect in violation of the warranty, Installer shall have the option to repair or replace any such defective product.
- B. Manufacturer shall warrant for 1 year from the Date of Substantial Completion that products will be free from defects in material or manufacture. In the event of any such defect in violation of the warranty, Manufacturer shall have the option to repair or replace any such defective product

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Unistrut Corporation. Other acceptable manufacturers with equivalent product to the specified manufacturer shall include:
 - 1. Haydon Corporation
 - 2. Cooper B-Line, Inc.
 - 3. Hilti, Inc.
 - 4. Flex-Strut, Inc.
- B. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Section 01 60 00 – Product Requirements.
 - 1. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".

2.02 MATERIALS

- A. All channel members shall be fabricated conforming to one of the following ASTM specifications:
 - 1. Plain Carbon Steel: ASTM A1011/A1011M SS Grade 33
 - 2. Pre-Galvanized Carbon Steel: ASTM A653/A653M Grade 33
 - 3. UNISTRUT DEFENDER™: ASTM A1046 SS Grade 33
- B. All fittings shall be fabricated conforming to one of the following ASTM specifications:
 - 1. Carbon Steel: All carbon steel fittings shall be fabricated from steel that meets/exceeds the physical requirements of ASTM A1011 SS Grade 33 and conforms to one of the following ASTM specifications:
 - a. ASTM A575
 - b. ASTM A576
 - c. ASTM A36/A36M
 - d. ASTM C635/C635M
 - e. ASTM C1059/C1059M
 - f. ASTM A1046
- C. Stainless Steel:
 - 1. ASTM A240/A240M (Type 304 or Type 316)
 - 2. ASTM A276/A276M (Type 304 or Type 316)
- D. Aluminum:
 - 1. ASTM B209 (Type 1100F or Type 5052-H32)

2.03 FASTENERS

- A. Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Welding: In conformance with AWS D1.1/D1.1M.

2.04 FINISHES

- A. Electro-Galvanized per ASTM B633, Type III SC 1
- B. Hot-Dipped Galvanized per ASTM A123/A123M or ASTM A153/A153M
 - 1. Zinc coated after all manufacturing operations are complete
 - 2. Zinc coating thickness shall be G65 (2.6 mils = 1.50 oz./ sq. ft. surface area)

PART 3 EXECUTION

3.01 EXAMINATION

- A. The installer shall inspect the work area prior to installation. If work area conditions are unsatisfactory, installation shall not proceed until satisfactory corrections are completed.
- B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION

- A. Installation shall be accomplished by a fully trained manufacturer authorized installer.
- B. Set Strut System components into final position true to line, level and plumb, in accordance with approved drawings.

3.03 CLEANING

- A. Upon completion of this section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

3.04 PROTECTION

- A. Upon completion of this scope of work, protect this work from damage during the remainder of construction on the project and until substantial completion.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous steel framing and supports.
 - 2. Miscellaneous steel trim including but not limited to:
 - a. Attachment plates and angle brackets for supporting guide-rail brackets.
 - b. Structural Steel shapes for elevator sub-sill.
- B. Products furnished, but not installed, under this Section:
 - 1. Loose steel lintels.
 - 2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.03 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- B. Seismic Requirements: Verify with Structural Engineer of Record.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Overhead support structures.
 - 2. Paint products.
 - 3. Grout.
- B. Shop Drawings: Show fabrication and installation details for metal fabrications.
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
- C. Delegated-Design Submittal: For installed products indicated to comply with performance requirements (deflection and vibration criteria for equipment and medical equipment and lighting mounts) and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 PRODUCTS

2.01 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.02 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.
- C. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- D. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.
- E. Slotted Channel Framing: Refer to Section 05 43 00

2.03 NON-FERROUS METALS

- A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

2.04 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls.
 - 1. Provide stainless-steel fasteners for fastening aluminum.
 - 2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.05 MISCELLANEOUS MATERIALS

- A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- D. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.06 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.
- C. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended.
- D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.
- E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches (600 mm) o.c.

2.07 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.08 MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
- C. Galvanize exterior miscellaneous steel trim.
- D. Prime miscellaneous steel trim with zinc-rich primer.

2.09 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.10 STEEL WELD PLATES AND ANGLES

- A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.11 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.12 STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize items as indicated, (all exposed structural steel lintels, columns, beams, etc.), to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
- B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
 - 1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 3. Other Items: SSPC-SP 3, "Power Tool Cleaning."
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 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. At exposed connections, finish exposed welds and surfaces smooth and blended.

- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.02 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
- C. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.03 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Non-structural dimension lumber framing.
- B. Fire retardant treated wood materials.
- C. Communications and electrical room mounting boards.
- D. Concealed wood blocking, nailers, and supports.
- E. Miscellaneous wood nailers, furring, and grounds.

1.03 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim
- B. Section 07 72 00 - Roof Accessories
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Section 12 32 16 - Manufactured Plastic Laminate Faced Casework

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.05 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Metal framing anchors.

1.06 SUBMITTALS

- A. Product Data: Provide technical data on wood preservative materials and application instructions.

1.07 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.08 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with DOC PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - a. Factory mark each piece of lumber with grade stamp of grading agency.
 - b. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 - c. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.02 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine; SPIB (GR).
 - 3. Spruce-pine-fir; NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - 6. Western woods; WCLIB or WWPA.
 - 7. Northern species; NLGA.
 - 8. Eastern softwoods; NeLMA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Revise list below; usually retain all species that meet requirements except those unavailable in Project's location. Species groups below are not necessarily of equal quality even when of same grade.
 - 2. Mixed southern pine, No. 2 grade; SPIB.
 - 3. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 - 4. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - 5. Three species groups below include last two above; if retaining any of three below, delete either or both of above to eliminate duplication.

6. Eastern softwoods, No. 2 Common grade; NELMA.
 7. Northern species, No. 2 Common grade; NLGA.
 8. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.03 CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.05 LOUVERED SLATWALL PANEL

- A. Provide 36" x 5/16" x 61" louvered panel w/ 1000-pound load capacity, as manufactured by AKRO-MILS and supplied by Grainger; Item #1UMD8; Mfr Model #30161.
- B. Color shall be Gray
- C. Contractor shall coordinate exact quantities based upon locations shown in the Drawings.

2.06 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to moisture, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C1002 or ASTM C954, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Bolts: Steel bolts complying with ASTM A307/ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488/E488M conducted by a qualified independent testing and inspecting agency.
1. Material" subparagraphs below are examples only. First subparagraph protects against corrosion in an indoor atmosphere; revise to suit other service conditions after verifying availability of thicker coatings.
 2. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 3. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).

2.07 ACCESSORIES

2.08 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
- B. Fire-Retardant-Treated Materials:
 - 1. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
 - b. All interior rough carpentry items are to be fire retardant treated.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3.02 WOOD GROUND, BLOCKING AND NAILER INSTALLATION

- A. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top

story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- D. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- E. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim as indicated on the drawings, including:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Toilet accessories.
 - 6. Wall-mounted door stops.
 - 7. Chalkboards and marker boards.
 - 8. Wall paneling and trim.
 - 9. Joints of rigid wall coverings that occur between studs.
 - 10. Other items indicated on drawings.

3.03 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.
 - 4. Size and Location: As indicated on drawings.

3.04 PROTECTION

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

END OF SECTION

SECTION 06 15 00
PLYWOOD SHEATHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Plywood parapet sheathing
- B. Fire retardant treatment of plywood.
- C. Preservative treatment of plywood.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 06 16 00 - Glass-Mat Gypsum Sheathing

1.04 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

1.05 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Capable of demonstrating that all wood procurement operations are conducted in accordance with procedures and policies of the Sustainable Forestry Initiative (SFI) Program.
- B. Code Compliance: Comply with requirements of the following:
 - 1. International Code Council Evaluation Service, ICC-ES ESR-1785.
 - 2. Voluntary Product Standard, DOC PS 2, "Performance Standard for Wood-Based Structural-Use Panels."

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Outdoor Storage: Comply with manufacturer's recommendations:
 - 1. Set panel bundles on supports to keep off ground.
 - 2. Cover panels loosely with waterproof protective material.
 - 3. Anchor covers on top of stack, but keep away from sides and bottom to assure adequate air circulation.
 - 4. When high moisture conditions exist, cut banding on panel stack to prevent edge damage.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

1.08 WARRANTY

- A. The manufacturer shall warrant the product against material defects, or defects in manufacturing, within the specified warranty period.
 - 1. Warranty Period: Lifetime beginning at Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Products of the manufacturer's listed below will be acceptable.
 - 1. Boise Cascade Company.

2. Georgia-Pacific LLC.
3. Weyerhaeuser Company .

B. Substitutions: Not permitted.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.03 PLYWOOD PARAPET WALL SHEATHING

- A. Plywood Roof and Parapet Wall Sheathing: DOC PS 1 veneer plywood; Exterior Grade; APA Structural I; Exposure 1 sheathing
1. Thickness: 5/8-inch.
 2. Edge Profile:
 - a. Roof Sheathing: Tongue & Groove.
 - b. Parapet Wall Sheathing: Square edge.

2.04 ACCESSORIES

- A. Fasteners and Anchors: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. For roof and parapet sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or of Type 304 stainless steel.

2.05 PLYWOOD TREATMENT

- A. Factory-Treated Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Fire-Retardant Treatment:
1. Type: AWPA U1, Use Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; with maximum flame spread index of 25 when tested in accordance with ASTM E84 and with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- C. Preservative Pressure Treatment:
1. Plywood: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
 - a. Kiln dry plywood after treatment to maximum moisture content of 18 percent.
 2. Marking: Mark each piece with stamp of an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that support framing is ready to receive plywood roof and parapet wall sheathing.

3.02 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Brush apply one coat of preservative treatment on wood in contact with roofing and related metal flashings. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.03 PARAPET SHEATHING INSTALLATION

- A. Install sheathing on the backside of the parapet walls in accordance with manufacturer's instructions.

END OF SECTION

SECTION 06 16 00
GLASS-MAT GYPSUM SHEATHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Glass mat gypsum sheathing.

1.03 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-Formed Metal Framing
- B. Section 06 10 00 - Rough Carpentry
- C. Section 07 21 00 - Thermal Insulation
- D. Section 07 27 26 - Fluid-Applied Membrane Air Barriers
- E. Section 09 22 16 - Gypsum Board Assemblies

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.05 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For following products, from ICC-ES:
 - 1. Preservative-treated plywood.
 - 2. Fire-retardant-treated plywood.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.08 WARRANTY

- A. The manufacturer shall warrant the product against delamination and deterioration for exposure to normal weather conditions for a period of one (1) year from Date of Substantial Completion.
- B. The manufacturer shall warrant the product against defects in manufacturing, for a period five (5) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Georgia-Pacific (G-P) Gypsum .
 - 1. Contacts: P: 800-225-6119 / Web: www.buildgp.com
- B. Other Acceptable Manufacturer: Equivalent products of the manufacturer's listed below will be acceptable.
 - 1. CertainTeed Corporation; GlasRoc.
 - 2. National Gypsum Company; Gold Bond e(2)XP.
 - 3. Temple-Inland Inc.; GreenGlass
 - 4. United States Gypsum Co.; Securock.
- C. Substitutions: Not permitted.

2.02 GLASS MAT GYPSUM WALL SHEATHING

- A. Product: DensGlass® Fireguard® Sheathing:
 - 1. Glass-Mat Gypsum Wall Sheathing: ASTM C1177/C1177M, Type X.
 - 2. Fire-Rated Assemblies: Product is UL and ULC certified as Type DGG and is included in numerous assembly designs investigated by UL and ULC for hourly fire resistance ratings.
 - 3. Thickness: 5/8-inch.
 - 4. Width (nom.): 48-inches.
 - 5. Length: 8-, 9-, or 10-feet.
 - 6. Weight: 2.5 lbs/sf.
 - 7. R-Value: 0.67.
 - 8. Physical Properties:
 - a. Compressive Strength: 500 psi (3445 kPa), minimum.
 - b. Permeance: > 17 perms.
 - c. Combustability: Product is noncombustible as described and tested in accordance with ASTM E136.
 - d. Surface Burning Characteristics: Flame spread rating: 0; smoke develop rating: 0, when tested in accordance with ASTM E84.
 - e. Air Barrier Compliance: Per the International Energy Conservation Code® (IECC), gypsum sheathing shall comply with the prescriptive code language for use as a continuous air barrier when the joints and openings are properly sealed.

2.03 FASTENERS

- A. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, according to ASTM B117
 - 1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C1002.
 - 2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C954.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Comply with GA-253 and with manufacturer's written instructions.
 - 1. Fasten gypsum sheathing to cold-formed metal framing with screws.
 - 2. Install boards with a 3/8-inch (9.5-mm) gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a 1/4-inch (6.4-mm) gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- E. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.
- F. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.
- G. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent

boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
 2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
- H. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud. Space fasteners approximately 8 inches (200 mm) o.c. and set back a minimum of 3/8 inch (9.5 mm) from edges and ends of boards.
- I. Seal sheathing joints according to sheathing manufacturer's written instructions.

3.02 PROTECTION

- A. Protect glass mat-surfaced gypsum sheathing that will be exposed to weather for more than 180 days by covering exposed exterior surface of sheathing with a securely fastened air-infiltration barrier. Apply covering immediately after sheathing is installed. Maximum exposure of assembly is 270 days prior to covering with exterior wall covering.
- B. Protect cutouts, corners, and joints in sheathing by filling with a flexible sealant or by applying tape recommended by sheathing manufacturer at time sheathing is applied.

END OF SECTION

SECTION 06 40 23
INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Interior standing and running trim.
- B. Closet and utility shelving.
- C. Slatwall systems.
- D. Louvered hanging system with bin racks.
- E. Display case and utility shelving.
- F. Shop finishing of interior woodwork.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 06 61 16 - Solid Surface Fabrications
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Section 09 91 23 - Interior Painting
- E. Section 12 32 16 - Manufactured Plastic Laminate Faced Casework
- F. Section 09 91 23 - Interior Painting

1.04 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.05 ACTION SUBMITTALS

- A. Submit in compliance with Section 01 32 00.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - 1. Show details full size.
 - 2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
 - 3. Show locations and sizes of cutouts and holes for plumbing fixtures faucets soap dispensers and other items installed in architectural woodwork.
 - 4. Apply AWI-certified compliance label to first page of Shop Drawings.
- C. Samples for Initial Selection:
 - 1. Shop-applied transparent finishes.
 - 2. Shop-applied opaque finishes.
- D. Samples for Verification:
 - 1. Lumber and panel products with shop-applied opaque finish, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels, for each finish system and color, with 1/2 of exposed surface finished.
- E. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
- B. Product Certificates: For each type of product, signed by product manufacturer.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of interior architectural woodwork that has been in this business for the past ten (10) years, and upon request, provide a listing of similar or larger projects recently completed.
- B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for Premium grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.08 MOCKUPS

- A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.
 - 2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 PRODUCTS

2.01 WOODWORK FABRICATORS

- A. Available Fabricators: Subject to compliance with requirements, fabricators offering interior architectural woodwork that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Creative Associates, Inc.
 - 2. C. S. Humphrey & Company, L.L.C.
 - 3. C & S Wood Shop, Inc.
 - 4. Duhnke Millwork Company
 - 5. Carroll Seating/TMI
 - 6. RCS Millwork, L.C.

2.02 INTERIOR WOODWORK

- A. Interior Woodwork shall include but not be limited to the following:

- B. Chair Rail:
 - 1. Chair rail, scheduled on the Drawings as Finish Type 'CR-1'.
 - a.
- C. Handrail:
 - 1. Handrail, scheduled on the Drawings as Finish Type 'HR-1'.
 - a.
- D. Wood Base:
 - 1. Wood base, scheduled on the Drawings as Finish Type 'WB-1'.
 - a.

2.03 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for Premium type of woodwork and quality grade specified, unless otherwise indicated.
 - 1. Wood Species for Opaque Finish: Any closed-grain hardwood.
 - 2. Wood Species and Cut for Transparent Finish:
 - a. Rift Cut White Oak.
- B. Wood Products:
 - 1. Hardwood Plywood:
 - a. 3/4-inch Walnut Cabinet Grade, G2S, Grade A-1, 7-Ply Veneer core, plain sliced.
 - b. Hardboard: AHA A135.4.
 - 2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
 - 3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
 - a. Particleboard at wet areas: Shall be Medex board.
 - 4. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.
 - a. Provide PVC or polyester edge banding complying with LMA EDG-1 on components with exposed or semi-exposed edges.

2.04 MISCELLANEOUS MATERIALS

- A. Concealed Furring, Blocking, Shims, and Hanging Strips: Refer to Section 06 10 00 - Rough Carpentry.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.
- C. Adhesives, General: Adhesives shall not contain urea formaldehyde.
- D. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - 1. Wood Glues: 30 g/L.
 - 2. Multipurpose Construction Adhesives: 70 g/L.
 - 3. Contact Adhesive: 250 g/L.

2.05 FABRICATION - INTERIOR WOODWORK

- A. Interior Woodwork Grade: Unless otherwise indicated, provide Premium-grade interior woodwork complying with referenced quality standard.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated.
- D. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.
- E. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 1. Seal edges of openings in countertops with a coat of varnish.

2.06 DISPLAY CASE AND UTILITY SHELVING

- A. Shelf Standards, Brackets and Rests:
 1. Manufacturer: Knape & Vogt (K&V).
 2. Products: Specified below.
- B. Shelving Systems:
 1. Pilaster Shelving, Adjustable:
 - a. Shelving:
 - 1) 1-inch thick thermoset decorative panel with 1 mm PVC edge banding (all sides).
 - 2) 1-inch thick thermoset decorative panel with 3 mm PVC edge banding (all sides).
 - b. Standards: K&V; No. 255, or approved equal.
 - c. Shelf Support Brackets: K&V; No. 256, or approved equal.
 2. Utility Shelving, Adjustable:
 - a. Shelving:
 - 1) 1-inch thick thermoset decorative panel with 1 mm PVC edge banding (all sides).
 - 2) 1-inch thick thermoset decorative panel with 3 mm PVC edge banding (all sides).
 - b. Standards: K&V; No. 85-ANO-XX; 1.25-inches wide by 1/2-inch deep, double slot design, 1-inch vertical adjustment.
 - c. Shelf Support Brackets: K&V; No. 185-ANO-XX; Depth as shown on drawings.
 - d. Shelf Rests: K&V; No. 106-ANO; or approved equal.
- C. Z-clip: Monarch Metal Fabricators MF 025 Z-clip with 5/8" lift off.

2.07 CLOSET ACCESSORIES

- A. Closet Shelving:
 1. Shelf and Rod Support: K&V No. 1195 in color as selected by Architect.
 2. Closet Rod: K&V No. 660-SS, 1-1/16" OD stainless steel closet rod, lengths as required.
 3. Closet Rod Flange Supports: K&V No. 735, each end of rod.

2.08 BIN RACKS AND LOUVERED HANGING SYSTEM

- A. Louvered Hanging Systems:
 1. Product: AKRO-MILS; Model No. 3016124SC, Louvered Wall Panel with (24) Bins.
 - a. Size: 36-inches wide by 5/16-inches deep by 61-inch high.
 - b. Load Capacity: 100 pounds.
 - c. Color: Gray
 - d. Installation: Wall-mounted.
 2. Bins:
 - a. Product: AkroBins, Model No. 30240.
 - 1) Size (Inside Dimensions): 6-1/2 inches wide by 12-inches deep by 6-3/4 inches high.
 - 2) Color: To be selected by Architect from standard product line.
 - 3) Quantity: 24
 3. Contractor shall coordinate exact quantities based upon locations shown in the Drawings.

2.09 SLATWALL

- A. Product: Slatwall 2000 Series as manufactured by Marlite Company or approved equal.

1. Panel Core: MDF.
2. Finish: High Pressure Laminate. Wilsonart Pinnacle Walnut 7992-38.
3. Edge Groove Treatment: Factory Painted Grooves.
4. Panel Size and Configuration: Horizontal Panel Format, 4'H X'8'W X ¾"T. 3" on-center grooves. Short edges square cut, Long edges with half groove to facilitate concealed joints and vertical stacking..
5. Trim: A770 Aluminum Edge Trim, A760 Aluminum Inside/Outside Corner Trim. Mill Finish.

PART 3 EXECUTION

3.01 PREPARATION

- A. Examine substrates, areas, and conditions where installation of Architectural Woodwork will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.
- B. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.02 INSTALLATION

- A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.
- B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).
- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.
- F. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.
- G. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 36 inches (900 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
 1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.
 2. Install wall railings on indicated metal brackets securely fastened to wall framing.
 3. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches (3 mm in 2400 mm).
- H. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
- I. Refer to Section 09 91 23 for final finishing of installed architectural woodwork.

3.03 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.04 PROTECTION

- A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION

SECTION 06 61 16
SOLID SURFACE FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Solid surface fabrications
- B. Solid surface sink bowls.
- C. Solid surface window sills.

1.03 RELATED REQUIREMENTS

- A. Section 04 20 00 - Brick and Concrete Masonry
- B. Section 06 10 00 - Rough Carpentry
- C. Section 07 92 00 - Joint Sealants
- D. Section 09 21 16 - Gypsum Board Assemblies
- E. Section 12 32 16 - Manufactured Plastic Laminate Faced Casework

1.04 REFERENCE STANDARDS

- A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- B. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.
- D. ASTM C384 - Standard Test Method for Impedance and Absorption of Acoustical Materials by Impedance Tube Method; 04.
- E. ASTM D1037 - Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials; 12.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- H. ASTM E84

1.05 SUBMITTALS

- A. Product data: Indicate product description, fabrication information and compliance with specified performance requirements.
- B. Shop Drawings: Indicate dimensions component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.
- C. Samples:
 - 1. Submit product data indicating compliance with specification requirements.
 - 2. Samples: Submit minimum 2-inch by 2-inch samples.
- D. Maintenance data: Submit manufacturer's care and maintenance data, including repair and cleaning instructions. Include in project close out documents.

1.06 QUALITY ASSURANCE

- A. Accessible Design: Comply with [the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."]

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver no components to project site until areas are ready for installation. Store indoors.
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.08 WARRANTY

- A. The manufacturer shall warrant the product/s to be free of defects in material and workmanship for a period of ten (10) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Solid Surfacing Manufacturer: DuPont
 - 1. Owner Standard: The solid surfacing products specified in this Section are restricted to the specified manufacturers and products unless indicated otherwise.
 - a. Substitutions: Not permitted.

2.02 SOLID SURFACING FABRICATIONS

- A. Solid Surfacing, designated in the Drawings as Finish Type SSF-1
 - 1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
- B. Type SSF-1 & SSF-2:
 - 1. Basis of Design: DuPont; Corian.
 - a. Pattern and Color: As scheduled
 - b. Solid Surfacing Material Thickness: 1/2-inch.
 - c. Edge Profile: Eased edge unless indicated otherwise.
 - 1) Bullnose edge at reception desk and nurses stations.
 - 2. Applications:
 - a. Countertops.
 - b. Transaction Tops.
 - c. Interior window sills.
 - d. Transition between resinous flooring and LVT flooring at restrooms.
 - e. Floor only wall base at door transition to be wrapped with resinous material.

2.03 MATERIALS

- A. Solid surfacing sheet over continuous substrate.
 - 1. Solid Surfacing Sheet : Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 200, maximum; when tested in accordance with ASTM E84.
 - b. NSF approved for food contact.
 - c. Color and Pattern: As indicated on drawings.
 - 2. Flat Sheet Thickness: 1/2 inch, minimum.
 - 3. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - 4. Physical Properties:
 - a. Tensile Strength: 6000 psi minimum, per ASTM D638
 - b. Fungi and Bacteria: Does not support microbial growth, per ASTM G21
 - c. Microbial Resistance: Highly resistant to mold growth, per UL 2824
- B. Particleboard: ANSI A208.2 - Grade M-2, made with binder containing no urea formaldehyde.
- C. Medium Density Fiberboard (MDF): ANSI A208.2 - Grade MD, made with binder containing no urea formaldehyde.

1. MDF shall contain fire-retardant chemicals injected with raw materials during manufacturing to achieve a maximum flame-spread rating of 25, and a maximum smoke development rating of 200 when tested to ASTM E84.
- D. Moisture-Resistant MDF (MR-MDF):
 1. Uses: Where countertops receive sinks or are subjected to liquid spills.
 2. Product: "Medex", as manufactured by Roseburg Forest Products Company, no substitutions.
 - a. ASTM D1037: Passed.
 - b. ASTM E84, Class C flame spread rating.
 - c. Density: 48 pcf, minimum.
- E. Adhesive for Bonding to Other Products: One component silicone to ASTM C920.
- F. Sealant: A standard mildew-resistant, FDA/UL®, and NSF/ANSI 51 compliant in Food Zone area, recognized silicone color matched sealant or clear silicone sealants.
- G. Sink/Bowl Mounting Hardware: Manufacturer's approved bowl clips, brass inserts and fasteners for attachment of undermount sinks/bowls.

2.04 SOLID SURFACING COUNTERTOPS

- A. Countertop shall be solid surfacing sheet over continuous substrate.
 1. Substrate Material: MDF and MR-MDF.
 2. Countertop Depth: As indicated in the Drawings.
 - a. ADA Compliant Countertops shall have a maximum depth of 24-inches (600-mm), measured from the farthest most projection of countertop to the face of back wall.
 3. Construction:
 - a. Exposed Edge Treatment: Built up to minimum 1-1/2 inches thick; eased edge; use marine edge at sinks.
 - b. Flat Sheet Thickness: 1/2-inch.
 - c. Countertop Overhang: 1-inch (25-mm) beyond face of base cabinets.
 - d. Open End Radii: Countertops with open ends shall have a 1-1/2 inch radius at the open end between the front and end faces.
 4. Back and End Splashes: Same sheet material, 1/2-inch thick, square top; minimum 4 inches high.
 - a. Finish Type: Match countertops.
 - b. Construction:
 - 1) Loose Splashes: Provide loose back and end splashes for field installation.
- B. Skirts: As indicated on drawings.
- C. Transaction Tops: Same as countertops.
- D. Integrated Sinks: Refer to Article below.

2.05 SOLID SURFACING WINDOW SILLS

- A. Finish Type: Refer to the "Interior Finish Legend" in the Drawings.
- B. Construction: Built-up of 1/2-inch thick solid surface sheet materials over a 1-inch substrate, for a total thickness of 1-1/2 inch.
 1. Adhesively joined with inconspicuous seams.
 2. Edges: Eased Edges.
 3. Drop Edge Height: As detailed in drawings.

2.06 WALL-HUNG VANITY TOPS

- A. Solid Surfacing Vanity Tops:
 1. Construction: Shall be built-up with 1/2-inch thick solid surface sheet over a 1-inch thick substrate, for a total thickness of 1-1/2 inches.
 - a. Substrate Material: MR-MDF.
 2. Finish Type: Refer to the "Interior Finish Legend" in the Drawings.
- B. Vanity Tops with Seamed Bowls:

1. Depth: As detailed in Drawings.
 2. Thickness: 3/4-inch.
 3. Edges: Eased.
 4. Provide countertops complete with backsplashes and endsplashes as shown on Drawings.
 - a. Profile: Non-Coved.
 5. Integrated Sinks and Bowls: Refer to Article below.
 - a. Installation Method: Hard Seam Submount.
- C. Vanity Tops with Undermount Bowls:
1. Depth: As detailed in Drawings.
 2. Thickness: 3/4-inch.
 3. Edges: Eased.
 4. Provide countertops complete with backsplashes and endsplashes as shown on Drawings.
 - a. Profile: Non-Coved.
 5. Integrated Sinks: Refer to Article below.
 - a. Installation Method: Soft Seam Undermount.
 - b. Use undermount hardware according to manufacturer's instructions.

2.07 SOLID PLASTIC WALL-HUNG VANITY TOPS

****VERIFY****

- A. Solid Plastic Wall-Hung Vanity Tops: Factory fabricated top, splashes, skirts, end supports, and center supports made of solid molded high density polyethylene (HDPE), complete with integrally molded sink bowls; tested in accordance with NFPA 286.
1. Sheet Thickness: 1 inch with edges radiused to 1/4 inch.
 2. Vanity Size: 24 inches deep by length indicated on drawings.
 3. Shoes: 3 inches, one piece molded HDPE.
 4. Attachment Brackets: 16 inches long, heavy duty extruded aluminum.
 5. Surface Burning Characteristics: Flame spread index of 75, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 6. NSF approved for food contact.
 7. Color and Texture: As indicated in drawings.

2.08 INTEGRATED SINKS

- A. Integrated Sinks, designated in the Drawings as Finish Type IS- #, and specified below.
1. Sink Bowls:
 - a. Product: DuPont "Corian" Lavatory Sink Bowl:
 - b. Type IS - #: Model 810P: 16-1/2 inch length by 13-1/8-inch width by 5-1/2-inch depth (inside sink dimensions); Oval; ADA compliant; Hard Seam Submount Installation.
 - c. Type IS-#: Model No. 820P: 14-3/4 inch length by 10-1/2 inch width by 5-1/2 inch depth (inside sink dimensions); Oval; ADA compliant; Hard Seam Submount Installation.
 - d. Type LAV-1: Gemstone; Model 1410-V
 2. Countertop Sinks, Single Basin:
 - a. Product: DuPont; "Corian" Countertop Sink, single bowl:
 - 1) Type IS- #: Model No. 804P: 15-3/4 inch length by 15-3/4 inches width by 8-1/8 inch depth (inside sink dimensions); Hard Seam Submount Installation.
 - 2) Type IS- #: Model No. 859P: 17-3/8 inch length by 13-3/8 inches width by 7-7/8 inch depth (inside sink dimensions); Hard Seam Submount Installation.
 3. Countertop Sinks, Double Basin:
 - a. Basis of Design: DuPont; "Corian" Solid Surface Sink, double bowl.
 - 1) Type IS- #: Model No. 850P: 29-inch length by 16-3/4 inch width by 9-inch depth (inside sink dimensions); Soft seam undermount installation.
 - 2) Type IS- #: Model No. 9412: 31-inch length by 16-3/4 inch width by 8-3/8 inch depth (inside sink dimensions); Soft seam undermount installation.
- B. GEMSTONE SINKS ****VERIFY****
1. Type SK-1: Gemstone; Model 1410-V, 14-1/4" length by 10-5/16" wide by 5" deep.
 2. Type SK-2: Gemstone; Model 1815-S; 17-5/8" length by 14-3/4" wide by 8-7/8" deep.

3. Type SK-3: Gemstone; Model 1613 **This Sink has overflow** 16-3/8" length by 13" wide by 5" deep; Oval
 4. Type SK-4: Gemstone; Model 3118-D Kitchen Sink; 29" length by 16" wide by 8-1/2" deep.
 5. Type SK-5: Gemstone; Model 1515-ES Single Bowl Sink; 14-3/4" length by 14-3/4" wide by 7-7/8" deep.
- C. Installation of Sinks to Countertop:
1. Hard Seam Submount Installation:
 - a. Applications: Where the edge of the deck and the sink bowl are flush, and the sink bowl is attached to the deck with joint adhesive.
 - b. Sink Types:
 2. Soft Seam Undermount Installation:
 - a. Applications: Where the sink bowl is recessed from the edge of the deck and is adhered with silicone adhesive.
 - b. Sink Types: Undermount kitchen, bar/ vanity sinks, and lavatories.

2.09 INSTALLATION MATERIALS

- A. Joint Adhesive: Methacrylate-based adhesive for chemically bonding solid surfacing seams. Color complementary to solid surfacing sheet material. UL 2818 GREENGUARD Gold certified and meets the Low VOC emission limit requirements of SCAQMD Rule 1168.
 1. Product: Corian Joint Adhesive.
- B. Silicone Joint Sealant/s: Mildew-resistant silicone sealant for filling gaps between countertops and terminating substrates in wet environment applications. Complies with ASTM C920, Type S (single component), Grade NS (nonsag).
 1. Product/s: Refer to Section 07 92 00 - Joint Sealants
 2. Color: Complementary to solid surfacing color.
- C. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex for general applications to fill gaps between countertops and at terminating substrates. Complies with ASTM C384, Type OP, Grade NF, and SCAQMD Rule 1168.
 1. Product/s: Refer to Section 07 92 00 - Joint Sealants
 2. Color: Complementary to quartz surfacing color.
- D. Silicone Adhesive: Countertop manufacturer's recommended silicone-based construction adhesive for backsplashes, endsplashes, and other applications according to manufacturer's published fabrication instructions.
- E. Hot-Melt Adhesive: To provide a temporary bond, to hold solid surface material in place until the main adhesive cures.
- F. Solvent: Product recommended by adhesive manufacturer to clean surface of solid surfacing to assure adhesion of adhesives and sealants.
- G. Cleaning Agents: Non-abrasive, low pH cleansers.

2.10 FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 1. Grade: Premium.
- B. Fabricate tops with shop-applied edges of materials and configuration indicated.
- C. Fabricate tops with shop-applied backsplashes, and loose endsplashes for field application.
- D. Install integrated sinks in countertops in shop.
 1. Provide cut-outs for plumbing fixtures and trim, washroom accessories, appliances, and related items. Confirm layout with manufacturer's cut-out templates before beginning work. Round corners of cut-outs and sand edges smooth.
- E. Joints: Form joints between components using manufacturer's standard joint adhesive; without conspicuous joints.

- F. Cut and finish component edges with clean sharp returns. Route radius and contours to template. Repair or reject defective and inaccurate work.
- G. Do not exceed manufacturer's recommended unsupported overhang distances.
- H. Radius corners and edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine walls and other surrounding construction prior to installation of solid surface fabrications.
 - 1. Verify that construction complies with indicated requirements of construction documents regarding size, configuration and other requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install components plumb and level, scribed to adjacent finishes, in accordance with approved shop drawings and product installation details.
- B. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
 - 2. Install countertops with no more than 1/8 inch in 96-inch (3 mm in 2400-mm) sag, bow, or other variation from a straight line.
 - a. Field install endsplashes
 - 3. Calk space between backsplash and wall with sealant.
 - 4. Fabricate field joints using manufacturer's recommended adhesive, with joints being inconspicuous in finished work. Exposed joints/seams are not permitted. Keep components and hands clean when making joints. Reinforce field joints as specified herein. Cut and finish component edges with clean, sharp returns.

3.03 SITE QUALITY CONTROL

- A. Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, to satisfaction of Architect at no cost to Owner.

3.04 CLEANING

- A. Remove excess adhesive and sealant from visible surfaces.
- B. Clean surfaces in accordance with manufacturer's "Care and Maintenance Instructions".

3.05 PROTECTION

- A. DO NOT stand on the installed countertops for any reason.
- B. Provide protective coverings to prevent physical damage or staining following installation for duration of Project.
- C. Protect surfaces from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 05 53
FIRE AND SMOKE ASSEMBLY IDENTIFICATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Identification markings for fire and smoke rated partitions, and fire rated walls.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting

1.03 REFERENCE STANDARDS

- A. ICC (IBC) - International Building Code; 2015.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of marking, indicating font, foreground and background colors, wording, and overall dimensions.
- C. Schedule: Completely define scope of proposed marking, and indicate location of affected walls and partitions, and number of markings.
- D. Samples: Submit two samples of each type of marking proposed for use, of size similar to that required for project, illustrating font, wording, and method of application.

1.05 QUALITY ASSURANCE

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

1.06 FIELD CONDITIONS

- A. Do not install painted markings when ambient temperature is lower than recommended by coating manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Partition Identification Labels:
 - 1. Fire Wall Signs, Inc
 - 2. Safety Supply Warehouse, Inc
- B. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - 1. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures"

2.02 FIRE AND SMOKE ASSEMBLY IDENTIFICATION

- A. Regulatory Requirements: Comply with "Marking and Identification" requirements of "Fire-Resistance Ratings and Fire Tests" chapter of ICC (IBC) 2009, 2012, 2015, or 2018
- B. Adhered Fire and Smoke Assembly Identification Signs: Printed vinyl or paper sign with factory applied adhesive backing.
- C. Applied Fire and Smoke Assembly Identification: Identification markings applied to partition with paint and a code compliant stencil.
- D. Languages: Provide sign markings in English.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. See Section 09 91 23 - Interior Painting for substrate preparation for painted markings.

3.03 INSTALLATION

- A. Locate markings as required by ICC (IBC) 2009, 2012, 2015, or 2018
- B. Install adhered markings in accordance with manufacturer's instructions.
- C. Install applied markings in accordance with Section 09 91 23.
- D. Install neatly, with horizontal edges level.

3.04 BUILDING ASSEMBLY IDENTIFICATION

- A. Refer to Section 07 05 53 - Fire and Smoke Assembly Identification, for requirements.

3.05 PENETRATION ASSEMBLY IDENTIFICATION

- A. Refer to Section 07 05 53 for requirements.

3.06

3.07

3.08

3.09

3.10 PROTECTION

- A. Protect from damage until Date of Substantial Completion; repair or replace damaged markings.

END OF SECTION

SECTION 07 81 00
APPLIED FIREPROOFING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Section includes sprayed fire-resistive materials (SFRM).

1.03 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing
- B. Section 05 21 00 - Steel Joist Framing
- C. Section 05 31 00 - Steel Decking
- D. Section 07 05 53 - Fire and Smoke Assembly Documentation
- E. Section 07 81 23 - Intumescent Fire-Resistive Materials
- F. Section 07 81 28 - Fire-Protective Intumescent Thermal Barriers
- G. Section 07 84 00 - Penetration Firestopping

1.04 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans, schedules, or both, indicating the following:
 - 1. Extent of fireproofing for each construction and fire-resistance rating.
 - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
 - 4. Treatment of fireproofing after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.
- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups to set quality standards for materials and execution and for preconstruction testing.
 - 1. Build mockup of each type of fireproofing and different substrate as shown on Drawings.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups of fireproofing.
 1. Provide test specimens and assemblies representative of proposed materials and construction.
- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

1.09 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is below 40 degrees F unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
 1. Primary structural frame (i.e. columns, beams/girders connected to columns, braces), 3 Hours: UL X790.
 2. Floor beams & associated secondary members, 2 Hours: UL N759
 3. Roof construction & associated secondary members, 1 1/2 Hours: UL D756.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction and the following VOC limits when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 1. Flat Paints and Coatings: 50 g/L.
 2. Nonflat Paints and Coatings: 150 g/L.
 3. Primers, Sealers, and Undercoaters: 200 g/L.
 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
- E. Asbestos: Provide products containing no detectable asbestos.

2.02 SPRAYED FIRE-RESISTIVE MATERIALS

- A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.
 - 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. Isolatek International; Cafco 300 or Cafco 400.
 - b. GCP Applied Technologies; MK-5
 - 2. Applications:
 - a. For Interior Applications; Concealed.
 - b. For Interior Applications; Exposed to View and Away from Damage.
 - 3. Bond Strength: Minimum 150-lbf/sq. ft. (7.18-kPa) cohesive and adhesive strength based on field testing according to ASTM E736.
 - 4. Density: Not less than 15 lb/cu. ft. as specified in the approved fire-resistance design, according to ASTM E605/E605M.
 - 5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E605, whichever is thicker, but not less than 0.375-inches.
 - 6. Combustion Characteristics: ASTM E136
 - 7. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 10 or less.
 - b. Smoke-Developed Index: 10 or less.
 - 8. Compressive Strength: Minimum 10 lbf/sq. in. (68.9 kPa) according to ASTM E760/E760M.
 - 9. Corrosion Resistance: No evidence of corrosion according to ASTM E937/E937M.
 - 10. Deflection: No cracking, spalling, or delamination according to ASTM E759/E759M.
 - 11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
 - 12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. (0.270 g/sq. m) in 24 hours according to ASTM E859/E859M.
 - 13. Fungal Resistance: No growth after 28 days when tested according to ASTM G21.
 - 14. Finish: Spray-textured finish.
 - a. Color: As indicated by manufacturer's designations.

2.03 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
 - 1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E736.
- C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written

recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.

1. Minimum weight of 1.7 psf, galvanized finish.
- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
 - F. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
 - G. Water: Clean, potable.
 - H. Overcoat: As recommended by manufacturer of applied fireproofing material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
 2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck has been completed before beginning fireproofing work.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work is complete before beginning fireproofing work.
- D. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.03 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable

to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
 - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
 - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
 - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
 - 2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written recommendations.
- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
 - 1. Spray-Textured Finish: Finish left as spray applied with no further treatment.

3.04 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Test and inspect as required by the applicable chapter of current adopted IBC.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
 - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
 - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

3.05 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.
- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

SECTION 07 81 23
INTUMESCENT FIRE RESISTIVE MATERIALS (IFRM)

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Thin-film intumescent fire-resistive material for application to exposed structural steel.
- B. Protective and/or decorative topcoats.

1.03 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing
- B. Section 05 21 00 - Steel Joist Framing
- C. Section 05 31 00 - Steel Decking
- D. Section 07 81 00 - Applied Fireproofing
- E. Section 07 84 00 - Penetration Firestopping

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- D. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- E. SSPC-PA 2 - Procedure For Determining Conformance To Dry Coating Thickness Requirements; 2015.
- F. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.05 DEFINITION

- A. Intumescent Fire-Resistive Materials, from here on referred to as IFRM's, shall refer specifically to water-based intumescent coating designed for the fire protection of interior structural steel.

1.06 SYSTEM DESCRIPTION

- A. The IFRM's shall be applied at the required thickness to provide the UL fire resistive ratings.
- B. Provide labor, materials, equipment, and application necessary for, and incidental to, the complete and proper installation of intumescent fire protection for application to steel structures and supports in accordance with all applicable requirements of contract documents.

1.07 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Performance characteristics and test results.
 - 2. Preparation instructions and recommendations.
 - 3. Storage and handling requirements and recommendations.
 - 4. Installation methods.
- B. Selection Samples: For decorative top coat, color chips representing manufacturer's full range of available colors and sheens.
- C. Verification Samples: For each thickness, color, sheen, and finish required, samples not less than 4 inches square on steel substrate, illustrating finished appearance.

- D. Certificates: Certify that intumescent fireproofing provided for this project meets or exceeds specified requirements in all respects.
- E. Test Reports: Published fire resistive designs for structural elements of the types required for the project, indicating hourly ratings of each assembly.
- F. Field Quality Control Submittals: Submit field test report.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.

1.08 QUALITY ASSURANCE

- A. Comply with ASTM E2924 for the testing, labeling, transportation, delivery, storage, shelf life, application and inspection of intumescent coatings.
- B. Provide materials and construction for hourly ratings listed in the Underwriters Laboratories, Inc. Fire Resistance Directory or as calculated by the American Iron and Steel Institute formula.
- C. Manufacturer Qualifications: Company that specializes in manufacturing the type of products specified, with minimum of ten years of documented experience.
- D. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.
- E. Mock-ups:
 - 1. Provide a mock-up for evaluation of surface preparation techniques and application workmanship; approved mock-up will serve as a standard of comparison for subsequent work of this section.
 - 2. Finish at least 100 sq ft of steel in areas designated by Architect.
 - 3. Evaluate mock-up for compliance with specified requirements, including thickness and finish texture.
 - 4. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 5. Refinish mock-up area as required to produce acceptable work.
 - 6. Approved mock-up may remain as part of the project.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened containers with identification labels and testing agency markings intact and legible.
- B. Store products in manufacturer's unopened packaging until ready for installation.
 - 1. Protect from freezing, and do not store in direct sunlight.
 - 2. Dispose of any materials that have come into contact with contaminants of any kind prior to application.
- C. Dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.10 FIELD CONDITIONS

- A. Protect areas of application from windblown dust and rain.
- B. Maintain ambient field conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under ambient conditions outside manufacturer's absolute limits.
 - 1. Provide temporary enclosures as required to control ambient conditions.
 - 2. Do not apply intumescent fireproofing when ambient temperatures are below 50 degrees F without specific approval from manufacturer.
 - 3. Maintain relative humidity between 40 and 60 percent in areas of application.
 - 4. Maintain ventilation in enclosed spaces during application and for not less than 72 hours afterward.

1.11 SEQUENCING & SCHEDULING

- A. Coordinate application of IFRM's with related work specified in other sections to comply with the following requirements:
 - 1. Prevent deterioration due to exposure to unfavorable environmental conditions.
 - 2. Protect fireproofing from abrasion and other damage likely to occur during construction operations after its application.
 - 3. The installation of piping, ducts, conduit or other suspended equipment shall not commence until the application of the IFRM is complete in that area.
 - 4. Install the IFRM to allow sufficient time for inspection, testing, and correction of defective fireproofing.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Isolatek International Corporation
 - 1. Other acceptable manufacturers with equivalent products to the specified manufacturer shall include:
 - a. Carboline Company.
 - b. Albi Manufacturing.
 - c. Contego International, Inc.
 - d. Hilti Inc.
 - 2. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures"

2.02 SYSTEM REQUIREMENTS

- A. Provide IFRM's tested by an independent testing agency in accordance with ASTM E119 and acceptable to authorities having jurisdiction (AHJ).
 - 1. Provide assemblies listed by UL or FM and bearing listing agency label or mark.
- B. Provide fire resistance ratings for building elements as required by the 2009, 2012, 2015, or 2018 IBC.
 - 1. Refer to the 'Life Safety Plan' in the drawings for fire-resistant ratings of beams and joists supporting floor and roof construction, steel columns, and steel deck

2.03 INTUMESCENT FIRE-RESISTIVE MATERIALS

- A. Product: CAFCO® SprayFilm® WB 5™ as supplied by Isolatek International.
- B. IFRM's shall be applied in accordance with drawings and/or specifications, and shall have been tested in accordance with the procedures of ANSI / UL 263 or ASTM E119, and reported by Underwriters Laboratories, Inc.
 - 1. Factory-mixed formulation.
 - 2. Water-Based Formulation: Approved by manufacturer and authorities having jurisdiction for indicated use.
 - 3. Verify with manufacturer that products selected are suitable for use indicated.
 - 4. UL Fire Tested Designs only based on ANSI/UL 263UL 263 (ASTM E119).
 - 5. Current Third Party Evaluation Service Report
 - 6. To assure an acceptable Architectural finish, no mesh is allowed.

2.04 MATERIALS

- A. IFRM Properties:
 - 1. Surface Burning Characteristics: Tested in accordance with ASTM E84.
 - a. Flame Spread Index (FSI): 25, maximum.
 - b. Smoke Developed Index (SDI): 50, maximum.
 - 2. For Interior Use:

- a. Use only water-based products.
- b. Use only products without fiber content.
- c. VOC Content: Less than 500 g per L when tested in accordance with 40 CFR 59, Subpart D (EPA Method 24).
- d. Durometer Hardness, Type D: 70, minimum, in accordance with ASTM D2240.

2.05 DECORATIVE TOPCOAT

- A. Topcoat materials shall be as required for color-coding, aesthetics or additional surface protection, approved by the thin-film fire resistive material manufacturer and applied in full accordance with the coating manufacturer's written instructions.
 - 1. Color and Gloss: As selected by Architect.

2.06 AUXILIARY MATERIALS

- A. Sealers and Primer: As required by tested and listed assemblies, and as recommended by fireproofing manufacturer to suit specific substrate conditions.
- B. Reinforcement: Glass fiber fabric matching type used in tested and listed assemblies.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates to determine if they are in satisfactory condition to receive intumescent fireproofing; verify that substrates are clean and free of oil, grease, incompatible primers, or other foreign substances capable of impairing bond to fireproofing system.
- B. Do not begin installation until substrates have been properly prepared.
- C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean substrates, removing dirt, dust, oil, grease, loose material, incompatible primers, or other substances which may impair bonding of fireproofing to the substrate.
- B. Thoroughly clean surfaces to receive fireproofing.
- C. Repair substrates to remove surface imperfections that could effect uniformity of texture and thickness of fireproofing system, and remove minor projections and fill voids that could telegraph through finished work.
- D. Cover or otherwise protect other work that might be damaged by fallout or overspray of fireproofing system, and provide temporary enclosures as necessary to confine operations and maintain required ambient field conditions.

3.03 APPLICATION

- A. The IFRM shall be applied at the required dry film thickness per the appropriate design number guidelines and manufacturer's written application instructions.
- B. Comply with manufacturer's instructions for particular conditions of installation in each case.
- C. Apply manufacturer's recommended primer to required coating thickness.
- D. Apply IFRM's to full thickness over entire area of each substrate to be protected.
- E. Apply coats at manufacturer's recommended rate to achieve dry film thickness (DFT) as required for fire resistance ratings designated for each condition.
- F. Apply intumescent fireproofing by spraying to maximum extent possible, and as necessary complete coverage by roller application or other method acceptable to manufacturer.
- G. Achieve uniform finished appearance complying with approved mock-up.

3.04 CLEAN UP AND REPAIR

- A. Upon completion of installation, all excess material, overspray and debris shall be cleared and removed from the job site.

- B. All patching of and repair to thin-film fire resistive material, due to damage by other trades, shall be performed under this section and paid for by the trade responsible for the damage. Patching shall be performed by an applicator with expertise in the installation of fire resistive or similar materials. Repair shall be in accordance with UL design number guidelines and manufacturers written application instructions.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00 - Quality Requirements.
 - 1. Arrange for testing of installed IFRM's by an independent testing laboratory using magnetic pull-off dry film thickness gage in accordance with SSPC-PA 2, and ensure it meets requirements of authorities having jurisdiction (AHJ).
 - 2. Submit field test reports promptly to Contractor and Architect.
- B. Repair or replace IFRM's at locations where test results indicate fireproofing does not meet specified requirements.

3.06 PROTECTION

- A. Protect installed IFRM from damage due to subsequent construction activities, so fireproofing is without damage or deterioration before Date of Substantial Completion.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 84 00
PENETRATION FIRESTOPPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Only tested firestop systems shall be used in specific locations as follows:
 - 1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - 2. Blank openings through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
 - 3. Openings and penetrations in fire-rated partitions or walls containing fire doors.
 - 4. Openings around structural members which penetrate floors or walls.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 04 20 00 - Unit Masonry
- C. Section 05 12 00 - Structural Steel Framing
- D. Section 05 21 00 - Steel Joist Framing
- E. Section 05 31 00 - Steel Decking
- F. Section 07 05 53 - Fire and Smoke Assembly Identification
- G. Section 07 81 00 - Applied Fireproofing
- H. Section 07 81 23 - Intumescent Fire-Resistive Materials
- I. Section 07 81 28 - Fire-Protective Intumescent Thermal Barriers
- J. Section 07 92 00 - Joint Sealants
- K. Section 09 21 16 - Gypsum Board Assemblies
- L. Division 21 - Fire Suppression
- M. Division 22 - Plumbing
- N. Division 23 - Heating, Ventilating, and Air Conditioning
- O. Division 26 - Electrical

1.04 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.05 SUBMITTALS

- A. Product Data: For each type of through-penetration firestop system product indicated.
- B. System Drawings: Submit documentation from a qualified third-party testing agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
- C. Product Certificates: Certificate of conformance signed by manufacturers of through-penetration firestop system products certifying that products comply with requirements.

1.06 QUALITY ASSURANCE

- A. Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Criteria" Article:

1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 2. Through-penetration firestop system products bear classification marking of qualified testing and inspection agency.
- B. Engage an experienced installer who is FM4991 certified, licensed and otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products per specified requirements. A manufacturer's willingness to sell its through-penetration firestop system products to a Contractor or to an installer engaged by Contractor does not confer qualifications on buyer.
 - C. Obtain through-penetration firestop systems for each type of penetration and construction condition indicated from a single manufacturer.
 - D. Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings".
 - E. Replace/Reinstall material removed for any and all destructive testing performed.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instructions for multi-component materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.
- C. Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- D. Do not install through-penetration firestop systems when substrates are wet due to rain, frost, condensation, or other causes.
- E. Do not use materials that contain flammable solvents.

1.09 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
 1. A 3" minimum "NO FLY-ZONE" (no penetrations allowed) as measured from the underside of structure along the top of the wall shall be observed for all new penetration(s) in new and existing fire rated wall construction.
 2. All sub-contractors shall coordinate and receive approval for proposed locations of new penetrations in fire rated walls with the General Contractor PRIOR to the commencement of work.
- B. Coordinate sizing of sleeves, openings, core-drilled holes or cut openings to accommodate through-penetration firestop systems.
- C. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- D. Upon the installation of acoustic ceiling tiles in ceiling grid, any work that shall occur above the ceiling by trades contracted directly with the Owner or the General Contractor shall follow the procedures outlined in the Owner's "Above Ceiling Permit Policy".

1.10 WARRANTY

- A. At project closeout, provide to Owner an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Hilti, Inc.
 - 1. Other Acceptable Manufacturers with equivalent products to the specified manufacturer shall include:
 - a. 3M Fire Protection Products
 - b. A/D Fire Protection Systems Inc .
 - c. Everkem Diversified Products, Inc.
 - d. Grabber Construction Products, Inc
 - e. Nelson FireStop Products
 - f. Passive Fire Protection Partners
 - g. Specified Technologies Inc
 - h. Tremco Commercial Sealants & Waterproofing
 - 2. Additional Manufacturers will be considered in accordance with the "or equal" provision specified in Section 01 60 00 – Product Requirements.
 - a. Substitutions: Submit a "Request for Substitution" for any manufacturer not named, in conformance with Section 01 33 00.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Fire-resistance-rated walls include fire-barrier walls and smoke-barrier walls.
 - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
 - 1. Horizontal assemblies include floors and floor/ceiling assemblies.
 - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
 - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
 - 1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at 0.30-inch wg (74.7 Pa) at both ambient and elevated temperatures.
- E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.
- F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.
- G. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.03 MIXING

- A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.04 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E 814 or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Pre-formed firestop devices for use with noncombustible and combustible pipes (closed and open systems), conduit, and/or cable bundles penetrating concrete floors
 1. Hilti Cast-In Place Firestop Device (CP 680-P)
 2. Hilti Cast-In Place Firestop Device (CP 680-M) for use with noncombustible penetrants.
 3. Hilti Cast-in Place Firestop System for Metal Decks (CFS CID MD P) including all components as described by manufacturer for proper installation.
 4. Hilti Cast-in Place Firestop System for Metal Decks (CFS CID MD M) including all components as described by manufacturer for proper installation, for use with noncombustible penetrants.
 5. Hilti Firestop Speed Sleeve (CP 653) for use with cable penetrations.
 6. Hilti Firestop Drop-In Device (CFS-DID) for use with noncombustible and combustible penetrants.
 7. Hilti Firestop Block (CFS-BL)
 8. Hilti Closet Stub (CFS-CID CS)
- C. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT)
 1. Hilti Intumescent Firestop Sealant (FS-ONE MAX)
 2. Hilti Fire Foam (CP 620)
 3. Hilti Flexible Firestop Sealant (CP 606)
 4. Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG)
 5. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL)
- D. Sealants or caulking materials for use with sheet metal ducts
 1. Hilti Silicone Sealant Gun Grade (CFS-S SIL GG)
 2. Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL)
 3. Hilti Flexible Firestop Sealant (CP 606)
 4. Hilti Intumescent Firestop Sealant (FS-ONE MAX)
- E. Intumescent sealants, caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe
 1. Hilti FS-ONE MAX Intumescent Firestop Sealant
- F. Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles
 1. Hilti; CFS-S SIL GG Firestop Silicone Sealant Gun-Grade
 2. Hilti; CFS-S SIL SL Firestop Silicone Sealant Self-Leveling
 3. Hilti CP-606 Flexible Firestop Sealant
 4. Hilti CP-620 Fire Foam
 5. Hilti FS-ONE MAX Intumescent Firestop Sealant
- G. Non-curing, re-penetrable intumescent putty or foam materials for use with flexible cable or cable bundles
 1. Hilti CP 618 Firestop Putty Stick

2. Hilti CFS-PL Firestop Plug
- H. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes
 1. Hilti; Firestop Box Insert
 2. Hilti CFS-P PA Firestop Putty Pad
 3. Hilti CP 617 Moldable Firestop Putty Pad
- I. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems)
 1. Hilti CP 643N Retrofit Firestop Collar
 2. Hilti CP 644 Firestop Collar, for 8" and 10" pipes
 3. Hilti CP-648-E / CP-648-S Wrap Strips
- J. Materials used for large openings and complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways
 1. Hilti; CFS-BL Firestop Block
 2. Hilti CP-637 Firestop Mortar
 3. Hilti CP-620 Fire Foam, 2-part polyurethane, suited for complex applications
 4. Hilti CP-675T Firestop Board
- K. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays and bundles, multiple steel and copper pipes, electrical busways in raceways
 1. Hilti; CFS-BL Firestop Block
 2. Hilti CP-675T Firestop Board
- L. Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls
 1. Hilti; CP653 Speed Sleeve
 2. Hilti CFS-CC Firestop Cable Collar
 3. Hilti CFS-SL-SK Firestop Sleeve
 4. Hilti; CFS-SL RK Retrofit Sleeve Kit for existing cables
 5. Hilti; CFS-SL SK Firestop Sleeve Kit
 6. Hilti CFS-SL GP Gangplate, for use with multiple cable management devices.
 7. Hilti CFS-SL GP-CAP Gangplate Cap, for use at blank openings in gangplate for future penetrations.
- M. For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits or cables is expected
 1. Hilti CFS-BL Firestop Block
 2. Hilti CFS-PL Firestop Plug
- N. For single or cable bundles up to one inch diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies
 1. Hilti CFS-D Firestop Cable Disc

PART 3 EXECUTION

3.01 PREPARATION

- A. Examination of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
- B. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 THROUGH PENETRATION FIRESTOP INSTALLATION

- A. General Requirements: Install through-penetration firestop systems in accordance with "Performance Criteria" Article and in accordance with the conditions of testing and classification as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration firestop systems products.
 - 1. Seal all openings or voids made by penetrations to ensure an air and water resistant seal.
 - 2. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of through-penetration firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - 3. Protect materials from damage on surfaces subjected to traffic.

3.03 BUILDING ASSEMBLY IDENTIFICATION

- A. Refer to Section 07 05 53 - Fire and Smoke Assembly Identification, for requirements.

3.04 PENETRATION ASSEMBLY IDENTIFICATION

- A. Refer to Section 07 05 53 - Fire and Smoke Assembly Identification, for requirements.

3.05 FIELD QUALITY CONTROL

- A. Inspections: Owner shall engage a qualified independent inspection agency to inspect through-penetration firestop systems.
- B. Keep areas of work accessible until inspection by authorities having jurisdiction.
- C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.06 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed openings to be free of excess through-penetration firestop system materials and soiling as work progresses.

PART 4 - SCHEDULES

4.01 SCHEDULE OF THROUGH PENETRATION FIRESTOP SYSTEMS

CONCRETE FLOORS			CONCRETE OR BLOCK WALLS		
TYPE OF PENETRANT	F-RATING (HR)	BA 818 OF DESIGN UL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BA 818 OF DESIGN UL SYSTEM
CIRCULAR BLANK OPENINGS	1	F-A-0006, C-AJ-0055, C-AJ-0090	CIRCULAR BLANK OPENINGS	1	C-AJ-0055, C-AJ-0090
	2	F-A-0006, C-AJ-0055, C-AJ-0090		2	C-AJ-0055, C-AJ-0090
	3	F-A-0006, C-AJ-0055, C-AJ-0090		3	C-AJ-0055, C-AJ-0090
SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, F-A-1028, F-A-1017	SINGLE METAL PIPES OR CONDUIT	1	C-AJ-1226, W-J-1067, W-J-1020
	2	C-AJ-1226, F-A-1028, F-A-1017		2	C-AJ-1226, W-J-1067, W-J-1020, W-J-1248
	3	C-AJ-1226, F-A-1017		3	C-AJ-1226, W-J-1041, W-J-1068
	4	C-BJ-1037, C-BJ-1034		4	C-BJ-1034, C-BJ-1037, W-J-1041, W-J-1042, W-J-1068
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	F-A-2053, F-A-2025, C-AJ-2109, C-AJ-2098, C-AJ-2271, C-AJ-2167	SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	1	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
	2	C-AJ-2098, C-AJ-2271, C-AJ-2167, C-BJ-2021, C-AJ-2371, C-AJ-2342		2	C-AJ-2109, C-AJ-2098, C-AJ-2167, C-AJ-2371, C-AJ-2342
	3	F-A-2054, C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342		3	C-AJ-2109, C-AJ-2098, C-AJ-2371, C-AJ-2342
	4	C-BJ-2016, C-AJ-2017		4	W-J-2057, W-J-2091
SINGLE/CABLE BUNDLES	1	F-A-3007, C-AJ-3095, C-AJ-3180, C-AJ-3283	SINGLE/CABLE BUNDLES	1	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167
	2	F-A-3007, C-AJ-3095, C-AJ-3334, F-A-3060		2	W-J-3036, C-AJ-3095, C-AJ-3180, W-J-3060, W-J-3167, W-J-3189
	3	F-A-3007, C-AJ-3095, C-AJ-3285		3	C-AJ-3095, C-AJ-3180, W-J-3167
CABLE TRAY	1	C-AJ-4034, C-AJ-4035		4	W-J-3060
	2	C-AJ-4034, C-AJ-4035	CABLE TRAY	1	W-J-4027, C-AJ-4034, C-AJ-4035
	3	C-AJ-4034, C-AJ-4035		2	W-J-4027, C-AJ-4034, C-AJ-4035
SINGLE INSULATED PIPES	1	F-A-5015, F-A-5017, C-AJ-5090, C-AJ-5091, C-AJ-5098, C-AJ-5048		3	C-AJ-4034, C-AJ-4035
	2	F-A-5015, F-A-5017, C-AJ-5090, C-AJ-5091, C-AJ-5098		4	W-J-8007
	3	F-A-5016, C-AJ-5090, F-A-5018	SINGLE INSULATED PIPES	1	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
	4	C-BJ-5008		2	C-AJ-5090, C-AJ-5091, C-AJ-5061, W-J-5042
ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, F-A-6002, C-AJ-6036		3	C-AJ-5090, C-AJ-5061
	2	C-AJ-6006, C-AJ-6017, F-A-6042, C-AJ-6036		4	C-BJ-5006, W-J-5028
	3	C-AJ-6006, C-AJ-6017	ELECTRICAL BUSWAY	1	C-AJ-6006, C-AJ-6017, C-AJ-6036
MECHANICAL DUCTWORK WITHOUT DAMPERS NON-INSULATED	1	C-AJ-7046, C-AJ-7051, C-AJ-7084		2	C-AJ-6006, C-AJ-6017, C-AJ-6036
	2	C-AJ-7046, C-AJ-7051, C-AJ-7085		3	C-AJ-6006, C-AJ-6017
	3	C-AJ-7046, C-AJ-7051		1	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	N/A**	N/A**		2	C-AJ-7046, C-AJ-7051, W-J-7021, W-J-7022
	N/A**	N/A**	MECHANICAL DUCTWORK WITHOUT DAMPERS INSULATED	3	C-AJ-7046, C-AJ-7051
MIXED PENETRANTS	1	C-AJ-8099, C-AJ-8056, C-AJ-8143		1	W-J-7029, W-J-7124
	2	C-AJ-8099, C-AJ-8056, C-AJ-8143		2	W-J-7091, W-J-7112, W-J-7124
	3	C-AJ-8099, C-AJ-8056	MIXED PENETRANTS	1	C-AJ-8099, C-AJ-8056, W-J-8007, C-AJ-8143
	4	C-AJ-8099		2	C-AJ-8099, C-AJ-8056, W-J-8007, C-AJ-8143
				3	C-AJ-8041, C-AJ-8056, W-J-8007, C-AJ-8099
				4	C-AJ-8099, W-J-8007

WOOD FLOOR			GYPSUM WALL		
TYPE OF PENETRANT	F-RATING (HR)	BA 818 OF DESIGN UL SYSTEM	TYPE OF PENETRANT	F-RATING (HR)	BA 818 OF DESIGN UL SYSTEM
METAL PIPES OR CONDUIT	1	F-C-1009, F-C-1059, F-C-1168	METAL PIPES OR CONDUIT	1	W-L-1054, W-L-1058, W-L-1164, W-L-1506
	2	F-C-1009, F-C-1059, F-C-1168		2	W-L-1054, W-L-1058, W-L-1164, W-L-1506
NON-METALLIC PIPE OR CONDUIT	1	F-C-2232, F-C-2030, F-C-2160, F-C-2389	NON-METALLIC PIPE OR CONDUIT	1	W-L-1110, W-L-1111, W-L-1165
	2	F-C-2029, F-C-2030, F-C-2128, F-C-2160		2	W-L-2078, W-L-2075, W-L-2128
SINGLE OR BUNDLED CABLES	1	F-C-3012, F-C-3110, F-C-3044	SINGLE OR BUNDLED CABLES	1	W-L-2184, W-L-2245
	2	F-C-3012, F-C-3110		2	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
INSULATED PIPES	1	F-C-5004, F-C-5037, F-C-5036	CABLE TRAY	1	W-L-3065, W-L-3111, W-L-3112, W-L-3334, W-L-3414, W-L-3396
	2	F-C-5004, F-C-5037		2	W-L-3385, W-L-3277
NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	F-C-7013	INSULATED PIPES	1	W-L-3139, W-L-3334
	2	F-C-7013		2	W-L-4011, W-L-4019, W-L-4081
INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	N/A**	NON-INSULATED MECHANICAL DUCTWORK WITHOUT DAMPERS	1	W-L-4011, W-L-4019, W-L-4081
	2	N/A**		2	W-L-4011, W-L-4019, W-L-4081
MIXED PENETRANTS	1	F-C-8009, F-C-8014, F-C-8026	MIXED PENETRANTS	1	W-L-8014
	2	F-C-8009, F-C-8014, F-C-8026		2	W-L-5028, W-L-5029, W-L-5047
				2	W-L-5028, W-L-5029, W-L-5047
				4	W-L-5072
				4	W-L-5072
				1	W-L-7047, W-L-7040, W-L-7042, W-L-7155
				2	W-L-7040, W-L-7042, W-L-7155
				1	W-L-7059, W-L-7153, W-L-7156, W-L-7151
				2	W-L-7059, W-L-7153, W-L-7156, W-L-7151
				1	W-L-1095, W-L-8013
				2	W-L-1095, W-L-8013
				4	W-L-8014

COMPOSITE METALDECK FLOOR			
TYPE OF PENETRANT	FLOOR COVERAGE	F-RATING (HR)	BA 818 OF DESIGN UL SYSTEM
CIRCULAR BLANK OPENINGS	2-1/2"	2	F-A-0040
	4-1/2"	2	F-A-0040, F-A-0041
SINGLE METALLIC PIPE OR CONDUIT (STEEL, IRON, COPPER)	2-1/2"	2	F-A-1192, F-A-1193
	4-1/2"	3	F-A-1192, F-A-1193
SINGLE NON-METALLIC PIPE OR CONDUIT (I.E. PVC, CPVC, ABS, FRP, ENT)	2-1/2"	2	F-A-1194
	4-1/2"	2	F-A-2310, F-A-2311
SINGLE/CABLE BUNDLES	2-1/2"	2	F-A-2313, F-A-2314, F-A-2315, F-A-2316
	4-1/2"	3	F-A-2310, F-A-2311, F-A-2312
SINGLE INSULATED PIPES	2-1/2"	3	F-A-3071, F-A-3072
	4-1/2"	2	F-A-5069, F-A-5070, F-A-5071
MIXED PENETRANTS	2-1/2"	3	F-A-5069, F-A-5070, F-A-5071
	4-1/2"	3	F-A-8065

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Joint Sealants

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 04 20 00 - Brick and Concrete Masonry
- C. Section 06 61 16 - Solid Surface Fabrications
- D. Section 08 11 13 - Hollow Metal Doors and Frames
- E. Section 09 21 16 - Gypsum Board Assemblies
- F. Section 09 30 00 - Tiling
- G. Section 12 32 16 - Manufactured Plastic Laminate Faced Casework
- H. Section 12 36 61 - Quartz Surfacing Fabrications
- I. Divisions 21, 22, 23, 26, 27 specifications regarding building service systems that penetrate walls, floors, and ceilings.

1.04 REFERENCE STANDARDS:

- A. ASTM C510 - Standard Test Method for Staining and Color Change of Single- or Multicomponent Joint Sealant, 1990.
- B. ASTM C639 - Test Method for Rheological (Flow) Properties of Elastomeric Sealants, 1990.
- C. ASTM C719 - Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement, 1993.
- D. ASTM C834 - Standard Specification for Latex Sealants.
- E. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
- F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
- G. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants.
- H. ASTM C1193 - Standard Guide for Use of Joint Sealants.
- I. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants.
- J. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
- K. ASTM D412. Test Method for Vulcanized Rubber and Thermo-Plastic Rubbers and Thermo-Plastic Elastomers/Tensions.
- L. ASTM D2240. Test Method for Rubber Property- Durometer Hardness.
- M. ASTM E90 -
- N. American Association of State Highway and Transportation Officials (AASHTO), Standard Specifications for Highway Bridges, Thirteenth Edition, 1992. See Table 25.2B for physical property requirements of bridge bearing quality neoprene.

1.05 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

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

1.06 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.07 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and testing agency.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

- E. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- F. Field-Adhesion Test Reports: For each sealant application tested.
- G. Warranties: Sample of special warranties.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.
 - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site.

1.09 PROJECT CONDITIONS

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

1.10 WARRANTY

- A. Installation Warranty: The installing subcontractor shall warrant the installation to be free of defects in material and workmanship for a period of one (1) year from Date of Substantial Completion.
- B. Special Manufacturers Warranty: The manufacturer shall warrant the products specified in this Section against material defects, or defects in manufacturing, for a period of five (5) years from the Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Subject to compliance with the Contract Documents, provide products of the following manufacturers:
 - 1. Dow Corning Corporation.
 - 2. GE Advanced Materials.
 - 3. Tremco Incorporated.
 - 4. Pecora Corporation.
 - 5. BASF Building Systems.
 - 6. Surebond.
 - 7. Sherwin Williams
 - 8. GE Advanced Materials.
 - 9. Sika Flex.

- B. Products of unnamed manufacturers with equivalent products to the manufacturers listed will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - 1. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".

2.02 MATERIALS, GENERAL

- A. Joint Sealants, designated in this Section as Sealant Type JS- #
 - 1. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
 - 2. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
 - a. Architectural Sealants: 250 g/L.
 - b. Sealant Primers for Nonporous Substrates: 250 g/L.
 - c. Sealant Primers for Porous Substrates: 775 g/L.
 - 3. Liquid-Applied Joint Sealants: Comply with ASTM C920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 4. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.
 - 5. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
 - 6. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.03 SILICONE JOINT SEALANTS

- A. Type JS-1: Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, for Use NT.
 - 1. Acceptable Products:
 - a. BASF Building Systems; Omniplus.
 - b. Dow Corning Corporation; 786 Mildew Resistant.
 - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
 - d. Tremco Incorporated; Tremsil 200 Sanitary.
- B. Type JS-2: Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 50, for Use NT.
 - 1. Acceptable Products:
 - a. BASF Building Systems; Omniseal 50.
 - b. Dow Corning Corporation; 795.
 - c. GE Advanced Materials; SilPruf SCS2000.
 - d. Pecora Corporation; Pecora 895.
 - e. Tremco Incorporated; Spectrem 2.
 - f. Sika Corporation, Construction Products Division; SikaSil-C995.

2.04 URETHANE JOINT SEALANTS

- A. Type JS-3: Single-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.
 - 1. Acceptable Products:
 - a. BASF Building Systems; Sonolastic SL 1.
 - b. Pecora Corporation; Urexpan NR-201.
 - c. Sika Corporation. Construction Products Division; Sikaflex - 1CSL.
 - d. Tremco Incorporated; Vulkem 45.

- B. Type JS-4: Multi-Component, Pourable, Traffic-Grade, Urethane Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.
 - 1. Acceptable Products:
 - a. Pecora Corporation; Dynatrol II.
 - b. Tremco Incorporated; Vulkem 245.
 - c. SikaFlex; 2c SL
 - d. Sherwin Williams; Loxon 2K SL
- C. Type JS-5: Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C920, Type M, Grade NS, Class 50, for Use NT.
 - 1. Acceptable Products:
 - a. Pecora Corporation; Dynatrol II.
 - b. Tremco Incorporated; Dymeric 240 FC.

2.05 POLYUREA SEALANTS

- A. Type JS-6: Semi-Rigid, Multi-Component Polyurea Sealant: Self-leveling, 100% solids, rapid curing, polyurea control joint and crack filler with a Shore D 85 or higher hardness when tested in accordance with ASTM D2240. Tensile strength of 1160 pounds per square inch when tested in accordance with ASTM D412.
 - 1. Acceptable Products:
 - a. VersaFlex; S/L 85.
 - b. L & M Construction Chemicals, Inc.; Joint Tite 750.
 - c. Curecrete Distribution Company, Inc.; Ashford Crete-Fill.
 - d. Adhesives Technologies Corp.; Crackbond JF311.

2.06 LATEX JOINT SEALANTS

- A. Type JS-7: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - 1. Acceptable Products:
 - a. BASF Building Systems; Sonolac.
 - b. Pecora Corporation; AC-20+.
 - c. Tremco Incorporated; Tremflex 834.

2.07 ACOUSTICAL JOINT SEALANTS

- A. Type JS-8: Acoustical Joint Sealant, Latex: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834
- B. Properties: Acoustical sealants shall have the following properties:
 - 1. Hardness of no more than 50 durometer Shore A as rated in ASTM D2240.
 - 2. Minimum elongation of 500% as rated in ASTM D412.
 - 3. Minimum joint width movement of 25% as rated in ASTM C719.
 - 4. Self Leveling type (S/L) if applied on floors in accordance with ASTM C639.
 - 5. Non-Sag type (N/S) if applied on walls in accordance with ASTM C639.
 - 6. Acoustical sealants must meet the following additional requirements where applied in exposed locations:
 - a. Acoustical sealants shall be paintable.
 - b. Acoustical sealants shall be skinning type.
 - c. Acoustical sealants shall be non-staining type as rated in ASTM C510.
- C. Acceptable Products:
 - 1. Exposed Locations:
 - a. Grabber; Acoustical Sound and Smoke Sealant #GSCSF
 - b. Pecora Corporation; AIS-919 Acoustical Latex Sealant
 - c. USG Corporation; SHEETROCK Acoustical Sealant

2.08 SECURITY JOINT SEALANTS

- A. Security Joint Sealants (if applicable): Shall be tamper-resistant (non-pickable) joint sealants designed for security and institutional applications.

1. Sealants shall meet or exceed the requirements of the "Behavioral Health Design Guide, 9th Edition", and "FGI Guidelines for Design and Construction of Hospitals" (Facility Guidelines Institute).
- B. Type JS-9: Single-component, tamper-resistant, non-sag, elastomeric polyurethane joint sealant, ASTM C920, Type S, Grade NS, Class 12.5, Use T1, M, G, A, and 0.
 1. Acceptable Products:
 - a. Pecora; "DynaFlex SC".
 - b. Sika Corporation; "SikaFlex- 11FC".
 - c. BASF Corporation; "MasterSeal CR-195".
 2. Physical Properties:
 - a. Tensile Strength: 1.7 MPa (250 psi) in accordance with ASTM D 412.
 - b. Shore A Hardness: 55 plus or minus 5 in accordance with ASTM C 661.
 - c. Dynamic Movement Capability: 12.5 percent in accordance with ASTM C 719.
 3. Color: Standard colors or painted to blend with adjacent surfaces.
 4. Provide security joint sealants, primers, backings, and accessory materials that are compatible with one another and with Project joint substrates.

2.09 PUTTY PADS

- A. Putty pads shall be made from polybutene-butyl with inert fillers or other approved permanently resilient self-adhering material.
- B. Putty pads shall have a minimum thickness of 1/8-inch.
- C. Acceptable Products:
 1. Harry A. Lowry & Associates Outlet Box Pads
 2. Hevi-Duty Nelson FSP Putty Pads
 3. STI; Spec Seal SSP Putty Pads
 4. 3M; Fire Barrier Putty Pads

2.10 PACKING MATERIAL

- A. Packing material shall be of the following types:
 1. Mineral Fiber
 2. Glass Fiber
 3. Preformed Pipe Insulation

2.11 JOINT SEALANT BACKING

- A. Provide sealant backings of material that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C1330, Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.
- D. Expansion Joint Material: Preformed sealant shall be preformed, pre-compressed, self-expanding. Expanding foam to be cellular foam impregnated with a water-based, non-drying, polymer-modified 100% acrylic dispersion. Install as a secondary sealant to urethane sealant w/ backer rod provide BACKERSEAL as manufactured by EMSEAL Joint Systems, Ltd as indicated on the drawings for vertical expansion joint locations.
 1. Install BACKERSEAL at depth sufficient to allow installation of properly sized backer rod and sealant in front of material.
 2. Size: As indicated on the Drawings

2.12 MISCELLANEOUS MATERIALS

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

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION OF JOINT SEALANTS, GENERAL

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C1193, unless otherwise indicated.
 - 4. Provide flush joint profile where indicated per Figure 8B in ASTM C1193.
 - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written recommendations.

3.04 PUTTY PADS

- A. Brush or wipe construction dust and dirt from recessed box.
 - 1. If surface is contaminated with oil, wipe with xylene or toluene to remove oily residue.
- B. Before mounting recessed box or attaching conduit, adhere putty pad to box back and mounting side(s). Leave 1/2-inch minimum overlap along the front surface to enable wrapping of plaster ring.
- C. Mount recessed box and install plaster ring. Tighten all loose fasteners.
- D. Continue wrapping recessed box, all conduit attachments and plaster ring with putty pad. Press putty pad firmly into surfaces.
 - 1. If necessary, cut and apply additional pieces of putty pad to achieve an airtight seal around the recessed box, conduit attachments, and plaster ring.
- E. After gypsum board installation, press putty pad firmly against gypsum board to create an airtight seal.
 - 1. If airtight seal is not continuous around the plaster ring perimeter, seal any gaps or voids with a liberal bead of acoustical sealant to create an airtight seal.

3.05 PUTTY

- A. Brush or wipe construction dust and dirt from cables and conduit.
 - 1. If surfaces are contaminated with oil, wipe with xylene or toluene to remove oily residue.
- B. Properly space cables away from each other inside the conduit.

- C. Tightly pack mineral fiber between all cables.
 - 1. Pack mineral fiber tight around cables the full depth of the sleeve, holding back the mineral fiber 1/4" from both ends of the conduit sleeve.
- D. Fill all spaces between the cables and conduit with putty to a 1/4" depth to create an airtight seal. The putty shall be flush with both ends of the conduit sleeve or conduit stub.

3.06 CLEANING

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

3.07 PROTECTION

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

PART 4 - SCHEDULES

4.01 EXTERIOR JOINT SEALANT SCHEDULE

- A. Joint Sealant Application: Joints in horizontal traffic surfaces.
 - 1. Joint Locations:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - 2. Sealant Type JS-4, Urethane.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint Sealant Application: Joints in vertical surfaces and horizontal non-traffic surfaces.
 - 1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Control and expansion joints in masonry.
 - c. Joints in exterior insulation and finish systems.
 - d. Joints between metal panels.
 - e. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors, windows and louvers.
 - g. Control and expansion joints in ceilings and other overhead surfaces.
 - h. Other joints as indicated.
 - 2. Sealant Type JS-2, Silicone.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint Sealant Application: Exterior joints in vertical surfaces.
 - 1. Joint Location:
 - a. Masonry control joints.
 - b. Joints around hollow metal frames and penetrating items.
 - c. Other joints as indicated.
 - 2. Sealant Type JS-5, Multi-component, non-sag Urethane.
 - 3. Color: As selected by Architect from manufacturer's full range.

4.02 INTERIOR JOINT SEALANT SCHEDULE

- A. Application: Joints in exposed concrete slabs that do NOT receive floorcoverings, tile, or dyed and polished finish.
 - 1. Joint Locations: Joints in cast-in-place concrete slabs.
 - 2. Sealant Type JS-4, Urethane.
 - 3. Color: As selected by Architect from manufacturer's full range of colors.
- B. Application: Joints in horizontal traffic surfaces at tile flooring
 - 1. Sealant Type JS-4, Urethane; Multi component, pourable, traffic grade, class 25.

2. Color: As selected by Architect from manufacturer's full range of colors.
- C. Application: Control/contraction joints in concrete slabs with dyed and polished finish.
 1. Sealant Type JS-6, Polyurea.
 2. Color: As selected by Architect from manufacturer's full range of colors.
- D. Application: Joints in vertical surfaces and horizontal non-traffic surfaces.
 1. Joint Locations:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical joints on exposed surfaces of interior unit masonry and concrete.
 2. Sealant Type JS-5, Urethane.
 3. Color: As selected by Architect from manufacturer's full range of colors.
- E. Application: Interior non-moving joints in vertical surfaces.
 1. Joint Locations:
 - a. Vertical joints in exposed surfaces of gypsum drywall partitions.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Other joints as indicated.
 2. Joint-Sealant Type JS-7, Acrylic Latex.
 3. Color: As selected by Architect from manufacturer's full range of colors.
- F. Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
 1. Joint Locations:
 - a. Joints between plumbing fixtures and adjoining walls, floors, countertops.
 - b. Joints between backsplashes and adjacent wall surfaces at wet locations.
 - c. Tile control and expansion joints where indicated.
 - d. Other joints at wet locations where or not specifically detailed or called out to seal joints from leakage of water.
 2. Type JS-1, Silicone.
 3. Color: As selected by Architect from manufacturer's full range of colors.
- G. Application: Acoustical joints in vertical surfaces and horizontal non-traffic surfaces.
 1. Joint Locations:
 - a. All wall locations where sound attenuation batts are shown in the wall types.
 - b. Apply putty pads to all recessed boxes sharing a stud space where separate recessed boxes are open to both sides of wall.
 - c. Other joints as indicated.
 2. Sealant Type JS-8, Acoustical.
 3. Color: As selected by Architect from manufacturer's full range of colors.
- H. Application: Joints in vertical surfaces and horizontal non-traffic surfaces where tamper-resistant (non-pickable) joint sealants are required.
 1. Joint Locations:
 - a. Perimeter of light fixtures, mirrors, toilet accessories, etc.
 - b. Perimeter of door and window frames.
 - c. Protrusions and penetrations
 - d. Resilient Base: Perimeter joints to the wall and floor, and vertical joints between base pieces.
 - e. Other joints as indicated.
 2. Sealant Type JS-9, Polyurethane.
 3. Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Interior and exterior expansion control systems and accessories, including provisions for fire rated assemblies, moisture barriers, waterproofing, acoustic measures, or thermal measures.
- B. Parking, open-air structure and plaza expansion joint systems.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 05 12 00 - Structural Steel Framing
- C. Section 05 50 00 - Metal Fabrications
- D. Section 04 20 00 - Brick and Concrete Masonry
- E. Section 07 52 00 - APP Modified Bituminous Membrane Roofing
- F. Section 07 54 23 - TPO Single-Ply Roofing Systems
- G. Section 07 62 00 - Sheet Metal Flashing and Trim
- H. Section 07 92 00 - Joint Sealants
- I. Section 09 21 16 - Gypsum Board Assemblies

1.04 REFERENCE STANDARDS

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.
- C. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
- D. ITS (DIR) - Directory of Listed Products; current edition.
- E. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.06 ACTION SUBMITTALS

- A. Manufacturer's Specifications, technical data, installation instructions, and detail drawings for each proposed system.
- B. Listings/ Certifications of all Fire Rated Assemblies secured through Registered Third Party Testing Agency.
- C. Representative sample of specified systems 4-inch (100-mm) minimum length (if required by Project Architect)

1.07 SYSTEM DESCRIPTION

- A. Joint coverplate systems shall permit daily thermal expansion and contraction of building elements, minor foundation settlement, and common windsway movements of the structure without disengagement.

1. Joint system details shall clearly indicate X-axis joint movement capabilities (horizontal contraction/ expansion). Y-axis joint movement (in-plane shear), and Z-axis movement (vertical shear) may be requested of the Manufacturer if applicable.
 2. Movement capabilities shall be clearly defined as a percentage of the nominal joint width or with distinct dimensions defined on product details.
- B. Joint Systems shall allow for seismic movement (if applicable), matching requirements as defined within the Project Specific Structural Specifications.
- C. Fire Rated Assemblies shall be tested by registered Third Party Testing Agencies in accordance with UL2079, ULC S115, or BS 476 classified systems. Expansion joint assembly fire rating shall match or exceed the fire rating of adjacent construction.

1.08 QUALITY ASSURANCE

- A. Manufacturer: Furnish assemblies from one (1) manufacturer with a minimum of five (5) years of experience in the design, engineering and fabrication of expansion joint systems.
- B. Installer: Firm with not less than three (3) years of successful experience in the installation of systems similar to those required by this project and acceptable to the manufacturer of the system.

1.09 DELIVERY AND STORAGE

- A. Manufacturer to provide protective film on all exposed cover plate components.
- B. Inspect materials upon arrival. Store components in original containers in a clean, dry location. Ensure temperature or moisture sensitive components are stored in a tempered location.
- C. Contractor to provide temporary protective covers on all installed finished surfaces. Protection is required to guard against both surface abrasions as well as overloading of horizontal deck components by construction traffic.

1.10 SEQUENCING

- A. Submittals shall be completed and remitted to the Project Architect within 4 weeks after award of subcontract.
- B. Subcontract for the work of this section shall be planned to allow sufficient time for Manufacturer's production and delivery scheduling.

1.11 WARRANTY

- A. Manufacturers Limited Warranty: Warrant product/s against material and manufacturing defects for five (5) years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Construction Specialties, Inc
1. Other acceptable manufacturers with equivalent products to the specified manufacturer shall include:
 - a. Architectural Art Mfg, Inc
 - b. Inpro
 - c. MM Systems Corp
 - d. Nystrom, Inc
 2. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures"

2.02 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
1. Exposed Finish Outdoors: Natural anodized

2. Exposed Finish at Floors: Natural anodized
3. Exposed Finish at Walls and Ceilings: Mill finish
- B. Stainless Steel: Alloy Type 304 for plates and strips.
 1. Brushed #4 surface finish standard
- C. Elastomeric Seals: ASTM E 1783; preformed elastomeric membranes or extrusions to be installed in metal frames.
- D. Compression Seals: ASTM E 1612; preformed elastomeric extrusions having an internal baffle system and designed to function under compression.
- E. Cellular Foam Seals: Extruded, compressible foam designed to function under compression.
- F. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to meet performance criteria for required fire-resistance rating.
- G. Moisture Barrier: Flexible elastomeric material, Santoprene.
- H. Accessories: Manufacturer's standard anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.03 FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Aluminum Finishes
 1. Mill finish.
 2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.04 INTERIOR FLOOR JOINT SYSTEMS

- A. Floor-to-Floor:
 1. Products:
 - a. Non-Rated: C-S; Model #GFT/GFST-200
 - b. Fire-Rated: C-S; Model #GFT/GFST-200 w/ RFX-2F
 2. Nominal Joint Width: 2-inches
 3. Type of Movement: Thermal and Seismic
 4. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 2 hours
 5. Type: Elastomeric seal, recessed mounted
 6. Cover-Plate Design: Recessed to accept field-applied finish materials
 7. Cover-Plate Recess Depth: As required to accommodate adjacent flooring
 8. Metal: Aluminum
 - a. Finish: Mill
 9. Seal Material: Santoprene
 - a. Color: As selected by Architect from manufacturer's full range
- B. Floor-to-Wall:
 1. Products:
 - a. Non-Rated: C-S; Model #GFTW-200
 - b. Fire-Rated: C-S; Model #GFTW-200 w/ RFX-2F
 2. Nominal Joint Width: 2-inches
 3. Type of Movement: Thermal and Seismic.

4. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 2 hours.
5. Type: Elastomeric seal, recessed mounted.
6. Cover-Plate Design: Recessed to accept field-applied finish materials.
7. Cover-Plate Recess Depth: As required to accommodate adjacent flooring.
8. Metal: Aluminum.
 - a. Finish: Mill
9. Seal Material: Santoprene.
 - a. Color: As selected by Architect from manufacturer's full range.

2.05 INTERIOR WALL AND CEILING JOINT SYSTEMS

- A. Wall-to-Wall:
 1. Products:
 - a. Non-Rated Walls: C-S; Model # FWF-200
 - b. 1-Hour Rated Walls: C-S; Model # FWF-200 w/ RFX-1W
 - c. 2-Hour Rated Walls: C-S; Model # FWF-200 w/ RFX-2W
 2. Design Criteria:
 - a. Nominal Joint Width: 2 inches.
 - b. Movement Capability: Per manufacturer
 - c. Type of Movement: Thermal and Seismic.
 3. Type: Elastomeric seal
 4. Metal: Aluminum
 - a. Finish: Mill
 5. Seal Material: Santoprene.
 - a. Color: As selected by Architect from manufacturer's full range.
- B. Ceiling-to-Ceiling:
 1. Product/s:
 - a. Drywall Construction: C-S; Model # FWF-200
 - b. Acoustical Ceiling Construction: C-S; Model # HC-200
 2. Nominal Joint Width: 2".
 3. Type: Elastomeric seal.
 4. Metal: Aluminum.
 - a. Finish: Mill
 5. Seal Material: Santoprene.
 - a. Color: As selected by Architect from manufacturer's full range.

2.06 EXTERIOR VERTICAL WALL JOINT SYSTEMS

- A. Wall-to-Wall:
 1. Product: C-S; Model # VF-200
 - a. Nominal Joint Width: 2-inches
 - b. Seal Depth: 2-1/2 inches
 - c. Movement Capability: Per manufacturer
 - d. All miters and changes in direction to be field fabricated.
 - e. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction.
 - f. Type of Movement: Thermal and Seismic.
 - g. Type: Pre-compressed joint filler
 - h. Seal Material: Silicone
 - 1) Color: As selected by Architect from manufacturer standards

2.07 ROOF EXPANSION JOINTS, BELLOWS SYSTEMS

- A. Roof-to-Roof:
 1. Product: C-S; Model # BRJ
 - a. Type: Bellows
 - b. Joint Width: 2-inches

- c. Movement Range: 50%+- of total nominal joint width
 - d. Metal Flange: Galvanized
 - 1) Finish: Mill
 - e. Bellows: EPDM
 - 1) Secondary Seal: Manufacturer's standard
 - f. Factory Fabricated Transitions: all end caps, transitions and miters to be factory fabricated to ensure weather integrity. Field fabrication is not acceptable
 - g. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction
- B. Roof-to-Wall:
- 1. Product: C-S; Model # BRJW
 - a. Type: Bellows
 - b. Joint Width: 2-inches
 - c. Movement Range: 50%+- of total nominal joint width
 - d. Metal Flange: Galvanized
 - 1) Finish: Mill
 - e. Bellows: EPDM
 - 1) Secondary Seal: Manufacturer's standard
 - f. Factory Fabricated Transitions: all end caps, transitions and miters to be factory fabricated to ensure weather integrity. Field fabrication is not acceptable
 - g. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction

2.08 ROOF EXPANSION JOINTS, COVERPLATE SYSTEMS

- A. Roof-to-Roof: C-S; Model # RJT-200
- B. Roof-to-Wall: C-S; Model # RJTW-200
- C. Design Criteria:
 - 1. Joint Width: 2-inches
 - 2. Exposed Metal: Aluminum
 - a. Finish: Mill
 - 3. Secondary Seal: 7-ply laminate reinforced Polyethylene
 - 4. Cover plate thickness shall be determined by the performance requirements of the roof, but shall be no less than 0.090-inches thick
 - 5. Factory Fabricated Transitions: all end caps, transitions and miters to be factory fabricated to ensure weather integrity. Field fabrication is not acceptable
 - 6. Fire-Resistance Rating: Provide joint system and fire-barrier assembly with a rating not less than that of adjacent construction

2.09 FABRICATION

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
 - 1. Joint Dimensions and Configurations: As indicated on drawings.
 - 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 - 3. Joint Cover Styles: Selected to suit conditions and traffic expected.
 - 4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
 - 5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 - 6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
 - 1. If floor covering is not indicated, obtain instructions from Architect before proceeding.
 - 2. If style is not indicated, provide extruded aluminum frame both sides, resilient seals, and minimize exposed metal.

- C. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
- D. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.
 - 1. Acceptable Evaluation Agencies: UL (DIR) and ITS (DIR).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.
- B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.02 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

3.03 PROTECTION

- A. Do not permit traffic over unprotected floor joint surfaces.
- B. Provide strippable coating to protect finish surface.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Interior fire-rated and non-fire-rated hollow metal doors and frames.
- B. Exterior hollow metal doors and frames.
- C. Hollow metal borrowed lite/sidelight glazing frames.

1.03 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants
- B. Section 08 14 23 - Plastic Laminate Clad Wood Doors
- C. Section 08 72 00 - Door Hardware
- D. Section 08 80 00 - Glazing
- E. Section 09 21 16 - Gypsum Board Assemblies
- F. Section 09 22 16 - Non-Structural Metal Framing
- G. Section 09 91 23 - Interior Painting

1.04 ABBREVIATIONS AND ACRONYMS

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

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.
- B. Shop Drawings: Include the following:
 - 1. Elevations of each door design.
 - 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. Other Action Submittals:
 - 1. 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 door hardware schedule.

1.06 INFORMATIONAL SUBMITTALS

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

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
 - 1. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
- C. Fire-Rated, Borrowed Lite Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.
- D. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

1.09 PROJECT CONDITIONS

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

1.10 COORDINATION

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Steelcraft
 - 1. Owner Standard: The product specified in this Section is restricted to this manufacturer. Product substitutions are not permitted.

2.02 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. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Powder-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.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."

2.03 EXTERIOR HOLLOW METAL DOORS

- A. Product: Steelcraft; Full Flush Hollow Metal Doors
 - 1. Standard: ANSI/SDI A250.8
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Edge Construction: Model 2 - Seamless.
 - 2. Model: L / SL Series (Laminated) and B Series (Steel stiffened).
 - 3. Physical Properties:
 - a. Door Face Metal Thickness: Coated, 16 gage, 0.053 inch, minimum.
 - b. Door Face Sheets: Flush.
 - c. Door Finish: Factory primed and field finished.
 - d. Door Thickness: 1-3/4 inch, nominal.
 - e. Door Core Material:
 - 1) Non-rated doors: Polyurethane, or polyisocyanurate.
 - 2) Fire-Rated Doors: Mineral Board.
 - 4. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8-inch in 2-inches (3 mm in 50 mm).
 - 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick, end closures or channels of same material as face sheets.
 - 6. Zinc Coating: A60/ZF180 galvanized coating; ASTM A653/A653M.
 - 7. Door Thermal Resistance: R-Value of 6.0, minimum.
 - 8. Top Closures for Outswinging Doors: Flush with top of faces and edges.
 - 9. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 - a. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
 - b. Hardware: Refer to Section 08 72 00.

2.04 INTERIOR HOLLOW METAL DOORS - EMBOSSED

OWNER STANDARD: All interior hollow metal doors shall be "Grain-Tech Series" doors, as manufactured by Steelcraft, no substitutions

- A. Product: Steelcraft; Grain-Tech Series Hollow Metal Doors, non-rated and fire-rated
 - 1. Fabricated from steel that has an embossed wood grain pattern extending the full height and width of the door. Provide doors with continuous vertical mechanical inter-locking joints at lock and hinge edges with visible edge seams. The wood grain embossment shall be 0.005-inches deep. The wood grain face sheets must be cleaned, phosphatized and prime painted with a stain absorbing primer. Vertical edges must be stained using conventional stains to achieve a color as selected by Architect
- B. Standard: ANSI/SDI A250.8 for level and model; ANSI/SDI A250.4 for physical performance level.
 - 1. Level: 2 - Heavy-duty
 - 2. Physical Performance Level B
 - 3. Edge Construction: Model 1 - Full Flush
- C. Physical Properties:
 - 1. Door Face Metal Thickness: Uncoated, 18 gage, 0.042 inch, minimum.
 - 2. Door Face Sheets: Embossed with wood grain
 - 3. Door Finish: Factory finished
 - 4. Door Thickness: 1-3/4 inch, nominal
 - 5. Door Core: Manufacturers standard core material/construction and in compliance with requirements

6. Vertical Beveled Edge: 1/8-inch in 2-inches for single acting doors
 7. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 - a. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet
 8. Hardware: Refer to Section 08 72 00
- D. Fire-Rated Doors:
1. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests")
 2. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction
 3. Provide units listed and labeled by UL (DIR)
 - a. Attach fire rating label to each fire rated unit
 4. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
 - a. Locations: Interior doors where indicated.
- E. Smoke and Draft Control Doors: Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
1. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 2. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
 3. Label: Include the "S" label on fire-rating label of door.

2.05 INTERIOR HOLLOW METAL DOORS, FULL FLUSH

- A. Product: Steelcraft; Full Flush Hollow Metal Doors, non-rated and fire-rated
1. Model: L Series
- B. Standard: ANSI/SDI A250.8 for level and model; ANSI/SDI A250.4 for physical performance level.
1. Level: 2 - Heavy-duty
 2. Physical Performance Level B
 3. Edge Construction: Model 1 - Full Flush
- C. Physical Properties:
1. Door Face Metal Thickness: Uncoated, 18 gage, 0.042 inch, minimum
 2. Door Face Sheets: Flush
 3. Door Finish: Factory primed and field finished.
 4. Door Thickness: 1-3/4 inch, nominal.
 5. Door Core: Manufacturers standard core material/construction and in compliance with requirements.
 6. Vertical Beveled Edge: 1/8-inch in 2 inches for single acting doors.
 7. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
 - a. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
 8. Hardware: Refer to Section 08 72 00
- D. Fire-Rated Doors:
1. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests")
 2. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction
 3. Provide units listed and labeled by UL (DIR)
 - a. Attach fire rating label to each fire rated unit

4. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
- E. Smoke and Draft Control Doors: Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following:
 1. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 2. Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
 3. Label: Include the "S" label on fire-rating label of door.

2.06 EXTERIOR HOLLOW METAL FRAMES

- A. Exterior Door Frames, non-rated and fire-rated
- B. Type: Full profile/continuously welded type
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating
 2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum
 3. Frame Finish: Factory primed and field finished
 4. Reinforcement: Provide high frequency hinge reinforcement at top hinge location
 5. Weatherstripping: See Section 08 72 00

2.07 INTERIOR HOLLOW METAL FRAMES

- A. Interior Door Frames, non-rated and fire-rated
- B. Type: Full profile/continuously welded type.
 1. Fabricate frames with mitered or coped corners.
 2. Frame Metal Thickness:
 - a. Steel or wood doors under 48-inches wide: 16 gage, 0.053 inch, uncoated.
 - b. Steel or wood doors over 48-inches wide: 14 gage, 0.067 inch, uncoated.
 - c. Borrowed Lite Glazed Frames: 16 gage, 0.053 inch, uncoated.
 3. Fire Rating: Same as door, labeled.
 4. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.
 5. Frame Finish: Factory primed and field finished.

2.08 BORROWED LIGHT GLAZING FRAMES

- A. Borrowed Lites Glazing Frames, non-rated and fire-rated
 1. Construction and face dimensions to match door frames, and as indicated on drawings.
- B. Type: Full profile/continuously welded type.
 1. Fabricate frames with mitered or coped corners.
- C. Frame Metal Thickness: 18 gage, 0.042 inch
- D. Fire Rating: Same as wall/door construction, labeled
- E. Frame Finish: Factory primed and field finished
- F. Transom Bars: Fixed, of profile same as jamb and head
- G. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.09 FRAME ANCHORS

- A. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Masonry Type (when applicable): 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.

- C. Post-installed Expansion Type for In-Place Concrete or Masonry (when applicable): Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- D. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
- E. All anchors in exterior walls shall be hot dip galvanized with non-corrosive anchors.

2.10 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.
- D. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

2.11 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00.
- B. Astragals for Double Doors: Specified in Section 08 72 00.
- C. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- D. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- E. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.
- F. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.
- G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- H. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

2.12 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 thickness of metal. 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. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
 - 1. Glazed Lites: Factory cut openings in doors.
 - 2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch (19 mm) beyond edge of door on which astragal is mounted.
 - 3. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- D. 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. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

2. 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.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
6. All frames shall be delivered with factory installed spreaders.
7. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Fire ratings may require additional anchors.
 - 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) Two anchors per head for frames above 42 inches (1066 mm) wide and mounted in metal-stud partitions.
 - c. Masonry Wall Type for doors and frames to 7'-0" high shall have 3 anchors per jamb in masonry and in excess of this height an additional anchor for each 2'-6" additional height or fraction thereof. Storm resistant framing systems shall have anchors in compliance with manufacturers tested assemblies for these openings.
 - d. Post-Installed Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
8. Door Silencers: Except on weather-stripped and acoustical doors, drill stops to receive door silencers as follows.
 - 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.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
 1. Locate hardware as indicated, matching Steelcraft standards for doors and frames, or if not indicated, according to ANSI A250.8.
 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 3. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
 4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 and 28 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites 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 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 type of glazing and type of installation indicated.

2.13 FINISHES

- A. Factory Prime Finish: All frames and door components shall be cleaned, phosphatized and finished standard with one coat of factory baked-on, rust-inhibited primer in accordance with ANSI A250.10 (Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames)
- B. Frame Undercoating (Bituminous Coating): Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
 - 1. Locations: Exterior door frames

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, 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.

3.02 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. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness
- C. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.03 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 ANSI/SDI A250.11.
 - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-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 frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
4. In-Place Gypsum Board Partitions: Secure frames in place with post-installed expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
6. 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 Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
 3. Smoke-Control Doors: Install doors according to NFPA 105.
- D. Glazing: Comply with installation requirements in Division 08 Section "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 (50 mm) o.c. from each corner.

3.04 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.
 1. Adjust for smooth and balanced door movement.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Touch-up:
 1. 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

SECTION 08 14 23
PLASTIC LAMINATE CLAD WOOD DOORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Flush solid core high pressure decorative laminate (HPDL) clad wood doors.
- B. Factory fitting HPDL clad wood doors to frames and factory machining for hardware.
- C. Light frames and glazing installed in clad wood doors.

1.03 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames
- B. Section 08 72 00 - Door Hardware
- C. Section 08 11 13 - Hollow Metal Doors and Frames

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, including door construction description and WDMA I.S.1-A and AWS classifications.
- B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the clad door supplier in order to prepare the doors and frames to receive the finish hardware items.
- C. Schedules: Submit manufacturer's schedules, including door dimensions, cutouts, species, finish, and hardware. Reference individual door numbers as indicated on the Drawings.
- D. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- E. Samples for Initial Selection: Submit two samples of door veneer, 6 by 6 inch in size illustrating wood grain, stain color, and sheen.
- F. Samples for Verification:
 - 1. Samples: Submit two samples of plastic laminate for each pattern as selected.
 - 2. Decorative laminate, 8 by 10 inches, for each color and pattern selected.
 - 3. Corner Sections of Door: Approximately 5-inches by 10-inches (127-mm by 250-mm), with door faces and edges representing actual materials to be used.
 - 4. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.
- G. Warranty: Sample of special warranties.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain clad wood doors through one source from a single manufacturer wherever possible.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors." and the following minimum values (for particle core doors):
 - 1. NWWDA TM-7 Cycle Slam Test: 1,000,000 cycles.
 - 2. NWWDA TM-8 Hinge Loading Test 1,000 lbs.
 - 3. NWWDA TM-10 Edge Screw Holding Test 850 lbs.
 - 4. NWWDA TM-10 Face Screw Holding Test 650 lbs.
- C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill)

or UL 10C. Doors shall be constructed in accordance with Category A guidelines as published by Intertek/Warnock Hersey.

1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.
 2. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.
 3. Smoke Control Door Assemblies: Comply with NFPA 105.
 - a. Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.
 4. Blocking: When through-bolts are not to be used, indicate size and location of blocking in 45-, 60-, and 90-minute mineral core doors
- D. Security Rating for Particle Core Doors: ASTM F476, Grade 40.
- E. Sound Rating Test Reports: Submit manufacturer's test results of STC ratings from testing performed by independent testing agency for sound resistant doors.
- F. Antimicrobial Surfaces: Silver-based resin surface achieving Pass grade conforming to JIS Z2801:2000 test method for antimicrobial efficacy including Escherichia coli and MRSA. Certification to be documented by reputable independent research institute.
- G. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing clad wood doors.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package clad wood doors individually in plastic bags or cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top rail with opening number used on Shop Drawings.

1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.08 WARRANTY

- A. Manufacturers' Warranty: Warrant clad wood doors for life of installation against warpage, delamination, and defects in materials and workmanship.
 1. Defects noted during warranty period shall be corrected at no cost to Owner. Corrective work shall include labor and material for repair, replacement, refinishing, and rehanging as required.
- B. Installation Warranty: The installing subcontractor shall warrant the installation to be free of defects in material and workmanship for a period of one (1) year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. OWNER STANDARD: All plastic laminate clad wood doors shall be manufactured by V.T. Industries, no substitutions unless noted otherwise
 1. Voluntary Alternates will be accepted that meet or exceed these specifications upon Owner review and approval based upon separate breakout pricing.

2.02 PLASTIC LAMINATE CLAD WOOD DOORS

- A. Basis-of-Design Product: VTI; "Heritage" Collection, Flush Solid-Core High-Pressure Decorative Laminate Clad Doors
 - 1. Type:
 - a. Non-Rated
 - b. Fire-Rated: 20-, 45-, 60-, and 90-minutes as indicated in drawings
- B. Compliance: WDMA I.S. 1A.
 - 1. Aesthetic Grade: Premium Grade
 - 2. Performance Grade: Extra Heavy Duty
- C. Door Construction:
 - 1. Door Thickness: 1-3/4 inches.
 - 2. Core Construction:
 - a. Particleboard Core Doors (Non-Rated & 20-Minute):
 - 1) Particleboard: ANSI A208.1, Grade 1-LD-2, 5-ply.
 - 2) Wood Stiles and Rails: As required to meet Extra Heavy Duty Performance level.
 - (a) Structural Composite Lumber at non-rated doors and manufacturer's standard non-combustible material at fire rated doors.
 - 3) Blocking: As required to meet Extra Heavy Duty Performance level.
 - 4) Low Emitting Materials: Interior flush clad wood doors must contain no added urea-formaldehyde resins
 - b. Mineral Core Doors (45-, 60-, and 90-Minute):
 - 1) Core: Non-combustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire protection rating indicated.
 - 2) Blocking: Provide composite blocking with improved screw holding capability approved for use in doors of fire protection ratings indicated as needed to eliminate through-bolting hardware.
 - 3) Stiles and rails: At 45-minute rated, provide structural composite lumber stiles and rails; at 60- and 90-minute rated, provide manufacturer's standard non-combustible material for stiles and rails.
 - (a) Edge Construction: At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance with outer stile matching polymer edging.
- D. High-Pressure Decorative Laminates: NEMA LD3.
 - 1. Door Faces: Face laminate doors with high-pressure decorative laminate/s
 - 2. Door Edge Banding:
 - a. Top and Bottom Door Edges (Rails): High Pressure Decorative Laminate (HPDL)
 - b. Vertical Door Edges (Stiles):
 - 1) PVC Edge Banding (Owner Standard): Provide 0.12 inch (3 mm) thick PVC edge banding for all doors.
 - (a) Exception: Provide HDPL on the vertical edges of doors of fire-rated door pairs.
 - 3. Laminate Selection: As indicated on the Interior Finish Legend in the drawings.
 - a. Finish: Manufacturer's standard.
 - b. Grade: General purpose, horizontal grade
- E. Positive Pressure Doors:
 - 1. Where UL 10C standards for positive pressure apply, doors shall be constructed in accordance with Category A guidelines as published by Intertek/Warnock Hersey.
 - 2. Smoke Gasketing: Apply smoke gasketing around frame perimeter and between door and pairs to meet Smoke (S) rating.
 - 3. Intertek/Warnock Hersey Category A Guidelines: Edge sealing systems not allowed on frames.

- F. Antimicrobial Surface: Provide clad wood doors with an EPA and NSF listed silver-based, antimicrobial finish approved use in medical and food preparation equipment. Antibacterial certification to be documented by reputable independent research institute.
- G. Transom Panels: Same construction and finish as door; same performance rating as door.

2.03 VISION LITE FRAMES AND GLAZING

- A. Metal Frames for Lite Openings in Doors:
 - 1. Product: VTI; Style #110 Metal Vision Frame.
 - a. Material: Frame formed of 0.048-inch (1.2-mm) thick, cold-rolled steel sheet.
 - 1) Finish: Factory applied beige polyester powder coating.
 - b. Glass Thickness: As scheduled.
 - c. Fire Protection Rating: Refer to Door Schedule.
- B. Flush Wood Lite Mouldings for Lite Openings in Doors:
 - 1. Product: VT Industries; Style VT1 (1/4" Glass) with metal glazing clips:
 - a. Wood lite mouldings have one side fixed into place with brads at the factory, along with one-half of Fire Clip™. The other side is temporarily tacked into place so glass and glazing can be installed at the jobsite. Remaining halves of Fire Clips™ are shipped loose, to be installed with glass. Field fitting of glass and glazing is the responsibility of the installer. Use of a glazing compound or caulking is required. All profiles have a tolerance of ±0.005 inches.
 - b. Wood Stop Materials:
 - 1) Doors with laminate faces will use poplar stops.
- C. Glazing: Refer to Section 08 80 00.

2.04 FABRICATION

- A. Prefit Doors:
 - 1. Prefit and bevel doors at factory to fit openings.
 - 2. Prefit Tolerances: WDMA I.S.1-A.
 - 3. Comply with requirements in NFPA 80 for fire rated doors.
- B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
 - 2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.
- C. Openings: Cut and trim openings through doors in factory.
 - 1. Light Openings: Trim openings with lite frame style indicated.
 - 2. Glazing: Comply with applicable requirements in Section 08 80 00.
 - 3. Louvers (when applicable): Factory install louvers in prepared openings.
- D. Undercut:
 - 1. Bottom of Door: 5/8 inch.
 - 2. Top and Sides: 1/8 inch.
- E. Electrical Raceways: Provide clad wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in Section 08 71 00. Wire nut connections are not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine locations to receive doors. Notify Architect of conditions that would adversely affect installation or subsequent use. Do not begin installation until unacceptable conditions are corrected.

- B. Ensure frames are solidly anchored, allowing no deflection when doors are installed.
- C. Ensure frames are plumb, level, square, and within tolerance.

3.02 PREPARATION

- A. Allow doors to become acclimated to building temperature and relative humidity for a minimum of 24 hours before installation.

3.03 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Install doors plumb, level, and square.
- C. Install door hardware as specified in Section 08 72 00.
- D. Coordinate installation of doors with installation of frames, hardware, and glazing.

3.04 ADJUSTING

- A. Operation: Re-hang or replace doors that do not swing or operate freely.
- B. Replace doors that do not comply with requirements. Doors may be repaired if work complies with requirements and shows no evidence of repair or refinishing.

3.05 CLEANING

- A. Clean doors promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

3.06 PROTECTION

- A. Protect installed doors from damage during construction.

END OF SECTION

SECTION 08 31 00
ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Wall and ceiling access door and frame units.

1.03 RELATED REQUIREMENTS

- A. Section 08 72 00 - Door Hardware
- B. Section 09 91 23 - Interior Painting
- C. Division 23 - HVAC duct access doors.

1.04 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10C for fire-rated access door assemblies installed vertically.
 - 2. Provide smoke gasketing for doors in 0 or 1 hour rated smoke partitions.

1.05 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Detail fabrication and installation of access doors and frames for each type of substrate.
- C. Samples: For each door face material, at least 3 by 5 inches (75 by 125 mm) in size, in specified finish.
- D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

1.06 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Karp Associates, Inc.
- B. Other acceptable manufacturers with equivalent products to the specified manufacturer shall include:
 - 1. Acudor Products, Inc.
 - 2. J. L. Industries, Inc.
 - 3. Milcor Inc.
- C. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".

1. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures"
- D. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

2.02 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, [Type 304] [Type 316]. Remove tool and die marks and stretch lines or blend into finish.
- D. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.
- E. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.
- F. Frame Anchors: Same type as door face.
- G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.03 ACCESS DOORS AND FRAMES

- A. Flush Access Doors with Concealed Flanges:
 1. Product: Karp, Model KDW. (Model DSC-214M for above ceiling or concealed areas with exposed flange type).
 - a. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 - b. Locations: Wall and ceiling.
 - c. Door Size: as required by location.
 - d. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - 1) Finish: Factory prime.
 - e. Frame Material: Same material and thickness as door.
 - f. Hinges: Manufacturer's standard.
 - g. Hardware: Lock.
- B. Fire-Rated Flush Access Doors with Exposed Flanges:
 1. Product: Karp, Model KRP-150-FR.
 - a. 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. Provide manufacturer's standard-width exposed flange, proportional to door size.
 - b. Locations: Wall or ceiling.
 - c. Fire-Resistance Rating: Not less than that of adjacent construction.
 - d. Temperature-Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.
 - e. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.
 - 1) Finish: Factory prime.
 - f. Frame Material: Same material, thickness, and finish as door.
 - g. Hinges: Manufacturer's standard.
 - h. Hardware: Latch.
- C. Fire-Rated, Flush Access Doors with Concealed Flanges:
 1. Product: Karp Model KRP-350 FR.
 - a. 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. Provide frame with gypsum board beads for concealed flange installation.
 - b. Locations: Wall.
 - c. Fire-Resistance Rating: Not less than that of adjacent construction.
 - d. Temperature-Rise Rating: 250 deg F (139 deg C) at the end of 30 minutes.

- e. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.
 - 1) Finish: Factory prime.
- f. Frame Material: Same material, thickness, and finish as door.
- g. Hinges: Manufacturer's standard.
- h. Hardware: Lock.

2.04 HARDWARE:

- A. Lock: Cam lock operated by key.
- B. Latch: Cam latch operated by screwdriver.

2.05 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
 - 1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
 - 2. Provide mounting holes in frames for attachment of units to metal framing.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

2.06 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

3.03 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 08 72 00
DOOR HARDWARE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Mechanical door hardware for swinging doors
- B. Cylinders for door hardware specified in other Sections
- C. Electrified door hardware

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 08 11 13 - Hollow Metal Doors and Frames
- C. Section 08 72 00 - Door Hardware
- D. Section 08 80 00 - Glazing
- E. Division 16 Sections for connections to electrical power system and for low-voltage wiring work.
- F. Division 16 Section "Access Control" for access control devices installed at door openings and provided as part of a security system.
- G. Division 16 Section "Fire-Alarm System" for connections to building fire-alarm system.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Details of electrified door hardware, indicating the following:
 - 1. Wiring Diagrams: For power, signal, and control wiring and including the following:
 - a. Details of interface of electrified door hardware and building safety and security systems.
 - b. Schematic diagram of systems that interface with electrified door hardware.
 - c. Point-to-point wiring.
 - d. Risers.
 - e. Elevations doors controlled by electrified door hardware.
 - 2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.
- C. Samples for Verification: Only as may be requested by Architect. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.
 - 1. Sample Size: Full-size units or minimum 2-by-4-inch (51-by-102-mm) Samples for sheet and 4-inch (102-mm) long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
- D. Other Action Submittals:
 - 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door

- hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
- b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
 - c. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
 - d. Content: Include the following information:
 - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.
 - 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - 5) Fastenings and other pertinent information.
 - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for door hardware.
 - 8) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For electrified door hardware, from the manufacturer.
 - 1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Warranty: Special warranty specified in this Section.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
 - 1. For door hardware, an Architectural Hardware Consultant (AHC) who is also an Electrified Hardware Consultant (EHC).
- C. Source Limitations: Obtain each type of door hardware from a single manufacturer.

1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.
- D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.
- E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.
- F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- G. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- H. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
 4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.
- I. Preinstallation Conference: Conduct conference at Project site.
 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Inspect and discuss preparatory work performed by other trades.
 3. Inspect and discuss electrical roughing-in for electrified door hardware.
 4. Review sequence of operation for each type of electrified door hardware.
 5. Review required testing, inspecting, and certifying procedures.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1.09 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.
- F. SLH STANDARD: All door hardware shall be coordinated and in compliance with SLH Door and Door Hardware Master Specification Guide.

1.10 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.
 - a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
 - b. Exit Devices: Two years from date of Substantial Completion.
 - c. Manual Closers: 10 years from date of Substantial Completion.
 - d. Concealed Floor Closers: 10 years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, provide twelve months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

1.12 KEYING

- A. All locks shall have cores provided by the Owner and shall be keyed by the Owner for a Schlage "Primus" key system.
- B. All locks to be keyed into the existing Schlage "Primus" key system.
- C. Owner shall provide keys as required.
- D. Contractor shall provide construction security cores and keys for construction staff as required, for building perimeter doors.

PART 2 PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
 - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
 - 2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:
 - 1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
 - 2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.02 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 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 schedule or comparable product by one of the following:
 - a. Hager Companies.
 - b. IVES Hardware; an Ingersoll-Rand Company.
 - c. Stanley Commercial Hardware; Div. of The Stanley Works.

2.03 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.
- D. Lock Trim:
 - 1. Dummy Trim: Match lever lock trim and escutcheons.
 - 2. Operating Device: Lever with escutcheons (roses).
- E. 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.
- F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Schlage Commercial Lock Division; an Ingersoll-Rand Company.
- G. Interconnected Locks: BHMA A156.12; Grade 1; Series 5000.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Schlage Commercial Lock Division; an Ingersoll-Rand Company.

2.04 ELECTRIC STRIKES

- A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by the following:
 - a. Von Duprin; an Ingersoll-Rand company.

2.05 AUTOMATIC AND SELF-LATCHING FLUSH BOLTS

- A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. IVES Hardware; an Ingersoll-Rand Company.

2.06 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Von Duprin; an Ingersoll-Rand Company.

2.07 LOCK CYLINDERS

- A. Provided by owner.

2.08 KEYING

- A. Provided by Owner

2.09 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. IVES Hardware; an Ingersoll-Rand Company.
 - b. Rockwood Manufacturing Company.

2.10 ACCESSORIES FOR PAIRS OF DOORS

- A. Astragals: BHMA A156.22.

2.11 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule by LCN Closers; an Ingersoll-Rand Company.

2.12 CONCEALED CLOSERS

- A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. LCN Closers; an Ingersoll-Rand Company.
 - b. Rixson Specialty Door Controls; an ASSA ABLOY Group Company.

2.13 CLOSER HOLDER RELEASE DEVICES

- A. Closer Holder Release Devices: BHMA A156.15; Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system or loss of power.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. LCN Closers; an Ingersoll-Rand Company.

2.14 MECHANICAL STOPS AND HOLDERS

- A. Wall- Stops: BHMA A156.16; polished cast brass, or bronze, base metal.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Burns Manufacturing Incorporated.
 - b. IVES Hardware; an Ingersoll-Rand Company.

- c. Rockwood Manufacturing Company.

2.15 ELECTROMAGNETIC STOPS AND HOLDERS

- A. Refer to Divisions 26 and 28.

2.16 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. Glynn-Johnson; an Ingersoll-Rand Company.
 - b. Rixson.

2.17 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. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on schedule or comparable product by one of the following:
 - a. National Guard Products.
 - b. Pemko Manufacturing Co.; an ASSA ABLOY Group Company.
 - c. Reese Enterprises, Inc.

2.18 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Burns Manufacturing Incorporated.
 - b. IVES Hardware; an Ingersoll-Rand Company.
 - c. Rockwood Manufacturing Company.

2.19 PLASTIC PROTECTION PLATES

- A. Plastic Protection Plates: BHMA A156.6; fabricated with four sides beveled; rigid plastic; 0.060-inch- (1.5-mm-) thick, PVC or acrylic-modified vinyl plastic.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties per plans:

2.20 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. 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."

2.21 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.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

- A. 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.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.03 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 1. Steelcraft Steel Doors and Frames hardware installation standard, and if not listed, then Standard Steel Doors and Frames: ANSI/SDI A250.8.
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Replace construction cores with permanent cores as directed by Owner.
 - 2. Furnish permanent cores to Owner for installation.
- E. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- F. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, . Verify location with Engineer.
 - 1. Configuration: Provide one power supply for each door opening with electrified door hardware.
- G. Stops: Provide wall stops for doors unless overhead or other type stops are indicated in door hardware schedule.
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.05 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
 - 2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.06 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.08 DOOR HARDWARE SCHEDULE

- A. Refer to the Drawings for the Door Hardware Schedule.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Glass Types include, but not limited to, the following:
 - 1. Flat glass.
 - 2. Insulating glass.
 - 3. Laminated glass.
 - 4. Sputter-coated vision glass
 - 5. Ceramic coated glass.
- B. Glass Assemblies include, but not limited to, the following:
 - 1. Insulating coated glass.
 - 2. Laminated coated glass.
 - 3. Insulating laminated coated glass
 - 4. Insulating coated spandrel glass

1.03 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames
- B. Section 08 12 13 - Interior Hollow Metal Frames
- C. Section 08 14 16 - Flush Wood Veneer Doors
- D. Section 08 14 23 - Plastic Laminate Clad Wood Doors
- E. Section 08 34 00 - Interior Healthcare Sliding Door Systems
- F. Section 08 42 29 - Automatic Entrances
- G. Section 08 42 43 - Manual Sliding Break-Away ICU/CCU Doors
- H. Section 08 43 13 - Aluminum Framed Entrances and Storefront
- I. Section 08 44 13 - Glazed Aluminum Curtainwalls
- J. Section 08 51 13 - Aluminum Windows
- K. Section 62 00 00 - Unit Skylights

1.04 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in inches according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating-glass unit.

1.05 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ICC's 2012 International Building Code by a qualified professional Missouri engineer, using the following design criteria:
 - 1. Design Wind Pressures:
 - a. 5 pounds per square foot (SF) for all interior glazing.

- b. Exterior glazing shall be per ASCE 7-05 requirements for the various locations on the building based on basic nominal design 3-second gust wind speed of 90 miles per hour at 33 ft above ground for Exposure C category, adjusted to this project's conditions.
 - 1) Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
 - 2) Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch (25 mm), whichever is less.

1.06 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
 - 2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
 - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.07 ACTION SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of glass product only if requested by Architect; 12 inches (300 mm) square.
- C. Glazing Accessory Samples: For gaskets sealants and spacers, in 12-inch (300-mm) lengths, only if requested by Architect.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.08 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installers and sealant testing agency.
- B. Product Certificates: For glass and glazing products, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for glazing sealants and glazing gaskets.
 - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.
- D. Preconstruction adhesion and compatibility test report.
- E. Warranties: Sample of special warranties.

1.09 QUALITY ASSURANCE

- A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
- B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

- C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- E. Source Limitations for Glass: Obtain laminated glass and clear glass from single source from single manufacturer for each glass type.
- F. Source Limitations for Glazing Accessories: Obtain tinted float glass, coated float glass, laminated glass and insulating glass from single source from single manufacturer for each product and installation method.
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
 - 2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- I. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, whether glazing is for use in fire doors or other openings, whether or not glazing passes hose-stream test, whether or not glazing has a temperature rise rating of 450 deg F (250 deg C), and the fire-resistance rating in minutes.
- J. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
- K. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts"-and others with applied frost membrane patterns to match glazing systems required for Project, including glazing methods.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- L. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 2. Review temporary protection requirements for glazing during and after installation.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.11 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.12 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Manufacturer: Subject to compliance with the Contract Documents, products of the manufacturer's listed below will be acceptable.
 - 1. Viracon
 - 2. Insulite Glass Company.
 - 3. AGC Glass North America, Inc.
 - 4. Cardinal Glass Industries.
 - 5. Oldcastle.
 - 6. Vitro Architectural Glass.
 - 7. Visteon
 - 8. Guardian Industries Corp.
 - 9. Pilkington North America
 - 10. PPG Industries, Inc.
- B. Substitutions: Additional manufacturer's will not be considered for the materials and products specified in this Section unless approved by the Architect.

2.02 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass. The IBC defines wind-borne debris regions. Enhanced protection applies to essential facilities. Verify requirements of authorities having jurisdiction.
- C. Abbreviations:
 - 1. AN - Annealed.

2. HS - Heat Strengthened.
3. FT - Fully Tempered.
4. LAM - Laminated.
5. STC - Sound Transmission Coefficient.
6. PVB - Polyvinyl Butyral.

2.03 MONOLITHIC GLASS PRODUCTS

- A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class 1 (clear) or Class 2 (tinted) as indicated.
- B. Heat-Treated Float Glass:
 1. Heat Strengthened (HS):
 - a. Compliance: ASTM C1048; Type 1; Class 1 (clear) or Class 2 (tinted); Quality q3.
 - 1) Uncoated glass, comply with requirements for Condition A.
 - 2) Coated glass, comply with requirements for Condition C.
 2. Fully Tempered (FT):
 - a. Compliance: ASTM C1048 ; Type 1; Class 1 (clear) or Class 2 (tinted); Quality q3.
 - 1) Uncoated glass, comply with requirements for Condition A.
 - 2) Coated glass, comply with requirements for Condition C.
 - 3) All tempered architectural safety glass shall conform with ANSI Z97.1.

2.04 FIRE AND IMPACT RATED GLAZING

- A. Refer to Section 08 81 17 - Fire-Rated Glass.

2.05 INSULATING GLAZING UNITS - HEAT STRENGTHENED

- A. Where indicated in the drawings or required by location.
- B. Insulating Glazing Units - Heat Strengthened Glass:
 1. Product: Viracon; Model No. VE32-2M Insulating Coated Glass Unit, or equivalent.
 - a. Overall Unit Thickness: 1-inch (25mm) unless indicated otherwise.
 - b. Color: Crystal Blue.
 2. Assembly:
 - a. Exterior Glass Ply: 1/4-inch (6mm) 'Crystal Blue' HS.
 - b. Coating: VE-2M on #2 Surface.
 - c. Air Space: 1/2-inch (13.2mm) clear air space with clear anodized spacer.
 - d. Silicone: Black
 - e. Interior Glass Ply: 1/4-inch (6mm) Clear AN
 3. Performance Requirements
 - a. Visible Light Transmittance: 46%
 - b. Exterior (Vis-Out) Reflectance: 7%
 - c. Winter U-Value: 0.3
 - d. Summer U-Value: 0.26
 - e. Shading Coefficient: 0.34
 - f. Solar Heat Gain Coefficient: 0.3
 - g. Light to Solar Gain Ratio: 1.53
- C. Insulating Glazing Units - Tempered Glass:
 1. Product: Viracon; Model No. VE32-2M Insulating Coated Glass Unit, or equivalent.
 - a. Overall Unit Thickness: 1-inch (25mm) unless indicated otherwise.
 - b. Color: Crystal Blue.
 2. Assembly:
 - a. Exterior Glass Ply: 1/4-inch (6mm) 'Crystal Blue', Fully Tempered.
 - b. Coating: VE-2M on #2 Surface
 - c. Air Space: 1/2-inch (13.2mm) clear air space with clear anodized spacer.
 - d. Silicone: Black.
 - e. Interior Glass Ply: 1/4-inch (6mm) Clear Fully Tempered.
 3. Performance Requirements
 - a. Visible Light Transmittance: 46%

- b. Exterior (Vis-Out) Reflectance: 7%
- c. Winter U-Value: 0.3
- d. Summer U-Value: 0.26
- e. Shading Coefficient: 0.34
- f. Solar Heat Gain Coefficient: 0.3
- g. Light to Solar Gain Ratio: 1.53

2.06 COATED GLASS PRODUCTS

- A. Low-Emissivity (Low-E) Coated Glass:
 - 1. Sputter-Coated Low-Emissivity (Low-E) Vision Glass:
 - a. Compliance: ASTM C 1376, coated by sputtered process, ASTM C 1036, Type I, Quality-Q3, Class 1 (Clear) or Class 2 (Tinted), and complying with other requirements specified.
 - b. Product: AGC; Energy Select 40, High-Performance; Triple-silver on clear substrate.
 - 1) Coating Position: Surface 2 unless indicated otherwise.
 - 2) Color: Neutral aesthetic, with a slightly bluer hue, 62% VLT and 0.28 SHGC.
- B. Ceramic-Coated Glass:
 - 1. Ceramic-Coated Spandrel Glass:
 - a. Compliance: ASTM C1048 Standard Specification for Heat-Treated Float Glass - Kind HS, Kind FT Coated and Uncoated, Condition B; ASTM C 1036 Type I, Quality q3.

2.07 LAMINATED (SECURITY) GLASS

- A. Compliance: ASTM C 1172 and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
- B. Construction: Laminate two (2) layers of glass with polyvinyl butyral (PVB) interlayer to comply with interlayer manufacturer's written recommendations.
 - 1. Glass Thickness: 1/8-inch.
 - 2. Polyvinyl Butyral (PVB) Interlayer:
 - a. Product:
 - 1) Viracon; "Vanceva® Color Interlay System".
 - b. Thickness: 0.060 inch.
 - 1) Provide thickness not less than that indicated and as needed to comply with requirements.
 - c. Interlayer Color:
 - 1) Clear, unless otherwise indicated.
 - 3. Overall Thickness: 5/16-inch.

2.08 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
 - 1. Neoprene complying with ASTM C 864.
 - 2. EPDM complying with ASTM C 864.
 - 3. Silicone complying with ASTM C 1115.
 - 4. Thermoplastic polyolefin rubber complying with ASTM C 1115.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene EPDM silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
 - 1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.
- C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.09 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 4. Colors of Exposed Glazing Sealants: Clear.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 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; 795.
 - b. GE Advanced Materials - Silicones; SilPruf SCS2000.
 - c. Sika Corporation, Construction Products Division; SikaSil-C995.
 - d. Tremco Incorporated; Spectrem 2.
 - 1) Applications: All Glass interior walls.

2.10 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 - 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.11 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.12 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.13 GLASS TYPES

- A. Glass Type FL: Heat-strengthened (HS) float glass.
 - 1. Thickness: 1/4-inch.
 - 2. Color: Clear .
 - 3. Provide safety glazing labeling.
- B. Glass Type T (Safety Glass): Fully tempered (FT) glass.
 - 1. Thickness: 1/4-inch.
 - 2. Color: Clear .
 - 3. Provide safety glazing labeling.
- C. Glass Type LAM (Security Glass): Laminated (LAM) glass.
 - 1. Thickness: 5/16-inch (1/8-inch AN + 0.060-inch PVB + 1/8-inch AN).
 - 2. Provide safety glazing labeling.
- D. Glass Type GL-I: Low-E coated, tinted insulating glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Thickness of Each Glass Lite: 1/4-inch.
 - 3. Outdoor Lite: Tinted, float glass or fully tempered float glass as required by location.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Clear float glass or fully tempered float glass, as required by location.
 - 6. Low-E Coating: #2 surface
 - 7. Provide safety glazing labeling.
- E. Glass Type GL-SP: Ceramic-coated, tinted, insulating spandrel glass.
 - 1. Overall Unit Thickness: 1 inch (25 mm).
 - 2. Thickness of Each Glass Lite: 1/4-inch.
 - 3. Outdoor Lite: Tinted fully tempered float glass.
 - 4. Interspace Content: Air.
 - 5. Indoor Lite: Clear float glass or fully tempered float glass, as required by location.
 - 6. Coating Location: Fourth surface.
- F. Glass Type GL-FPR: Fire-protection-rated glass.
 - 1. Refer to Section 08 81 17 for requirements.
 - 2. Refer to drawings for fire labeling.
- G. Glass Type GL-FIR: Fire-resistant-rated glass.
 - 1. Refer to Section 08 81 17 for requirements.
 - 2. Refer to drawings for fire labeling.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.03 GLAZING INSTALLATION, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
 3. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
 4. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
 5. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
 6. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
 7. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.
- H. **TAPE GLAZING**
 1. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

2. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
3. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
4. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
5. Do not remove release paper from tape until right before each glazing unit is installed.
6. Apply heel bead of elastomeric sealant.
7. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
8. Apply cap bead of elastomeric sealant over exposed edge of tape.

I. GASKET GLAZING (DRY)

1. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
2. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
3. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
4. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
5. Install gaskets so they protrude past face of glazing stops.

J. SEALANT GLAZING (WET)

1. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
2. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
3. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

K. CLEANING AND PROTECTION

1. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.
2. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
3. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
4. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

5. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

SECTION 08 81 17
FIRE-RATED GLASS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Fire-protection-rated glazing.
- B. Fire-resistance-rated glazing.

1.03 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames
- B. Section 08 14 16 - Flush Wood Veneer Doors
- C. Section 08 14 23 - Plastic Laminate Clad Doors
- D. Section 08 80 00 - Glazing
- E. Section 09 21 16 - Gypsum Board Assemblies

1.04 DEFINITIONS

- A. Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period exceeding 45-minutes.
- B. Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve fire-doors indicated fire-rating period as indicated on drawings.

1.05 PERFORMANCE REQUIREMENTS

- A. Fire-rated, clear and wireless glazing material for use in locations such as doors, sidelites, transoms, borrowed lites, and wall applications with fire rating requirements ranging from 45-minutes to 3-hours with required hose stream test; for use in interior or exterior applications.
- B. Provides protection by reducing the radiant and conductive heat transfer.

1.06 SUBMITTALS

- A. Product data: Submit manufacturer's technical data for each glazing material required, including installation and maintenance instructions.
- B. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer's permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.
- C. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.
- D. Samples: Submit, for verification purposes, approx. 8-inch by 10-inch sample for each type of glass indicated.

1.07 QUALITY ASSURANCE

- A. Glazing Standards: FGMA Glazing Manual and Sealant Manual.
- B. Fire Resistance Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire resistive assemblies.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to specified destination in manufacturer or distributor's packaging, undamaged, complete with installation instructions.
- B. Store off ground, under cover, protected from weather and construction activities.
- C. Do not expose the non-PVB side of glass to UV light.
- D. Store sheets of glass vertically. DO NOT lean.

1.09 WARRANTY

- A. The manufacturer shall warrant the product against material defects, or defects in manufacturing, for ten (10) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Technical Glass Products (TGP)
 - 1. Other acceptable manufacturers with equivalent products to the specified manufacturer shall include:
 - a. Fire-Resistance Rated Glass:
 - 1) SAFTIFIRST.
 - 2) Vetrotech North America.
 - b. Fire-Protection Rated Glass:
 - 1) SAFTIFIRST.
 - 2) SCHOTT North America.
 - 3) Vetrotech North America.
 - 2. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures"

2.02 GLASS PRODUCTS, GENERAL

- A. Safety Glazing Labeling: Permanently mark glazing with certification label of 16 CFR 1201 Category I and Category II, ANSI Z97.1 and CAN/CGSB-12.1-M. Label shall indicate manufacturer's name, type of glass, and safety glazing standard with which glass complies.
- B. Float Glass, Tempered (Safety) Glass, Laminated (Security) Glass: Refer to Section 08 80 00 for requirements.

2.03 FIRE PROTECTION RATED GLAZING MATERIALS

- A. Fire Protection Rated Glazing: Scheduled on the Drawings as Glazing Type GL-FIR-1.
- B. Product: TGP; FireLite Plus®, Fire Protection Rated Glass.
 - 1. Glass Type: Safety ceramic glass.
 - 2. Performance:
 - a. Fire-rated glass ceramic clear and wireless glazing material listed for use in non-impact safety-rated locations such as transoms and borrowed lites with fire rating requirements ranging from 20 to 90 minutes with required hose stream test.
 - b. Passes positive pressure test standards UL 10C
 - 3. Applications:
 - a. Glazing in fire-rated door assemblies.
 - b. Glazing in fire-rated window assemblies.
 - c. Other locations as indicated on drawings.
 - 4. Properties:
 - a. Thickness: 5/16 inch [8 mm] overall.
 - b. Weight: 4 lbs./sq. ft.
 - c. Approximate Visible Transmission: 85 percent.

- d. Approximate Visible Reflection: 9 percent.
- e. Fire-Rating:
 - 1) Doors: 20-, 45-, 60-, and 90-minutes, and 3-hours.
 - 2) Other Applications: 20-, 45-, 60-, and 90-minutes.
- f. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201 (Cat. I and II).
- g. STC Rating: Approximately 38 dB.
- h. Positive Pressure Test: UL 10C; passes.
- i. Surface Finish:
 - 1) Standard Grade is polished for a surface quality that is comparable to alternative fire-rated ceramics marketed as having a premium finish.
 - 2) Premium Grade is finish ground and polished on both surfaces to provide superior surface quality, improving overall clarity and providing a surface that is unmatched by alternative products.

2.04 FIRE-RESISTANCE RATED GLAZING MATERIALS

- A. Fire-Resistance-Rated Glazing: Scheduled on the Drawings as Glazing Type GL-FIR-2.
- B. Product: TGP; Pilkington Pyrostop®, Fire Resistance Rated Glazing.
 - 1. Glass Type: Tempered Glass with Intumescent Interlayers:
 - a. Construction: Composed of multiple plies of Pilkington Optiwhite™ tempered, high visible light transmission glass laminated with intumescent interlayers, and complying with 16 CFR 1201 Category II and ANSI Z97.1..
 - 2. Fire-Resistive Rating: 45-, 60-, or 90-minutes.
 - a. Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 or UL 263.
 - 3. Applications:
 - a. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are classified and labeled by UL, for fire ratings indicated, based on testing according to NFPA 257 and UL 9.
 - 1) Fire Rating Duration: 45-minutes.
 - b. Fire-Rated Wall Assemblies: Assemblies complying with ASTM E119 that are classified and labeled by UL, for fire ratings indicated, based on testing in accordance with UL 263, ASTM E119.
 - 1) Fire Rating Duration: 120-minutes.
 - c. Fire-Rated Doors:
 - 1) Fire-Rating Duration: 45-, 60-, or 90-minutes.
 - 4. Impact Safety Resistance: ANSI Z97.1 and CPSC 16CFR1201(Cat. I and II).
 - 5. STC Rating: Up to 46 dB.
 - 6. Interior Glazing - Properties:

Fire-Rating	45 minute	60 minute	60 minute	120 minute
Manu.	45-200	60-101	60-201	120-106
Designation				
Glazing Type	single	single	single	IGU
Nom. Thickness	3/4-inch	7/8-inch	1-1/16 inches	2-1/4 inches
Weight (lbs/sf)	9.2	10.85	12.5	22.9
Daylight	86%	87%	86%	75%
Transmission				
Sound	40dB	41dB	44dB	46dB
Transmission				
Coefficient				

- 7. Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's

- name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.
8. Glazing Accessories: Manufacturer's standard compression gaskets, standoff, spacers, setting blocks and other accessories necessary for a complete installation.
- C. Product: TGP; Pilkington Pyroclear®, Fire-Resistant Glass.
1. Composition:
 - a. Configurations are available with a translucent interlayer for added obscurity and privacy.
 2. Thickness:
 - a. Interior Use, Monolithic: 6 mm, 8 mm, or 10 mm.
 - b. Interior Use, Laminated: 13 mm.
 3. Fire-Rating Period: 30- or 60-minutes.
 4. Performance and Testing:
 - a. Approximate Visible Transmission: Varies with thickness (approximate range 88 to 75 percent).
 - b. Impact Safety Resistance: ANSI Z97.1 and CPSC 16 CFR 1201 (Cat. I and II).
 - c. STC Rating:
 - d. Fire Rating: Fire rating classified and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E119 and UL 263.
 5. Permanently label each piece of fire-resistance-rated glass with the appropriate marking.

2.05 GLAZING ACCESSORIES

- A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.
- B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
- C. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 1. AAMA 804.3 tape, where indicated.
 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
 2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.06 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

- C. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.07 FABRICATION

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine glass framing, with glazier present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Observable edge damage or face imperfections.
- B. Do not proceed with glazing until unsatisfactory conditions have been corrected.
- C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.02 INSTALLATION (GLAZING)

- A. Comply with referenced GANA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
- B. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
- C. Set units of glass in each series with uniformity of pattern, draw, bow, and similar characteristics.
- D. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.
- E. Place setting blocks located at quarter points of glass with edge block no more than 6-inches from corners.
- F. Glaze vertically into labeled fire-rated metal frames or partition walls with the same fire rating as glass and push against tape for full contact at perimeter of pane or unit.
- G. Place glazing tape on free perimeter of glazing in same manner described above.
- H. Install removable stop and secure without displacement of tape.
- I. Do not remove protective edge tape.
- J. Install removable stop and secure without displacement of tape.
- K. Do not pressure glaze.
- L. Glaze exterior openings with PVB layer toward the exterior of the building.
- M. Knife trim protruding tape.
- N. Apply cap bead of silicone sealant along void between the stop and the glazing, to uniform line, with bevel to form watershed away from glass. Tool or wipe sealant surface smooth.
- O. Provide minimum 3/16-inch edge clearance.
- P. Install in vision panels in fire-rated doors to requirements of NFPA 80.
- Q. Install so that appropriate UL and Pilkington Pyrostop® markings remain permanently visible.
- R. Install so that appropriate [UL] [FireLite Plus®] markings remain permanently visible.

3.03 PROTECTION AND CLEANING

- A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.
- B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. This section applies to new and existing floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resinous flooring
 - 2. Resilient flooring
 - 3. Tile carpeting
 - 4. Thin-set porcelain floor tile.
- B. Preparation of new concrete floor slabs for installation of floor coverings.
- C. In-situ concrete relative humidity and surface pH testing to all concrete specified to receive floorcoverings.
- D. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- E. Remedial floor coatings.
- F. Remedial floor sheet membrane.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete
- B. Section 09 30 00 - Tiling
- C. Section 09 65 00 - Resilient Flooring
- D. Section 09 68 13 - Tile Carpeting
- E. Section 09 69 23 - Resinous Flooring and Wall Systems

1.04 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2016a.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.06 SUBMITTALS

- A. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
- C. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.

2. Summary of conditions encountered.
 3. Moisture and alkalinity (pH) test reports.
 4. Copies of specified test methods.
 5. Recommendations for remediation of unsatisfactory surfaces.
 6. Product data for recommended remedial coating.
 7. Include certification of accuracy by authorized official of testing agency.
 8. Submit report to Architect.
 9. Submit report not more than two business days after conclusion of testing to all parties.
- D. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.

1.07 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
1. Provide access for and cooperate with testing agency.
 2. Confirm date of start of testing at least 10 days prior to actual start.
 3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Architect when specified ambient conditions have been achieved and when testing will start.
- D. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- E. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.09 COORDINATION

- A. Testing includes concrete placed below, on and above grade
- B. Testing shall take place after allowing concrete to dry for a minimum of 28 days.
- C. Testing is to be scheduled no less than 1 and no more than 6 weeks prior to scheduled flooring installation.

1.10 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX MC RAPID: www.ardexamericas.com/#sle.
 - b. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE SUPERCAP Moisture Vapor Control with LATICRETE SUPERCAP Underlayment: www.laticrete.com/#sle.
 - d. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
- B. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 - 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.

PART 3 EXECUTION

3.01 PREPARATION

- A. Perform following operations in the order indicated:
 - 1. Preliminary cleaning.
 - 2. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 3. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 4. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 5. Specified remediation, if required.
 - 6. Patching, smoothing, and leveling, as required.
 - 7. Other preparation specified.
 - 8. Adhesive bond and compatibility test.
 - 9. Protection.
- B. Remediations:
 - 1. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 - 2. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.03 INTERNAL RELATIVE HUMIDITY TESTING

- A. In-situ relative humidity testing shall comply with the requirements of ASTM F2170.
- B. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period.
- C. The number of in-situ relative humidity test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to 3 in the first 1,000 sq.ft. and 1 per each additional 1,000 square feet.
- D. Test Method:
 - 1. Determine the thickness of the concrete slab, typically from construction documents.
 - 2. Utilizing a roto-hammer, drill test holes to a depth equal to 40% of the concrete thickness. Hole diameter shall not exceed outside diameter of the probe by more than 0.04". Drilling operation must be dry.
 - a. Exception: Elevated structural slab (not poured in pans) should be tested at a depth equal to 20% of its thickness.
 - 3. Vacuum and brush all concrete dust from test hole.
 - 4. Insert a relative humidity probe (sensor) to the full depth of test hole. Place cap over probe.
 - 5. Permit the test site to acclimate, or equilibrate for 24 hours prior to taking relative humidity readings.
 - 6. Remove the cap and insert the cylindrical reading device to obtain reading from the in-situ probe.
 - 7. Read and record temperature and relative humidity at the test site.
- E. Acceptable Testing Equipment:
 - 1. Tramex® CMEX II Electronic Moisture Meter, with the optional Tramex Hygro-i® relative humidity probe, or equal.

3.04 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- C. Alternate Test Method: Electronic pH Meter.
 - 1. Acceptable Testing Equipment:
 - a. Wagner, Rapid RH® Digital pH Meter, or equal.
- D. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.05 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. If applicable, comply with requirements and recommendations of floor covering manufacturer.

3.06 APPLICATION OF REMEDIAL FLOOR COATING

- A. If applicable, comply with requirements and recommendations of coating manufacturer.

3.07 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

- A. If applicable, install in accordance with sheet membrane manufacturer's instructions.

3.08 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Requirements for gypsum board assemblies.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 07 21 00 - Thermal Insulation
- C. Section 07 84 00 - Penetration Firestopping
- D. Section 07 92 00 - Joint Sealants
- E. Section 09 22 16 - Non-Structural Metal Framing
- F. Section 09 30 00 - Tiling
- G. Section 09 91 23 - Interior Painting

1.04 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Verification Samples: For each finish product specified, two samples, representing actual product and finish.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.07 PROJECT CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gypsum Board:
 - 1. Specified Manufacturer: USG Corporation

- a. Other Acceptable Manufacturers with equivalent products to the specified manufacturer shall include:
 - 1) CertainTeed Corp.
 - 2) Georgia-Pacific Gypsum LLC.
 - 3) National Gypsum Company.
 - 4) Temple-Inland.
 - 2. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".
- B. Trim and Accessories:
 - 1. Manufacturer: Subject to compliance with the Contract Documents, provide products of the manufacturers named for each product type specified in this Section.
 - 2. Products of other manufacturers with equivalent products to the manufacturers listed will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

2.03 GYPSUM PANELS, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. **Owner Material Standards:**
 - 1. **All interior gypsum panels shall be moisture and mold resistant, unless otherwise indicated.**
 - 2. **All interior gypsum panels on vertical surfaces, including non-fire-rated and fire-resistive-rated assemblies, shall be Type X material.**
 - 3. **All interior gypsum panels on vertical surfaces, including non-fire-rated and fire-resistive-rated assemblies, shall be abuse-resistant / high-impact material**

2.04 INTERIOR GYPSUM PANELS

- A. Interior Gypsum Panels, designated in this Section as Panel Type GB- #
- B. Type GB-2: TYPE X GYPSUM PANELS, MOISTURE- AND MOLD-RESISTANT
 - 1. Product: USG; Sheetrock® Brand EcoSmart Panels Mold Tough® Firecode® X Panels
 - a. Compliance: ASTM C1396/C1396M, for Type X, water-resistant gypsum wallboard and exterior gypsum soffit board
 - b. UL Type Designation: ULIX
 - c. Panel Size: Manufacturer standard
 - d. Thickness: 5/8 inch.
 - e. Edges: Tapered.
 - 2. Physical Properties:
 - a. Non-Combustibility (ASTM E136): Meets or exceeds criteria.
 - b. Surface-Burning Characteristics (ASTM E84):
 - 1) Flame Spread: 5.
 - 2) Smoke Developed: 5.

- 3) Class A
 - c. Mold Resistance (ASTM D3273): Meets or exceeds criteria
- 3. Uses:
 - a. As a substrate for tiling (refer to Section 09 30 00).
 - 1) Not suitable for use as a substrate for tile in wet areas such as tubs and showers, and other areas subject to direct water exposure.
 - b. Fire-rated wall construction.
 - c. Non-fire-rated wall construction.
 - d. Fire-rated ceiling and soffit construction where applicable.
- C. Type GB-4: GYPSUM CEILING PANELS, MOISTURE- AND MOLD-RESISTANT
 - 1. Product: USG; "Sheetrock® Brand UltraLight Gypsum Panels Mold Tough"
 - a. Compliance: ASTM C1396/C1396M, for water-resistant gypsum wallboard and exterior gypsum soffit board
 - b. UL Type Designation: Not Applicable
 - c. Panel Size: Manufacturer standard
 - d. Thickness: 1/2-inch
 - e. Edges: Tapered
 - 2. Physical Properties:
 - a. Non-Combustibility (ASTM E136): Meets or exceeds criteria
 - b. Surface-Burning Characteristics (ASTM E84):
 - 1) Flame Spread: 15
 - 2) Smoke Developed: 0
 - 3) Class A
 - c. Mold Resistance (ASTM D3273): Meets or exceeds criteria
 - 3. Uses:
 - a. Occurs at non-fire-rated single-layer ceiling and soffit construction where applicable.
- D. Type GB-6: Not Used.
- E. Type GB-7: TYPE X GYPSUM PANELS, ABUSE-RESISTANT AND HIGH-IMPACT
 - 1. Product: USG; "Sheetrock® Brand Mold Tough® VHI Firecode® X Panels"
 - a. Compliance: ASTM C1396/C1396M, for Type X and water-resistant gypsum wallboard
 - b. UL Type Designation: AR
 - c. Panel Size: Manufacturer standard
 - d. Thickness: 5/8 inch
 - e. Edges: Tapered
 - 2. For abuse-resistant construction over steel framing, minimum 20-gauge drywall steel studs are required
 - 3. Physical Properties:
 - a. Non-Combustibility (ASTM E136): Meets or exceeds criteria
 - b. Surface-Burning Properties (ASTM E84):
 - 1) Flame Spread: 15
 - 2) Smoke Developed: 5
 - 3) Class A
 - 4. Performance:
 - a. Abrasion Resistance (ASTM D4977): Level 2
 - b. Indentation Resistance (ASTM D5240): Level 2
 - c. Soft-Body Impact Resistance (ASTM C1629/C1629M): Level 3
 - d. Hard-Body Impact Resistance (ASTM C1629/C1629M): Level 3
 - e. Mold Resistance (ASTM D3273): Meets or exceeds criteria
 - 5. Uses:
 - a. Occurs at **all** non-fire-rated and fire-rated walls throughout the building up to 10'-0" AFF.

2.05 SHAFTWALL GYPSUM LINER PANELS

- A. Product: USG; Sheetrock® Brand Glass-Mat Liner Panels Mold Tough®.
 - 1. Compliance: ASTM C1396/C1396M, Type X, with moisture resistance.
 - 2. UL Type Designation: SLX
 - 3. Panel Size: Manufacturer standard
 - 4. Thickness: 1 inch.
 - 5. Long Edges: Double Beveled.
- B. Physical Properties:
 - 1. Mold Resistance (ASTM D3273): Meets or exceeds criteria
 - 2. Non-Combustibility (ASTM E136): Meets or exceeds criteria
 - 3. Surface-Burning Characteristics (ASTM E84):
 - a. Flame Spread: 20
 - b. Smoke Developed: 0
 - c. Class A
 - 4. ASTM C473:
 - a. Core Hardness: Not less than 11.
 - b. Flexural Strength (lbft).
 - 1) Parallel: Not less than 77.
 - 2) Perpendicular: Not less than 228.
- C. Uses:
 - 1. Shaft wall liner panel.
 - a. Fire Rating as indicated on drawings.
 - 2. Area separation wall systems.

2.06 GLASS-MAT BACKERBOARD

- A. Product: USG; "Durock™ Brand Glass-Mat Tile Backerboard"
 - 1. Compliance: ASTM C1178/C1178M
 - 2. Panel Size: Manufacturer standard
 - 3. Thickness: 5/8 inch
- B. Physical Properties:
 - 1. Mold Resistance: ASTM D3273: Score of 10
 - 2. ASTM E84 Surface-Burning Characteristics:
 - a. Flame Spread: 15
 - b. Smoke Developed: 5
 - 3. Permeability: ASTM E96/E96M: <1 perm
- C. Uses:
 - 1. Used behind porcelain and ceramic tile where indicated
- D. Fastener Requirements:
 - 1. Screws for Fastening Backerboard to Metal Stud Framing: DUROCK Tile Backer Screws, 1-5/8 inches long.

2.07 TRIM ACCESSORIES

- A. Interior Trim: Conform to ASTM C1047.
 - 1. Manufacturer / Products: USG Sheetrock® and Beadex® Brand Paper-Faced Metal Corner Bead and Trim, or equivalent.
 - 2. Material: Paper-plastic-paper copolymer mud-applied corner trim.
 - 3. Shapes:
 - a. Cornerbead
 - b. Outside 90-degree corner
 - c. Inside 90-degree corner
 - d. L-trim corner profile
 - e. J-trim
 - f. Reveal trim

- g. Flexible corner trim for off-angles

2.08 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use setting-type, sandable topping compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.09 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Resilient Sound Isolation Clips (RSIC):
 - 1. Product: Model #RSIC-1, as manufactured by TM Soundproofing.
 - a. RSIC-1 assembly decouples and isolates the gypsum board or plywood from the structure increasing the acoustical performance of the system.
 - b. Application: Install at the Type H partition type where metal furring strips are being attached to the CMU wall at the east wall of Room Nos. 115, 116, 117, 118, and 119.
- C. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
 - 1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Steel Drill Screws: ASTM C1002, unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- E. Sound Attenuation Blankets (Batts): Refer to Section 07 21 00.
- F. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
 - 1. Acceptable Manufacturer/ Products:
 - a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
 - b. Grabber Construction Products; Acoustical Sealant GSC.
 - c. Pecora Corporation; AIS-919.
 - d. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
 - e. Tremco; Acoustical Sealant.
 - f. USG Corporation; SHEETROCK Acoustical Sealant.
 - 2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Thermal Insulation: Refer to Section 07 21 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.03 INSTALLATION - GYPSUM BOARD

- A. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 - 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- B. Multilayer Application:
 - 1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 - 2. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

- C. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.04 INSTALLATION - TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840, as shown on the drawings or coordinated with the Architect prior to the start of work. Control joints shall be installed in face layer of the gypsum board at the following locations:
 - 1. Ceilings: Install control joints in ceilings at 50-foot intervals in either direction to limit areas to 2,500 SF. Control joints shall also be installed where ceiling framing changes direction.
 - 2. Walls: In long partition runs without full height breaks, control joints should be installed at 30'-0" intervals, from floor to ceiling.
 - 3. Doorways and other wall openings: Full height door frames or other full height breaks in the wall surface may be considered as control joints. Less than ceiling height frames should have control joints extending to the ceiling from both corners. Borrowed lite frames should have control joints extending to the floor and ceiling from both corners.
 - 4. Control joints should be installed at weak points in framing where any movement might be expected.
 - 5. Align ceiling and soffit gypsum joints with wall gypsum joints where possible.
- C. Interior Trim: Install with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions. All exposed edges of gypsum shall have trim.

3.05 GYPSUM BOARD FINISH LEVELS

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below according to ASTM C840
 - 1. LEVEL 0: UNFINISHED
 - a. Uses: Temporary construction, dust walls.
 - b. This level has the designation of zero because there is no finish. There is no taping, no joint cement, and no painting. The drywall is erected and is then complete.
 - 2. LEVEL 1: TAPE (FIRE TAPING)
 - a. Uses: Plenum areas above ceiling, and other areas where gypsum board may be concealed.
 - b. Level 1 Finish Requirements:
 - 1) Taping: All joints and angles shall have tape set in joint compound, but not embedded in it.
 - (a) Tape does not need to be covered with joint compound.
 - 2) Coverage of fastener heads, beads, and accessories: Not required.
 - 3) Surface: Tool marks and ridges are acceptable.
 - 3. LEVEL 2: EMBED COAT
 - a. Uses: Substrates for tile (ASTM C630), and other areas where an unfinished appearance is desired.
 - b. Level 2 Finish requirements:

- 1) Taping: All joints and angles shall have tape embedded in joint compound. Joints and angles shall be wiped with a joint knife, leaving a thin coating of joint compound.
 - (a) Fire-Taping: Where a fire resistance rating is required for the gypsum board assembly, details of construction should be in accordance with reports of fire tests of assemblies that have met the requirements of the fire rating imposed.
 - 2) Fastener heads, beads, and accessories shall be covered with one coat of joint compound. Remove excess compound.
 - 3) Surface: Tool marks and ridges are acceptable.
4. LEVEL 3: FILL COAT
- a. Uses: For surfaces that may receive a medium-to-heavy (knockdown) texture or heavyweight wall covering.
 - b. Level 3 Finish Requirements:
 - 1) Taping: Level 2 with an additional coat of joint compound over the taped joints and angles (2 coats total).
 - 2) Coverage of fastener heads, beads, and accessories: Level 2 with one additional coat of joint compound (2 coats total).
 - 3) Surface shall be smooth and free of tool marks and ridges.
 - 4) Primer: The prepared surface shall be covered with drywall primer prior to the application of the final topcoats.
5. LEVEL 4 : FINISH COAT
- a. Applications:
 - 1) Typical finish level for all exposed gypsum board surfaces scheduled to receive paint finishes.
 - (a) Refer to the Interior Finish Legend for paint sheen callouts.
 - 2) For surfaces covered with lightweight wallcovering, if applicable.
 - b. Finish Requirements:
 - 1) Taping: Level 3 with two additional coats of joint compound added over the taped joints (4 coats total), and one additional coat added over all angles (3 coats total)
 - 2) Coverage of fastener heads, beads, and accessories: Level 3 with one additional coat of joint compound (3 coats total).
 - 3) Surface shall be smooth and free of tool marks and ridges.
 - 4) Primer: The prepared surface shall be covered with drywall primer prior to the application of the final topcoats.

3.06 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 1. Indications that panels are wet, or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Non-load-bearing steel framing systems for interior gypsum board assemblies.
- B. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.03 RELATED REQUIREMENTS

- A. Section 05 40 00 - Cold-formed Metal Framing
- B. Section 06 10 00 - Rough Carpentry
- C. Section 07 21 00 - Thermal Insulation
- D. Section 07 92 00 - Joint Sealants
- E. Section 09 21 16 - Gypsum Board Assemblies

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Provide sealed engineering calculations and designs as may be required for special framing conditions based on deflection limitations of L/240, 5 lbs/sq. ft. live load and dead load per location for painted finishes. Facebrick, stone and tile finishes shall have L/640 deflection limitations.

1.05 INFORMATION SUBMITTALS

- A. Evaluation Reports: For dimpled steel studs, Pro steel studs and runners, and firestop tracks, from ICC-ES.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis-of-Design Manufacturer: ClarkDietrich
 - 1. Products of unnamed manufacturers with equivalent products to the specified manufacturer will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".

2.02 DESCRIPTION

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.03 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40 (Z180), hot-dip galvanized, unless otherwise indicated.

- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or Pro steel studs and runners.
1. Steel Studs and Runners:
 - a. Minimum Base-Metal Thickness: 0.0346 inch
 - b. Depth: As indicated on Drawings, 3-5/8 inches (92 mm), 6 inches (152 mm), 2-1/2 inches (64 mm), 1-5/8 inches (41 mm).
 - c. Typical studs scheduled for full height installation to bottom of metal roof deck above shall be 3-5/8" ProSTUD 33 MIL, for very high impact gypsum boards, by Clark Dietrich or equal.
 2. Partial Height Wall Framing: Where indicated on the drawings, provide MidWall partial wall framing system as manufactured by The Steel Network. Provide sizes, clips and details for a complete installation.
 3. Slip-Type Head Joints: Where indicated, provide one of the following, allowing for 1" of movement:
 - a. Single Long-Leg Slotted Runner System: ASTM C 645 top runner with 2-1/2-inch deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 4. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - a. Minimum Base-Metal Thickness: 0.033 inch (0.84 mm).
 5. Cold-Rolled Channel Bridging: Steel, 0.053-inch (1.34-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
 - a. Depth: 1-1/2 inches (38 mm).
 - b. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
 6. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
 - a. Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
 - b. Depth: 7/8 inch (22.2 mm).

2.04 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- (1.59-mm-) diameter wire, or double strand of 0.048-inch- (1.21-mm-) diameter wire.
- B. Hanger Attachments to Concrete:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
 - a. Type: Post-installed, expansion anchor.
 - b. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.
- D. Flat Hangers: Steel sheet, 1 by 3/16 inch (25 by 5 mm) by length indicated.
1. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch (1.34 mm) and minimum 1/2-inch- (13-mm-) wide flanges.
 - a. Depth: 1-1/2 inches (38 mm).
 2. Furring Channels (Furring Members):
 - a. Cold-Rolled Channels: 0.053-inch (1.34-mm) uncoated-steel thickness, with minimum 1/2-inch- (13-mm-) wide flanges, 3/4 inch (19 mm) deep.
 - b. Steel Studs and Runners: ASTM C 645.

- 1) Minimum Base-Metal Thickness: As indicated on Drawings or determined by span and loading requirements.
- 2) Depth: As indicated on Drawings, 3-5/8 inches (92 mm) typical and others as needed by spans and loadings.
- 3) Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22 mm) deep.
 - (a) Minimum Base-Metal Thickness: 0.018 inch (0.45 mm).
3. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
 - 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) Armstrong World Industries, Inc.; Drywall Grid Systems.
 - 2) Chicago Metallic Corporation; Drywall Grid System.
 - 3) USG Corporation; Drywall Suspension System.

2.05 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
 2. Isolation Strip at Exterior Walls: Provide one of the following:
 - a. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.
 - b. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
 2. Coordination with Sprayed Fire-Resistive Materials:
 - a. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches (610 mm) o.c.
 - b. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.03 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
 2. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
 3. Install bracing at terminations in assemblies.

4. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.04 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
 1. Space studs as follows:
 - a. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 - b. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 - c. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
 2. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
 - a. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - b. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
 - 1) Install two 20 ga. studs at each jamb unless otherwise indicated.
 - 2) Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - 3) Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 4) Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 5) Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - 6) Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 7) Curved Partitions:
 - (a) Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - (b) Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches (150 mm) o.c.
 3. Direct Furring:
 - a. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
 4. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

3.05 INSTALLING SUSPENSION SYSTEMS

- A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

- a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - 1) Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - (a) Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards, minimum of 5 pounds per square foot uniform live load plus dead loads with L/360 deflection limit.
 - 2) Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 3) Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4) Do not connect or suspend steel framing from ducts, pipes, or conduit.
- 2. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- 3. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- 4. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- 5. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09 30 50
METAL EDGE PROTECTION AND TRANSITION PROFILES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Edge-protection and transition profiles for floors, walls, and stair nosings.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 09 30 00 - Tiling
- C. Section 09 65 00 - Resilient Flooring
- D. Section 09 68 13 - Tile Carpeting
- E. Section 09 69 23 - Seamless Resinous Flooring and Wall Coverings

1.04 DEFINITIONS

- A. Metal Edge Protection and Transition Profiles from here on shall be referred to as "Edge Protection".

1.05 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) long, representing actual product, color, and finish.
- C. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum five-years experience.
- B. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

1.08 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.

1.09 COORDINATION

- A. Coordinate Work with other operations and installation of floor finish materials to avoid damage to installed materials.

1.10 WARRANTY

- A. Floor and Wall Profiles - Limited Warranty: The manufacturer shall warrant the product against material defects, or defects in manufacturing, for five (5) years from Date of Substantial Completion.

- B. Cove-Shaped Profiles - Limited Warranty: The manufacturer shall warrant the product against material defects, or defects in manufacturing, for five (5) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Schluter Systems
 - 1. Products of other manufacturers with equivalent products to the manufacturers listed will be considered in accordance with the "or equal" provision specified in Division 01 "Product Requirements".
 - a. Product Substitutions: Comply with the requirements specified in Division 01 "Substitution Procedures".

2.02 WALL EDGE PROTECTION

- A. Wall Edge Protection, designated in the Drawings as Finish Type MT- #
 - 1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
- B. Type MT-2: Schluter-QUADEC
 - 1. Description: Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer.
 - 2. Corners:
 - a. Provide with matching inside corners.
 - b. Provide with matching outside corners.
 - c. Provide with internal connectors.
 - 3. Material and Finish:
 - a. E - Stainless Steel Type 304 = V2A.
 - 1) Height as required to coordinate with tile selection and setting system selected.

2.03 EDGE PROTECTION PROFILES FOR STAIR NOSINGS

- A. Edge Protection for Stair Nosings, designated in the Drawings as Finish Type SNT- #
 - 1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
- B. Type SNT-1:
 - 1. Product: Schluter-TREP-E
 - a. Description: roll-formed stainless steel profile with ribbed, 1-3/16 inch (30 mm) wide exposed surface with rounded leading edge, and integrated trapezoid-perforated anchoring leg.
 - b. End Caps: Provide with matching end caps.
 - c. Material and Finish:
 - 1) E - Stainless Steel Type 304 = V2A.
 - (a) Height as required to coordinate with tile selection and setting system selected.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.04 PROTECTION

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

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Suspended exposed tee metal grid ceiling system.
- B. Acoustical units:
 - 1. Acoustical panels.

1.03 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies
- B. Division 21 - Fire Protection
- C. Division 23 - HVAC
- D. Division 26 - Electrical

1.04 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2017.
- E. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- F. UL (FRD) - Fire Resistance Directory; current edition.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.06 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, 6-inches- (150-mm-) in size.
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
 - 1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
 - 2. Concealed Suspension-System Members: 6-inch- (150-mm-) long Sample of each type.
 - 3. Exposed Moldings and Trim: Set of 6-inch- (150-mm-) long Samples of each type and color.

1.07 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Revise subparagraphs below to suit Project.

2. Ceiling suspension-system members.
 3. Method of attaching hangers to building structure.
 - a. Retain first subparagraph below if cast-in-place attachment devices are required for Project.
 - b. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
 4. Size and location of initial access modules for acoustical tile.
 5. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 6. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical tile ceiling, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical tile ceiling suspension system and anchor and fastener type, from ICC-ES.
- E. Field quality-control reports.

1.08 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.09 MAINTENANCE MATERIAL SUBMITTALS

- A. Deliver extra acoustical units for Owner's use in maintenance. Label and store where directed by the Owner including codes used on the Drawings. Do not deliver to the Project site until the Owner is prepared to receive and store maintenance materials.
1. Ceiling Panels: For each type specified, provide full-size panels in unopened boxes equal to no less than 5 percent of quantity installed.

1.10 QUALITY ASSURANCE

- A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.
- B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.12 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.13 WARRANTY

- A. Warranty: ClimaPlus™ 30 year limited system warranty. Contains a broad spectrum antimicrobial additive on the face and back of the panel that provides resistance against the growth of mold and mildew. Includes sag resistance performance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustical Panels:
 - 1. Specified Manufacturer: USG Interiors, Inc.
 - a. Other Acceptable Manufacturer: None identified. No substitutions will be considered or accepted.
- B. Suspension Systems:
 - 1. Specified Manufacturer: USG Interiors, Inc.
 - a. Other Acceptable Manufacturer: None identified. No substitutions will be considered or accepted.

2.02 DESIGN/ PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to the 2012, 2015, or 2018 IBC, Section 1613 or ASCE 7.
 - 1. Seismic Risk Category: IV
 - 2. Site Classification: C
 - 3. Seismic Design Category (Table 1613.2.5(2)): C
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.03 ACOUSTICAL PANELS

- A. Owner Standard: The acoustical ceiling products specified in this Section are restricted to the specified manufacturers and products unless indicated otherwise.
- B. Acoustical Panels, designated in the Drawings as Finish Type ACT- #.
 - 1. Refer to the "Interior Finish Legend" in the Drawings for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
- C. Type ACT-1:
 - 1. Product: USG; Radar Clima Plus #2210.
 - a. Material: Mineral Fiber.
 - b. Size: 24 by 24 inches.
 - c. Thickness: 5/8 inches.
 - d. Edge: Square.
 - e. Color: White.
 - f. Surface Pattern: Perforated, small holes, and light texture.
 - g. Applications: Public Spaces, Back of House.
 - h. ASTM E84:
 - 1) Flame Spread: 25 or less.
 - 2) Smoke Developed: 50 or less.
 - 3) Fire Rating: Class A.
 - 2. Acoustics: 0.55 NRC / 33 CAC.
 - 3. Suspension System: Exposed grid, Type A.
- D. Type ACT-2:
 - 1. Product: USG; Clean Room Clima Plus #56099 Panels.
 - a. Description: Panels have an embossed, vinyl-laminated face with sealed back and edges for use in Class 100 (ISO 5) clean rooms..
 - b. Size: 24 by 24 inches.
 - c. Thickness: 5/8 inches.
 - d. Edge: Square.
 - e. Color: White.
 - f. Surface Pattern: Unperforated.
 - g. Applications: Operating Rooms, Food Prep.
 - h. ASTM E84:
 - 1) Flame Spread: 25 or less.

- 2) Smoke Developed: 50 or less.
 - 3) Fire Rating: Firecode®.
 2. Acoustics: 0.00 NRC / 35 CAC.
 3. Suspension System: Exposed grid, Type A.
- E. Type ACT-3:
 1. Product: USG; Mars Healthcare Panel #86169
 - a. Classification: Provide ceiling panels complying with ASTM E 1264 for type, form and pattern as follows:
 - 1) Type: IV, mineral base with membrane faced overlay
 - 2) Form: 1 & 2, Nodular and water felted
 - 3) Pattern: E & G, smooth and light texture
 - b. Size: 24 by 24 inches.
 - c. Thickness: 3/4 inches.
 - d. Edge: Square.
 - e. Color: White.
 2. ASTM E84:
 - a. Flame Spread: 25 or less.
 - b. Smoke Developed: 50 or less.
 - c. Fire Rating: Class A.
 3. Acoustics: 0.75 NRC / 35 CAC / 0.90 LR
 4. Suspension System: Exposed grid, Type A.

2.04 SUSPENSION SYSTEM

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- B. Exposed Steel Suspension System Type A: Formed steel, commercial quality cold rolled; heavy-duty.
 1. Product: USG; "DONN® Brand DX/DXL™ 15/16" Acoustical Suspension System", or equivalent.
 2. Profile: Tee; 15/16 inch wide face.
 3. Construction: Double web.
 4. Finish: White painted.
 5. Grid Module: As indicated in drawings.
 6. Fire Rating: Class A.
 7. Seismic Criteria:
 - a. Reference Seismic standards per ASTM E580 and CISC guidelines.
 - b. Seismic Design Category as defined by the 2018 IBC (International Building Code): A-C.

2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Perimeter Moldings: Same material and finish as grid.
 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Gypsum Board: Fire rated type; 5/8 inch thick, ends and edges square, paper faced.
- D. Products: Subject to compliance with requirements available products that may be incorporated into the Work include, but are not limited to, the following:
 1. Acoustical Sealant for Concealed Joints:
 - a. Henkel Corporation; OSI Sealants Pro-Series SC-175 Rubber Base Sound Sealant.
 - b. Pecora Corporation; AIS-919.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.

- E. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 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.

3.02 PREPARATION

- 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.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
 - 1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50-percent of acoustical unit size.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
- F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- H. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- I. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- J. Do not eccentrically load system or induce rotation of runners.
- K. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.
- L. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.
- M. Install light fixture boxes constructed of gypsum board above light fixtures in accordance with fire rated assembly requirements and light fixture ventilation requirements.

3.04 INSTALLATION - ACOUSTICAL PANELS

- A. Install acoustical units in accordance with manufacturer's instructions.

- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Lay directional patterned units with pattern parallel to longest room axis.
- D. Fit border trim neatly against abutting surfaces.
- E. Install units after above-ceiling work is complete.
- F. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- G. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- H. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- I. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Resilient sheet flooring.
- B. Static control resilient sheet flooring.
- C. Resilient tile flooring.
- D. Static control resilient tile flooring.
- E. Installation accessories.

1.03 RELATED REQUIREMENTS

- A. Section 09 05 61 - Common Work Results for Flooring Preparation
- B. Section 03 30 00 - Cast-in-Place Concrete
- C. Section 09 30 50 - Metal Edge Protection and Transition Profiles
- D. Section 09 65 13 - Resilient Base and Accessories

1.04 REFERENCE STANDARDS

- A. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials; 2017a.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2015.
- C. ASTM F970 - Standard Test Method for Static Load Limit; 2015.
- D. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections of each different color and pattern of floor covering required.
 - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.
- D. Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch (150-by-230-mm) Sample applied to a rigid backing and prepared by Installer for this Project.
- E. Product Schedule: For floor coverings. Use same designations indicated on Drawings.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

1.07 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor covering to include in maintenance manuals.

1.08 MAINTENANCE MATERIAL SUBMITTALS

- A. Deliver extra resilient flooring material for Owner's use in maintenance. Label and store where directed by the Owner including codes used on the Drawings. Do not deliver to the Project site until the Owner is prepared to receive and store maintenance materials.
 - 1. Resilient Sheet Floor Covering: Furnish quantity not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, in roll form and in full roll width for each color, pattern, and type of floor covering installed.
 - 2. Resilient Tile Floor Covering: For each type specified, provide full-size tiles in unopened cartons equal to no less than 3 percent of each type and color installed.

1.09 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.
 - 1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 65 deg F or more than 90 deg F. Store rolls upright.

1.11 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F (21 deg C) or more than 85 deg F (29 deg C), in spaces to receive floor coverings during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Close spaces to traffic during floor covering installation.
- C. Close spaces to traffic for 48 hours after floor covering installation.
- D. Install floor coverings after other finishing operations, including painting, have been completed.

1.12 WARRANTY

- A. Refer to products specified for warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Owner Standard: The products specified in this Section are restricted to those of the manufacturers named for each finish type specified.
 - 1. Product substitutions: Not permitted.

2.02 RESILIENT SHEET FLOORING

- A. Owner Standard: The resilient sheet flooring products specified below are restricted to the manufacturers/products indicated, no exceptions.
- B. Resilient Sheet Flooring, designated in the Drawings as Finish Type RSF- #
 - 1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
- C. Type RSF-1, RSF-2, RSF-3, & RSF-4:
 - 1. Manufacturer: Armstrong Flooring, Inc
 - 2. Product: As scheduled

- a. Color: As scheduled
 - b. Seaming Method: Heat welded
 - 1) Refer to "Seams" Article this Section.
 - 3. Integral Flash Cove Base: As scheduled
 - a. Refer to "Integral Flash Cove Base" Article this Section.
 - 4. Compliance: ASTM F1913
 - 5. Warranty: 10-Year Limited Commercial Warranty
- D. Seams:
- 1. Heat Welded Seams:
 - a. Provide vinyl weld rod. Color of weld rod shall be compatible with field color of flooring or as selected by Architect to contrast with field color of flooring.
 - 1) Weld rods shall be sealed after installation. Provide weld rod coating pen from manufacturer.
 - 2. Chemically Bonded Seams: Provide seam adhesive at seams as recommended by the resilient flooring manufacturer.
 - a. VOC Content: Not more than 510g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. Integral Flash Cove Base:
- 1. Where indicated, provide integral flash cove wall base by extending sheet flooring 6-inches up the wall using adhesive, welding rod, and accessories recommended and approved by the flooring manufacturer.
 - 2. Integral Flash Cove Base, designated on the Interior Finish Legend in the Drawings as Finish Type Type IB- #
 - 3. Type IB-1:
 - a. Material: Match Type RSF-1
 - b. Height: 6-inches
 - 4. Type IB-2:
 - a. Material: Match Type RSF-2
 - b. Height: 6-inches
 - 5. Accessories:
 - a. Cove Strip: 1-inch (25-mm) radius provided or approved by manufacturer; plastic.
 - b. Cap Strip: Square metal cap provided or approved by manufacturer.
 - c. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.

2.03 RUBBER FLOORING

- A. Owner Standard: The rubber flooring products specified in this Section are restricted to the manufacturers and products indicated.
- B. Rubber Flooring, designated in the Drawings as Finish Type RBF- #
 - 1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
 - 2. Type RBF-1, RBF-2, RBF-3, & RBF-5:
 - a. Application: Rubber Tile
 - b. Manufacturer: As scheduled
 - c. Model/ Pattern/ Style: As scheduled
 - d. Color: As scheduled
 - e. Size: As scheduled
 - f. Installation Method: As scheduled
 - 3. Type RBF-4:
 - a. Application: Rubber Flooring
 - b. Manufacturer: As scheduled
 - c. Model/ Pattern/ Style: As scheduled
 - d. Color: As scheduled
 - e. Size: As scheduled

- f. Installation Method: As scheduled

2.04 LUXURY VINYL TILE FLOORING

- A. Owner Standard: The resilient tile flooring products specified in this Section are restricted to the manufacturers and products indicated.
- B. Luxury Vinyl Floor Tile (LVT), designated in the Drawings as Finish Type LVT- #
1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
 2. Type LVT-1:
 - a. Manufacturer: Mannington.
 - b. Product: Amtico - Wood
 - c. Color: #AROW8200 - Regency Walnut
 - d. Total Thickness: 2.5-mm
 - e. Size: 4-1/2 inches by 36-inches
 - f. Installation Method: Random.
 - g. Performance:
 - 1) Static Load (ASTM F970): 2,000 PSI; Residual Indent = 0.005"
 - 2) Fire Test Data:
 - (a) Flame Spread (ASTM E648): Class I.
 - (b) Smoke Density (ASTM E662): Less than 450.
 - h. Compliance: ASTM F1700 Class III, Type B
 - i. Warranty: Limited 20 Year Commercial Warranty; Limited 20 Year Quantum Guard® HP Wear Warranty
 3. Type LVT-2:
 - a. Manufacturer / Product: Mannington.
 - b. Style: Amtico Stone
 - c. Color: AROSTV13 - Corinthian Marble
 - d. Total Thickness: 2.5-mm
 - e. Size: 18-inches by 18-inches
 - f. Installation Method: Ashlar.
 - g. Performance:
 - 1) Static Load (ASTM F970): 2,000 PSI; Residual Indent = 0.005"
 - 2) Fire Test Data:
 - (a) Flame Spread (ASTM E648): Class I.
 - (b) Smoke Density (ASTM E662): Less than 450.
 - h. Compliance: ASTM F1700 Class III, Type B
 - i. Warranty: Limited 20 Year Commercial Warranty; Limited 20 Year Quantum Guard® HP Wear Warranty
 4. Type LVT-3:
 - a. Manufacturer / Product: Mannington.
 - b. Style: Amtico Stone
 - c. Color: AROSMS43 - Stria Basalt
 - d. Total Thickness: 2.5-mm
 - e. Size: 18-inches by 18-inches
 - f. Installation Method: Ashlar.
 - g. Performance:
 - 1) Static Load (ASTM F970): 2,000 PSI; Residual Indent = 0.005"
 - 2) Fire Test Data:
 - (a) Flame Spread (ASTM E648): Class I.
 - (b) Smoke Density (ASTM E662): Less than 450.
 - h. Compliance: ASTM F1700 Class III, Type B
 - i. Warranty: Limited 20 Year Commercial Warranty; Limited 20 Year Quantum Guard® HP Wear Warranty

2.05 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Sheet-Vinyl-to-Resinous-Flooring Transitions in Patient Rooms: Where indicated, provide underlayment materials and labor required to transition the sheet vinyl flooring in the patient rooms to meet the resinous flooring being installed in the adjacent toilet rooms. Coordinate the transition with the Architect.
 - 1. Self-Drying, Cement-Based Finish Underlayment: Provide ARDEX Feather Finish, as manufactured by ARDEX Engineered Cements or approved equal. Prepare subfloor and install per manufacturer's written instructions.
 - 2. Primer: Provide manufacturer's recommended primer for subflooring application.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
 - 1. Adhesives shall have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Allow for full-spread Henry 452 Epoxy Flooring Adhesive at all exam rooms/patient bed locations.
 - 3. In lieu of epoxy flooring adhesive and/or manufacturer's adhesive, Spray-Lock 3500 may be substituted. Follow manufacturer's instructions for use and application thicknesses.
- D. Edge Protection:
 - 1. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition. Refer to Section 09 65 13.
 - 2. Provide metal edge protection products of width shown on the drawings, and of required thickness to protect exposed edges of the flooring. Refer to Section 09 30 50.
- E. Copper Grounding Strips: Type and size as recommended for static control flooring.
- F. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions (i.e. moisture tests, bond test, pH test, etc.).
- B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

3.02 PREPARATION

- A. Subfloor Cleaning: The surface shall be free of dust, solvents, varnish, paint, wax, oil, grease, sealers, release agents, curing compounds, residual adhesive, adhesive removers and other foreign materials that might affect the adhesion of resilient flooring to the concrete or cause a discoloration of the flooring from below.
- B. Subfloor Relative Humidity and pH Testing: Refer to Section 09 05 61 for requirements.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor coverings until they are same temperature as space where they are to be installed.
- E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.03 INSTALLATION

- A. Install flooring in strict accordance with manufacturer's written instructions.
- B. General Requirements:

1. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
 2. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
 3. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.
 4. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.
 5. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
 - a. Fit joints and butt seams tightly.
 - b. Set flooring in place, press with heavy roller to attain full adhesion.
 6. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
 7. Install flooring on recessed floor access covers, maintaining floor pattern.
- C. Static Control Flooring: Place copper grounding strip in conductive adhesive and apply additional adhesive to top side of strip before installing static control flooring. Allow strip to extend beyond flooring in accordance with static control flooring manufacturer's instructions.
- D. Resilient Sheet Flooring:
1. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
 2. Seams are prohibited in bathrooms, kitchens, toilet rooms, and custodial closets.
 3. Seams:
 - a. Heat-Welded Seams: Comply with ASTM F1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.
 - b. Chemically-Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless floor covering. Prepare seams and apply compound to produce tightly-fitted seams without gaps, overlays, or excess bonding compound on floor covering surfaces.
 4. Integral Flash Cove Base: Cove resilient floor coverings 6 inches (152 mm) up vertical surfaces where indicated on drawings. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.
 - a. Install metal corners at inside and outside corners.
- E. Resilient Tile Flooring:
1. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - a. Lay tiles in pattern indicated, or verify with Architect.
 2. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 3. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
 4. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
 5. Install plank tile with a random offset of at least 6 inches from adjacent rows.
- F. Resilient Base and Edge Protection: Refer to Section 09 65 13 for requirements.
- G. Resilient Stair Coverings: Refer to Section 09 65 13 for requirements.

- H. Metal Edge Protection: Refer to Section 09 30 50 for requirements.
- I. Joint Sealant: Apply sealant around columns, at door frames, and at other joints and penetrations.
- J.

3.04 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.
- B. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Resilient wall base.
- B. Resilient molding accessories.

1.03 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies
- B. Section 09 65 00 - Resilient Flooring
- C. Section 09 68 13 - Tile Carpeting
- D. Section 09 69 23 - Resinous Flooring, Base, and Walls

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12-inches (300 mm) long, of each resilient product color, texture, and pattern required.
- D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.05 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.07 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 65 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.08 EXTRA MATERIALS

- A. Deliver extra resilient base units for Owner's use in maintenance. Label and store where directed by the Owner including codes used on the Drawings. Do not deliver to the Project site until the Owner is prepared to receive and store maintenance materials.

1. Furnish not less than 10 linear feet for every 500 linear feet, or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.09 WARRANTY

- A. Warranty: Provide manufacturer's standard warranty against manufacturing defects in material or workmanship during the warranty period.
 1. Warranty Period: One (1) year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Resilient Base and Accessories:
 1. Specified Manufacturer: Roppe Corporation.
 - a. Other Acceptable Manufacturer: Equivalent products of the manufacturer's listed below will be acceptable.
 - 1) Johnsonite
 - 2) Flexco, Inc.
 - 3) Burke Flooring.
 - b. Substitutions: Not permitted.

2.02 MATERIALS

- A. Rubber Wall Base and Accessories: Meet or exceed the requirements of ASTM F1861, Type TS (Thermoset) rubber formulations, Group 1 (solid, homogeneous).
 1. Construction: 100% vulcanized homogenous rubber compound comprised of a premium blend and SBR rubber materials.

2.03 PERFORMANCE REQUIREMENTS

- A. Materials shall meet or exceed the following performance criteria:
 1. Flame Spread / Smoke Density (ASTM E84): Class B.
 2. Flammability / Critical Radiant Flux (ASTM E648): Class I.
 3. Smoke Density (ASTM E662): < 450: Passes.
 4. Flexibility (ASTM F137): Passes.
 5. Color Stability: Meets or exceeds ASTM F1861 requirements for color stability when tested to ASTM F1515.
 6. Chemical Resistant (ASTM D925): Passed.
 7. SCS FloorScore® Certified.
- B. Manufacturing facility shall be ISO 9001 and ISO 14001 Certified.

2.04 RESILIENT BASE

- A. Resilient Base: Designated on the Interior Finish Legend in the Drawings as Finish Type RWB- #.
- B. Type RWB-1:
 1. Product: Roppe; Pinnacle Plus.
 - a. Thickness: 3/8-inch.
 - b. Height: 4-5/8 inches.
 - c. Color: #110 - Brown.
 - d. Profile: Toeless (Straight), Model #65.
 - e. Length: 8-foot lengths.
 2. Adhesive: As recommended by Manufacturer.
 3. Installation:
 - a. Outside Corners: Preformed.
 - b. Inside Corners: Job formed.
- C. Type RWB-2:
 1. Product: Roppe; Pinnacle Standard.
 - a. Thickness: 1/8 inch.
 - b. Height: 4 inches.

- c. Color: #110 - Brown.
 - d. Profile: Toe (Coved).
 - e. Length: 120-foot coils.
 - 2. Adhesive: As recommended by Manufacturer.
 - 3. Installation:
 - a. Outside Corners: Preformed.
 - b. Inside Corners: Job formed.
- D. Type RWB-3:
- 1. Product: Roppe; Pinnacle.
 - a. Thickness: 1/8 inch.
 - b. Height: 4 inches.
 - c. Color: #110 - Brown.
 - d. Profile: Toe (Coved).
 - e. Length: 120-foot coils.
 - 2. Adhesive: As recommended by Manufacturer.
 - 3. Installation:
 - a. Outside Corners: Preformed.
 - b. Inside Corners: Job formed.

2.05 RESILIENT STAIR TREADS AND RISERS

- A. Resilient Stair Treads and Risers: Designated on the Interior Finish Legend in the Drawings as Finish Type RST- #
- B. Type RST-1:
- 1. Product: _____
 - 2. Tread Depth: _____
 - 3. Tread Length: _____
 - 4. Riser Height: _____
 - 5. Coordinating Landing Tile: _____
 - 6. Color: _____
 - 7. Pattern: _____
- C. Type RST-2:
- 1. Product: _____
 - 2. Tread Depth: _____
 - 3. Tread Length: _____
 - 4. Riser Height: _____
 - 5. Coordinating Landing Tile: _____
 - 6. Color: _____
 - 7. Pattern: _____

2.06 VINYL ACCESSORIES

- A. Vinyl Accessories: Designated on the Interior Finish Legend in the Drawings as Finish Type TRS- #.
- 1. Description: Trims, transitions, nosings and other accessories.
 - 2. Composition: Vinyl; Homogeneous composition of polyvinyl chloride (PVC), high quality additives, and colorants.
 - 3. Performance Requirements:
 - a. Flame Spread / Smoke Density (ASTM E84): Class B; Smoke Index: <450.
 - b. Critical Radiant Flux (ASTM E648): Class I.
 - c. Hardness: ASTM D 2240: Not less than 85 Shore A
 - d. Abrasion Resistance (ASTM D 3389): 0.22 mg/cycle
 - e. Slip Resistance (ASTM D 2047): Exceeds Federal Standards and ADA recommendations for flat surfaces.
- B. Type TRS-XX: Transition Strip:
- 1. Product:

- a. Description:
- C. Type TRS-XX: Reducer Strip:
 - 1. Product:
 - a. Description:
- D. Type TRS-XX: T-Moulding:
 - 1. Product:
 - a. Description:

2.07 RUBBER ACCESSORIES

- A. Rubber Accessories: Designated on the Interior Finish Legend in the Drawings as Finish Type TRS- #.
 - 1. Description: Trims, transitions, nosings and other accessories.
 - 2. Composition: Rubber; 100% vulcanized homogenous rubber compound comprised of a premium blend and SBR rubber materials.
 - 3. Performance Requirements:
 - a. Critical Radiant Flux (ASTM E648): Standard Test Method for Critical Radiant Flux of 0.45 watts/cm² or greater, Class I.
 - b. Slip Resistance: ASTM D2047: Exceeds Federal Standards and ADA recommendations of .5 for flat surfaces
 - 4. Warranty: 2-year limited.
- B. Type TRS-XX: Reducer Strip:
 - 1. Product: Roppe; #23 Reducer Strip, 3/16-inch
 - 2. Description: Reducer Strip.
 - 3. Width: 1-5/16 inches.
 - 4. Butting Gauge: 3/16 inch.
 - 5. Length: 9-foot sections.
 - 6. ADA compliant for changes in level.
- C. Type TRS-XX: Reducer Strip:
 - 1. Basis of Design: Roppe; #21 Reducer Strip, 0.080" for resilient floor.
 - 2. Width: 1-inch, beveled.
 - 3. Butting Gauge: 0.080-inch.
 - 4. Length: 9-foot sections.
 - 5. ADA compliant for changes in level.
- D. Type TRS-XX: T-Moulding:
 - 1. Product: Roppe; Model # 1/4-inch materials to 1/8-inch materials
 - 2. Description: T-Moulding with track base.
 - 3. Width: 1-1/16 inches.
 - 4. Snap-in type 'T' mouldings that require a track base.
 - 5. ADA compliant for changes in level.
- E. Type TRS-XX: Edge Guards:
 - 1. Product: Roppe; Underlap Carpet Edge Guard.
 - 2. Description: Edge Guard Mouldings to transition from floor material to subfloor.
 - 3. Profile and Dimensions: As required for thickness of floor material.
 - 4. ADA compliant for changes in level.
- F. Type TRS-XX: Subfloor Levellers:
 - 1. Product: Roppe; Model #301, 302, 303, or 304.
 - 2. Description: Subfloor Leveler is a solid, homogeneous, thermoplastic product made to level or ramp resilient flooring products.
 - 3. Nominal Starting Thickness: 0.040-inches (1.016 mm)
 - 4. Nominal Final Thickness: As required for thickness of floor material.
 - 5. Nominal Width: 48-inches (1.219 m)
 - 6. Nominal Length: As required for smooth transition.

7. ADA compliant for changes in level.

2.08 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

3.02 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. Preformed Corners: Install preformed corners before installing straight pieces.
- G. Job-Formed Corners:
 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
 2. Inside Corners: Use straight pieces of maximum lengths possible.

3.04 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 1. Remove adhesive and other blemishes from exposed surfaces.
 2. Sweep and vacuum surfaces thoroughly.

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

END OF SECTION

SECTION 09 69 23
SEAMLESS RESINOUS FLOOR AND WALL COVERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Seamless Resinous Floor Covering (from here on referred to as "Seamless Flooring")
- B. Seamless Resinous Wall Covering (from here on referred to as "Seamless Walls")
- C. Seamless Resinous Integral Cove Base

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-In-Place Concrete
- B. Section 04 20 00 - Brick and Concrete Masonry
- C. Section 09 05 61 - Common Work Results for Flooring Preparation
- D. Section 09 21 16 - Gypsum Board Assemblies

1.04 ACTION SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- B. Shop Drawings: Submit details of construction; include relationship with adjacent construction.
- C. Selection Samples: For each finish product specified complete sets of color chips representing manufacturer's full range of available colors and patterns.
 - 1. Submit manufacturer's standard color chart. Computerized custom color matching shall be available upon request. Furnish required number of sets of this information for review and selection.
- D. Verification Samples: For each finish product specified, two samples, minimum size 6 inches square representing actual product, color, and patterns.
 - 1. Submit a cured system sample which the Contractor has made for verification purposes and finish texture approval.
- E. Maintenance Data: For maintenance manuals.

1.05 INFORMATION SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, from manufacturer.
- C. Material Test Reports: For each resinous flooring system.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain materials from a single manufacturer with a minimum of five years verifiable experience providing materials of the type specified in this section.
- B. Installer Qualifications:
 - 1. Installation shall be performed by a manufacturer approved installer with skilled mechanics having not less than three years satisfactory experience in the installation of the type of system as specified in this section, and shall be approved in writing by the manufacturer of the seamless flooring and wall systems.

- C. Source Limitations: Obtain primary resinous materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

1.08 PRE-INSTALLATION MEETINGS

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

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. The Contractor shall visit the jobsite prior to the installation of the seamless flooring and wall systems to evaluate substrate condition, including substrate moisture transmission, quantity and severity of cracking, and the extent of repairs needed. Substrate imperfections should be repaired only after mechanical preparation of the substrate. Surface preparation reveals most imperfections requiring repair. Concrete substrates shall be tested to verify that the moisture vapor transmission of the substrate does not exceed the manufacturers' recommendations.
- C. Concrete subfloor tolerances shall be in accordance with ACI 302. Each drain in the installation area shall be working and raised or lowered to the actual finished elevation of the seamless flooring.
- D. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during application of seamless flooring and wall system.
- E. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

1.11 WARRANTY

- A. Installation Warranty: The Contractor shall warrant the installation to be free of defects in material and workmanship for a period of one (1) year from Date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Desco Coatings, Inc. (P: 800-426-4164).
 - 1. Other Acceptable Manufacturer: None identified. No substitutions will be considered or accepted.

2.02 PERFORMANCE REQUIREMENTS

- A. Physical Properties:
 - 1. Compressive Strength (ASTM C579): 10,200 psi
 - 2. Tensile Strength ASTM C307: 1,650 psi
 - 3. Flexural Modulus of Elasticity (ASTM C580): 4,000 psi
 - 4. Abrasion Resistance (ASTM D4060): 0.080 mg maximum weight loss
 - 5. Hardness (ASTM D2240): 85-90, Shore D
 - 6. Bond Strength (ASTM D4541): 425 psi
- B. Recommended Moisture Vapor Transmission Considerations:
 - 1. Placement of slabs-on-grade over a Class A vapor retarder as defined by ASTM E145.
 - 2. A water cement ratio of 0.45 and 0.5.
 - 3. Curing by ASTM C171 sheet materials for curing concrete.
 - 4. A slump in the range of 3 to 4 inches which can be increased by the use of super plasticizers.
- C. Flame Spread: ASTM E84

1. Results shall be rated as Class A.
 - a. Flame Spread below 25.
 - b. Smoke Development, 100

2.03 SEAMLESS RESINOUS FLOOR COVERING ("SEAMLESS FLOORING")

- A. Seamless Flooring, designated in the Drawings as Finish Type RES- #
 1. Refer to the "Interior Finish Legend" for pertinent information on this finish type
- B. Type RES-1:
 1. Product: Desco; Quartz Cremona TG / OR Series with Bio-Finish
 - a. Description: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor covering designed to produce a seamless installation.
 - b. Uses: As scheduled
 - c. Overall System Thickness: 1/4-inch (6.4 mm)
 - d. Surface Texture: Standard Slip Resistant
 - e. Color: As scheduled
 2. Body Coats:
 - a. Resin: Epoxy
 - b. Formulation Description: High solids
 - c. Application Method: Hand troweled
 - 1) Thickness/ Number of Coats: 2 @ 1/8 inch (3.2 mm)
 - 2) Overall System Thickness: 1/4-inch (6.4 mm)
 - 3) No broadcasting of aggregate allowed
 - d. Aggregates: Grade 11 quartz aggregate with 20% of grade 28 as a filler.
 3. Topcoat/s:
 - a. Product: SR Co-Polymer;100% solids
 - b. Color: Clear.
 - c. Number of Coats: One or two as may be required for desired finish texture

2.04 SEAMLESS RESINOUS WALL COVERING ("SEAMLESS WALLS")

- A. Seamless Walls, designated in the Drawings as Finish Type RES-#
 1. Refer to the "Interior Finish Legend" for pertinent information on this finish type
- B. Type RES-2:
 1. Product: Desco; Quartz Cremona TG / OR Series with Bio-Finish
 - a. Description: Abrasion-, impact- and chemical-resistant, decorative-aggregate-filled, epoxy-resin-based, monolithic floor covering designed to produce a seamless installation.
 - b. Uses: As scheduled
 - c. Overall System Thickness: 1/4-inch (6.4 mm)
 - d. Surface Texture: Smooth or Orange Peel
 - e. Color: As scheduled
 2. Body Coats:
 - a. Resin: Epoxy
 - b. Formulation Description: High solids
 - c. Application Method: Hand troweled
 - 1) Thickness/ Number of Coats: 2 @ 1/8 inch (3.2 mm)
 - 2) Overall System Thickness: 1/4-inch (6.4 mm)
 - 3) No broadcasting of aggregate allowed
 - d. Aggregates: Grade 11 quartz aggregate with 20% of grade 28 as a filler.
 3. Topcoat/s:
 - a. Product: SR Co-Polymer;100% solids
 - b. Color: Clear.
 - c. Number of Coats: One or two as may be required for desired finish texture

2.05 SEAMLESS RESINOUS INTEGRAL COVE BASE

- A. Integral Cove Base: Provide a turned-up cove base with 1-inch radius cove as indicated on drawings.
 - 1. Integral Cove Base, designated in the Drawings as Finish Type IB-3
 - a. Refer to the "Interior Finish Legend" for pertinent information on this finish type
 - 2. Height: 6 inch
 - 3. Color: As scheduled
 - 4. Texture: Smooth or Orange Peel

2.06 ACCESSORIES

- A. Primer: Type recommended by manufacturer for substrate and body coats indicated.
- B. Waterproofing Membrane: Type recommended by manufacturer for substrate and primer and body coats indicated.
- C. Reinforcing Membrane: Flexible resin formulation that is recommended by manufacturer for substrate and primer and body coats indicated and that prevents substrate cracks from reflecting through resinous flooring.
 - 1. Formulation Description: As recommended by manufacturer.
 - a. Provide fiberglass scrim embedded in reinforcing membrane.
- D. Patching and Fill Material: Resinous product of or approved by manufacturer and recommended by manufacturer for application indicated.
- E. Binder and all successive grout and top coats shall be 100% solids clear/epoxy resin. Ceramic coated quartz aggregates are to be used to achieve all color. No pigmented epoxy base or top coats allowed.
- F. Final top coat material and texture shall be determined by reviewing material samples with ranges of texture. Urethane UV resistant clear topcoat with approved grit and quantity shall be applied to all areas unless otherwise noted.

PART 3 - EXECUTION

3.01 TESTING OF CONCRETE SUBSTRATE

- A. Refer to Section 09 05 61 - Common Work Results for Flooring Preparation

3.02 PREPARATION

- A. General: Prepare and clean substrates according to manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for seamless flooring and wall application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous systems.
 - 1. Roughen concrete substrates as follows:
 - a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
 - b. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to manufacturer's written instructions.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through seamless flooring and walls, according to manufacturer's written instructions.

3.03 APPLICATION

- A. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

- B. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
 - 1. Apply waterproofing membrane to integral cove base substrates.
- C. Apply reinforcing membrane to substrate cracks.
- D. Seamless Floor and Wall Covering - Application:
 - 1. Apply components of seamless floor and wall covering according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 - a. Coordinate application of components to provide optimum adhesion of resinous system to substrate, and optimum intercoat adhesion.
 - b. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 - c. At substrate expansion and isolation joints, comply with manufacturer's written instructions.
 - 2. Apply self-leveling slurry body coats, troweled body coats, grout coats and topcoats per manufacturer requirements.
 - 3. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
 - 4. Apply troweled body coats in thickness indicated for flooring system. Hand trowel and grout to fill voids. Build-up slopes in flooring as required to drain, with smooth transitions, as indicated on plans. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- E. Seamless Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
 - 1. Cove Base Height: 6 inches.

3.04 FIELD QUALITY CONTROL

- A. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.

3.05 PROTECTION

- A. Protect seamless flooring and wall finishes from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION

SECTION 09 82 00
SPECIAL WALL COATING

PART 1 GENERAL

1.01 THE REQUIREMENTS

- A. As set forth in the headings of General Conditions, Supplementary General Conditions and Division 1, General Requirements shall apply to this branch of the work.

1.02 SCOPE

- A. The work included in this section covers all labor, materials and supervision necessary for the installation of Special Coating System to all areas as set forth in the Room Finish Schedules, Drawings, and Specifications.
- B. This specification covers a glazed inorganic coating system, which imparts a continuous finish to masonry and similar interior surfaces that is resistant to heat, moisture, abrasions, staining, chemicals, fading, fungus growth, and fire.
- C. It includes the application of foundation of filler coats (over porous substrates), a mastic color coat and a separate unpigmented non-yellow solution glaze.

1.03 QUALITY ASSURANCE

- A. The materials installed under this section shall be listed by The Underwriter's Laboratories in accordance with their standards for incombustible coatings. The results obtained by the Underwriter's Laboratories tests must meet or exceed the following standards:
 - 1. Flame Spread: 43
 - 2. Fuel Contributed: 0
 - 3. Smoke Developed: 68
- B. Smoke developed under the above rating shall be non-toxic.
- C. This material shall be a minimum of 90% inorganic and shall not include any thermo-setting resins.
- D. No emulsion based coatings shall be installed under this Section.
- E. Material used shall meet all tests required by Federal Specification TT-C-001225, inorganic, glazed coating system for interior surfaces.
- F. Testing includes a standard for color stability and a measure of filling for smooth and porous backings as determined by the percentage of list reflectance on a portable field meter.

1.04 APPROVAL (BEFORE BIDDING)

- A. The coatings manufacturer and applicator shall be jointly responsible for the performance requirements of the products covered by this section and shall submit an independence laboratory compliance certification to the Architect.

1.05 QUALIFICATIONS

- A. The work under this specification shall be performed by tradesmen with not less than two years experience with the specific product specified and employed by a coatings contractor licensed or directed by the manufacturer of the coating materials.
- B. Contractor shall have received written approval by the Architect of their previous satisfactory performance prior to time of bidding.

1.06 SUBMITTALS

- A. Colors And Textures
 - 1. Custom colors and textures will be selected by the Architect, per material schedule.
 - 2. Submit color samples for approval, as directed.
 - 3. Submit complete manufacturer's literature covering these products.
 - 4. Literature shall include flame spread test, wash-ability tests, stain tests, etc., and complete preparation and application direction.

- B. Prior to application, the Contractor shall submit the following items to the Architect for approval before material is ordered.
 - 1. Manufacturer's catalog cuts and detailed information indicating composition of material, compliance with specified quality standards, surface preparation and methods of application and curing.
 - 2. Samples of materials, on a hard backing showing color and finish characteristics of the product for use. Samples shall be labeled indicating the manufacturer, trade name, project and date of submittal.
 - 3. Sufficient data on applicator's experience and job histories to show he has been actively and successfully engaged in applying coatings of this particular type, in this local area, for the past two years.

1.07 SAMPLES

- A. A sample room, wall, or panel of this coating system shall be installed on the job site as designated by the Architect.
- B. Only after approval of the sample panel by the Architect can the coating application proceed, and in addition to all the aforementioned evaluations, all work on the project shall perform to the quality standard established by the approved job site sample.

1.08 WARRANTY

- A. Applicator shall notify manufacturer of project requirements before bidding. Manufacturer shall provide single source warranty for entire installation, including labor for two years. Warranty shall include removal and replacement if proven defective. Defective items are, but not limited to, debonding, discoloration, excessive wear and staining by bodily fluids.
- B. B.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Products: Refer to Interior Finish Schedule and Materials/Color Group Schedule.
- B. All resins shall be those recommended by the manufacturer, first quality, freshly compounded.
- C. Fiberglass cloth shall be a 6 oz fiberglass cloth.
- D. Custom colors and textures shall be as selected by the Architect, per material schedule.
- E. Glaze coat shall be a separate non-yellowing, aqueous glaze coat having a gloss or matte finish as selected by Architect. Specifier should select either a matte or gloss finish.
- F. Coating will conform to the following physical properties.

METHOD		RESULTS
H. Fire Hazard	ASTM E-84	
Flame Spread - 0		
1. Fuel Contributed 0-5		
2. Smoke Developed 5		
I. Compressive Strength	ASTM 695-85	
10,370 psi		
J. Tensile Strength	ASTM 695-85	
3,160 psi		
K. Tensile Elongation	ASTM D638-86	
8.0%		
L. Abrasion Resistance	ASTM D4060-90	
.033		
M. Mar Resistance	ASTM D5178-91	
1.0Kg		

N.	Colorfastness Unaffected	100 Hours in fedeometer	
O.	Toxicity Approved		Department of Agriculture
P.	Hardness	82	Shore D
Q.	Chemical Resistance Unaffected	Acetic Acid 10%	
	1. Fluorbic Acid 25%		Unaffected
	2. Hydrofluoric Acid 10%	Unaffected	
	3. Sulfuric Acid 65%		Unaffected
	4. Citric Acid 4oz/gal		Unaffected
	5. Hydrochloric Acid 45 fl.oz/gal	Unaffected	
	6. Potassium Hydroxide 7 oz/gal	Unaffected	
	7. Trisodium Phosphate 3 oz/gal	Unaffected	

PART 3 EXECUTION

3.01 PREPARATION

- A. The General Contractor shall allow sufficient time to the specialty applicator to complete the coating application and at no time shall speed of project completion or unsuitable drying conditions be allowed to detrimentally speed up these operations.
- B. All backings must be properly cured and dry.
- C. Moisture content shall not exceed 16%.
- D. Wall temperature is to be maintained at a minimum of 50°F. during application, and for a minimum of 24 hours thereafter.
- E. The General Contractor shall provide sufficient electric power, light, heat and working conditions to permit the proper application of his coating.
- F. Areas to be coated shall be kept free of traffic, and no other trade shall be allowed to work in the area during the application procedure.
- G. Plumbing fixtures, toilet and moveable partitions, radiators, grills, etc., shall not be installed until the coating has been applied.
- H. Painting and decorating, including installation of resilient floor covering shall be completed after the coating has been applied.
- I. Hard floors and base such as concrete, ceramic tile or terrazzo, shall be completely finished before the coating application.

3.02 INSTALLATION

- A. The General Contractor shall allow sufficient time to the specialty applicator to complete the coating application with properly manned crews and at no time shall speed of project completion or unsuitable drying conditions be allowed to detrimentally speed up these operations. All substrates must be properly cured and dry. Moisture content shall not exceed 16 percent. Substrate temperature is to be maintained at a minimum of 50 degrees F during application and for a minimum of 24 hours thereafter.
- B. Hard floors and base shall be completely finished before coatings application.
- C. Plumbing fixtures, moveable partitions, grills, etc. shall not be installed until the coatings have been applied.
- D. The completed coating system shall produce a surface which is free of sags, runs, craters, pin holes, porosity and other physical defects.
- E. Application shall be by roller, spray or trowel. Total thickness shall be 15 mils over smooth surfaces, 45 to 50 mils over CMU, 20 to 25 mils over concrete and 25 to 40 mils including 2 oz to 6 oz fiberglass.

- F. FC Coating shall be applied to the lower 5 feet of OR's and other scheduled rooms in a six step process including priming, laying fiberglass, sanding of joints and imperfections, two body coats and three sealer coats. FX Coating for upper walls and ceilings shall be a three coat process.
- G. When coatings are completed, the fiberglass cloth shall not be detectable by texture or pin holes. Transitions between systems shall be tapered and smooth.
- H. Field inspection to insure against these deficiencies may be made with a 7X magnifying light by the Architect or his inspector.
- I. Sealant, where necessary, shall be installed after the coating application. The sealant compound installed by other shall be of the "non-petroleum" based type, e.g., Thiokol.

3.03 PROTECTION

- A. At the completion of the installation, an inspection will be made jointly by the coating contractor and the General Contractor is to obtain approval that the coated surfaces are free of damage.
- B. It will then be the responsibility of the General Contractor to protect this work from subsequent damage.

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Surface preparation and the field application of paints, stains, and varnishes on interior substrates.

1.03 RELATED REQUIREMENTS

- A. Section 04 20 00 - Brick and Concrete Masonry
- B. Section 04 26 00 - Single-Wythe Unit Masonry
- C. Section 07 92 00 - Joint Sealants
- D. Section 09 21 16 - Gypsum Board Assemblies
- E. Division 21 - Fire Protection
- F. Division 22 - Plumbing
- G. Division 26 - Electrical

1.04 DEFINITIONS

- A. DFT: Dry Film Thickness.
- B. DTM: Direct To Metal.
- C. VOC: Volatile Organic Compounds.
- D. Paint Gloss Levels:
 - 1. Flat - Less than 5 Percent.
 - 2. Eggshell - 5 - 20 Percent.
 - 3. Satin - 20 - 35 Percent.
 - 4. Semi-Gloss - 30 - 65 Percent.
 - 5. Gloss - Over 65 Percent.

1.05 SUBMITTALS

- A. Product Data: Provide a complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category.
 - 2. Cross-reference to specified paint system(s) that the product is to be used in; include description of each system.
- B. Samples: Submit two paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.
 - 3. Allow 30 days for approval process, after receipt of complete samples by Architect.
 - a. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as factory finished metals, have been approved.
- C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- D. Manufacturer's Instructions: Indicate special surface preparation procedures.
- E. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets

(MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.06 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.07 EXTRA MATERIALS

- A. Deliver extra resilient base units for Owner's use in maintenance. Label and store where directed by the Owner including codes used on the Drawings. Do not deliver to the Project site until the Owner is prepared to receive and store maintenance materials.
 - 1. Paint: One (1) unopened gallon can of each color and sheen specified.
 - a. Label each container with color in addition to the manufacturer's label.
 - b. Include one copy of the Interior Finish Schedule with the paint material.
 - c. Include MSDS information for all materials delivered.

1.08 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum ten years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience and approved by manufacturer.
- C. Paint exposed surfaces. If a color of finish, or a surface is not specifically mentioned, Architect will select from standard products, colors and sheens available.
- D. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels unless indicated.
- E. All materials, preparation and workmanship shall conform to requirements of the latest edition of the Architectural Painting Specification Manual by the Master Painters Institute (MPI) (hereafter referred to as the MPI Painting Manual) as issued by the local MPI Accredited Quality Assurance Association having jurisdiction.
- F. All paint manufacturers and products used shall be as listed under the Approved Product List section of the MPI Painting Manual.
- G. Coordination:
 - 1. Provide finish coats which are compatible with the prime coats actually used.
 - 2. Review other Sections of these Specifications as required, verifying the primer coats to be used and assuring compatibility of the total coating system for the various substrate.
 - 3. Furnish information on the characteristics of the specific finish materials to assure that compatible primer coats are used.
 - 4. Provide barrier coats over non-compatible primers, or remove the primer and re-prime as required.
 - 5. Notify the Architect in writing of anticipated problems in using the specified coating system over prime-coatings supplied under other Sections.

1.09 MOCK-UP

- A. Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.

- a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
- 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Provide door and frame assembly illustrating paint color, texture, and finish.
- C. Mock-up may remain as part of the work.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.
- C. Disposal:
 - 1. Never pour leftover coating down any sink or drain. Use up material on the job or seal can and store safely for future use.
 - 2. Do not incinerate closed containers.
 - 3. For specific disposal or recycle guidelines, contact the local waste management agency or district. Recycle whenever possible.

1.11 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
- B. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

1.12 WARRANTY

- A. Inspection of all surfaces to be coated must be done by the manufacturer's representative to insure proper preparation prior to application. All thinners, fillers, primers and finish coatings shall be from the same manufacturer to support a product warranty. Products other than those submitted shall be accompanied by a letter stating its fitness for use and compatibility.
- B. Manufacturer Warranty: Manufacturer shall warrant the products specified in this Section against material defects or defects in manufacturing, for a period of one (1) year from Date of Substantial Completion.
- C. The painting contractor shall furnish a guarantee to repair or replace any or all work which is found to be defective in workmanship or materials, together with any adjacent work disturbed by rectifying the defective work, for two (2) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Sherwin-Williams Paint Company (The)
 - 1. Additional manufacturers will be considered in accordance with the "or equal" provision specified in Section 01 60 00 – Product Requirements.
 - a. Substitutions: Submit a "Request for Substitution" for any manufacturer not named, in conformance with Section 01 33 00.
- B. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
- C. Primer Sealers: Same manufacturer as top coats.

2.02 MATERIALS - GENERAL

- A. Volatile Organic Compound (VOC) Content:

1. Provide coatings that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D-National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- B. Compatibility: Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.03 MIXING AND TINTING

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
- B. MPI Standards: Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
- C. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
- D. Unless noted otherwise, typical paint system consists of:
 1. One (1) Coat of Primer/Filler
 2. One (1) Intermediate Coat
 3. One (1) Top Coat
- E. Tinting of Paint Finishes: Tint each coat as follows:
 1. Primer Coat: Do NOT tint primer coat.
 2. Intermediate Coat/s: Tint intermediate coat/s as base color, applied with a FLAT sheen.
 3. Top Coat: Final finish coat shall be applied as base color with the specified sheen.
- F. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.04 PAINT FINISHES - COLOR AND SHEEN

- A. Paint Finishes: Designated on the Interior Finish Legend in the Drawings as Finish Type PT- #.
 1. Paint Type PT-1, PT-2, PT-3, PT-5, PT-6, and PT-7: Refer to Finish Schedule for Color and Sheen callouts.
- B. Epoxy Paint Finishes: Designated on the Interior Finish Legend in the Drawings as Finish Type PT- #A.
 1. Paint Type PT-1A, PT-2A: Refer to Finish Schedule for Color and Sheen callouts.

2.05 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner may engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
- B. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished, with Applicator present, prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Plaster and Stucco: 12 percent.
 - 3. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 - 4. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 5. Concrete Floors and Traffic Surfaces: 8 percent.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- G. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by top coat manufacturer.
- H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- I. Gypsum Board Substrates: Fill minor defects with filler compound. Spot prime defects after repair.
- J. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- K. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.

2. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- L. 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.
- M. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- N. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
- O. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
 1. Use applicators and techniques suited for paint and substrate indicated.
 - a. 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.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
 1. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- H. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- I. Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 2. Prime surfaces to receive wall coverings.
 3. Painting of Exposed Roof Structure:
 - a. In finished occupied areas, paint roof deck, bar joists, girders, beams, and columns, unless otherwise indicated.
 4. Painting of Mechanical and Electrical Materials Exposed to View:

- a. In finished occupied areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - d. Paint dampers exposed behind louvers and grilles to match face panels.
- J. Do NOT paint or finish the following work items:
- 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Glass.
 - 10. Wall, ceilings, floors, and mechanical/electrical work located in utility, mechanical, and electrical spaces, unless indicated otherwise.
 - 11. Acoustical materials, unless specifically indicated.
 - 12. Concealed pipes, ducts, and conduits.
- K. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 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.
- B. Painted interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent upon inspection:
- 1. Brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
 - 2. evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - 3. Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - 4. Damage due to application on moist surfaces or caused by inadequate protection from the weather.
 - 5. Damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).
- C. Painted surfaces shall be considered unacceptable if any of the following are evident under daylight conditions for exterior surfaces:
- 1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").
 - 2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 1000 mm (39").
 - 3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.

4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.

3.05 PROTECTION AND REPAIR

- A. Provide "Wet Paint" signs to protect newly painted finishes.
- B. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- C. Protect work of other trades against damage from painting by providing surface-applied protection prior to preparation and painting. After completing painting operations, remove temporary protective wrappings.
- D. Protect completed coating applications from damage by subsequent construction activities until completion of painting project.
- E. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 CLEANING

- A. Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
- B. Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

PART 4 - SCHEDULES

4.01 INTERIOR COATING SYSTEMS - WALL SURFACES

- A. Concrete and Concrete Masonry Units (CMU):
 1. Institutional Low-Odor/VOC Latex Paint System:
 - a. Eg-Shel Finish:
 - 1) Filler: PrepRite® Block Filler, B25W25
 - 2) Intermediate Coat: ProMar® 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series
 - 3) Top Coat: ProMar® 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series
 2. Pre-Catalyzed Water-Based Epoxy Paint System:
 - a. Eg-Shel Finish:
 - 1) Filler: PrepRite® Block Filler, B25W25
 - 2) Intermediate Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Eg-Shel, K45-151 Series
 - 3) Top Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Eg-Shel, K45-151 Series
- B. Gypsum Board Substrates:
 1. Institutional Low-Odor/VOC Latex Paint System:
 - a. Eg-Shel Finish:
 - 1) Primer: ProMar® 200 Zero VOC Latex Primer, B28W2600
 - 2) Intermediate Coat: ProMar® 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series
 - 3) Top Coat: ProMar® 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series
 2. Pre-Catalyzed Waterbased Epoxy Paint System:
 - a. Eg-Shel Finish:
 - 1) Primer: ProMar® 200 Zero VOC Latex Primer, B28W2600
 - 2) Intermediate Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Eg-Shel, K45 Series
 - 3) Top Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Eg-Shel, K45 Series

4.02 INTERIOR COATING SYSTEMS - CEILING AND SOFFIT SURFACES

- A. Gypsum Board:

1. Institutional Low Odor/VOC Latex Paint System:
 - a. Flat Finish:
 - 1) Primer: ProMar® 200 Zero VOC Latex Primer, B28W2600
 - 2) Intermediate Coat: ProMar® 200 Zero VOC Interior Latex Flat, B30-2600 Series
 - 3) Top Coat: ProMar® 200 Zero VOC Interior Latex Flat, B30-2600 Series

4.03 INTERIOR COATING SYSTEMS - WOOD SURFACES

- A. Opaque Finishes: Provide the following opaque paint finish systems over interior wood surfaces, if indicated in the drawings:
 1. Latex System:
 - a. Semi-Gloss Finish:
 - 1) Primer: PrepRite® ProBlock® Latex Primer/Sealer, B51-620 Series
 - 2) Intermediate Coat: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series
 - 3) Top Coat: ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series
- B. Clear Finishes:
 1. Polyurethane System
 - a. 1st Coat: S-W Minwax Fast Drying Polyurethane, Satin
 - b. 2nd Coat: S-W Minwax Fast Drying Polyurethane, Satin

4.04 INTERIOR COATING SYSTEMS - METAL SURFACES

- A. Ferrous Metal: Includes, but not limited to, interior metal doors, metal door frames, and miscellaneous metals, if indicated in the drawings:
 1. **Pre-Catalyzed Waterbased Epoxy System:**
 - a. **Semi-Gloss Finish:**
 - 1) **Primer: Pro Industrial™ Pro-Cryl® Universal Primer, B66-310 Series**
 - 2) **Intermediate Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46-1150 Series**
 - 3) **Top Coat: Pro Industrial™ Pre-Catalyzed Water Based Epoxy Semi-Gloss, K46-1150 Series**
- B. Non-Ferrous (Galvanized) Metal Substrates:
 1. Pre-Catalyzed Waterbased Epoxy Paint System:
 - a. Semi-Gloss Finish:
 - 1) Primer: Pro Industrial™ Pro-Cryl® Universal Primer, B66-310 Series
 - 2) Intermediate Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series
 - 3) Top Coat: Pro Industrial™ Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 Series

END OF SECTION

SECTION 10 21 23
CUBICLES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Cubicle curtains with surface-mounted overhead tracking system.
- B. Shower curtains and accessories

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 09 51 00 - Acoustical Ceilings
- C. Section 10 28 00 - Washroom Accessories

1.04 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2018b.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.

1.05 SUBMITTALS

- A. Submit in conformance with the provisions of Section 01 33 00 - Submittal Procedures
- B. Product Data: Provide data for curtain fabric, track and hardware.
- C. Shop Drawings: Indicate a reflected ceiling plan view of curtain track, hangers and suspension points, attachment details, schedule of curtain sizes.
- D. Samples for Verification: Provide samples of the following:
 - 1. Curtain Fabric: 12-inch square swatch or larger sample as required to show complete pattern repeat, from dye lot used for the work, with specified treatments applied.
 - 2. Mesh Top: Not less than 4 inches square, demonstrating manufacture's standard hemming around mesh perimeter with matching fabric.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Do not install cubicles until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where cubicles are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1.07 WARRANTY

- A. Tracking System:
 - 1. The manufacturer shall warrant the product against material defects, or defects in manufacturing, for one (1) year from Date of Substantial Completion.
- B. Curtain:
 - 1. The manufacturer shall warrant the product against material defects, or defects in manufacturing, for five (5) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Cubicle Tracking Systems:

1. Specified Manufacturer: InPro Corporation
 2. Other Acceptable Manufacturers: Equivalent products of the manufacturer's listed below will be acceptable.
 - a. C/S General Cubicle
 - b. Marshal/McMurry
 - c. Imperial Fastener Company, Inc.
 - d. Standard Textile Company, Inc.
 - e. Tubular Specialties Manufacturing, Inc.
- B. Cubicle Curtains:
1. Specified Manufacturer: Standard Textile
 2. Other Acceptable Manufacturers: None identified. No substitutions will be considered or accepted.
- C. Shower Curtains and Accessories:
1. Specified Manufacturer: InPro Corporation
 2. Other Acceptable Manufacturers: Equivalent products of the manufacturer's listed below will be acceptable.
 - a. Construction Specialties (C/S)
 - b. Bobrick
 - c. Bradley

2.02 CUBICLE TRACKING SYSTEMS

- A. Cubicle Tracking System:
1. Product: C/S; Model #6062N, or equivalent.
 2. Description: Surface-mounted track/s of heavy extruded aluminum, 1-3/8 inch by 3/4-inch, slotted to receive roller carriers, complete with accessories and components required for complete and secure installation.
 - a. Profile: Channel.
 - b. Mounting: Surface.
 3. Structural Performance: Capable of supporting vertical test load of 50 lbs without visible deflection of track or damage to supports, safely supporting moving loads, and sufficiently rigid to resist visible deflection and without permanent set.
 4. Track End Stop: To fit track section.
 5. Track Bends: Minimum 12 inch radius; fabricated without deformation of track section or impeding movement of carriers.
 6. Finish on Exposed Surfaces: Clear anodized.
 7. Curtain Carriers: Model #1062N, virgin nylon axle with nylon wheels complete with nickel-plated brass bead-chain and hook assembly.
 - a. Provide one carrier for each 6-inches of cubicle curtain width.
 8. Wand: Plastic hollow section, attached to lead carrier, for pull-to-close action.
 9. Installation Accessories: Types required for specified mounting method and substrate conditions.
 10. Mounting:
 - a. Track shall be ceiling surface-mounted with #8 pan head screws or with toggle or molly bolts spaced no more than 30" apart.
 - b. Coordination: Comply with NFPA 13 requirements and coordinate installation of sprinkler heads with the cubicle curtain track.

2.03 CUBICLE CURTAIN

- A. Cubicle Curtain: Finish Type CC- #, as specified below:
- B. Type CC-1:
1. Manufacturer: Standard Textile, no substitutions.
 - a. Contacts: P: 800-999-0400 / Web: www.standardtextile.com
 2. Product: #CM000603
 3. Pattern: Peonies

4. Color: Pumppernickel.
5. Width: 72-inches.
6. Length: As indicated on Drawings.
7. Physical Properties:
 - a. Content: 100% Polyester
 - b. Characteristics: Antimicrobial, Flame-resistant, and sustainable.
 - c. Open Mesh Cloth: Open weave to permit air circulation; flameproof material, manufacturer's standard color.
 - 1) Attachment of Curtain Fabric to Open Mesh Cloth: Manufacturer's standard sewn seam.
8. Fire Performance:
 - a. Surface Burning Characteristics (ASTM E-84): Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - b. Inherently flame resistant or flameproofed; capable of passing NFPA 701 test.
- C. Fabrication:
 1. Curtain Width: Equal to track length from which curtain is hung plus 10 percent, but not less than 12-inches (300 mm).
 2. Curtain Length: Equal to floor-to-ceiling height minus 2-inches from finished ceiling at top and 15-inches above finished floor at bottom.
 3. Mesh Top: Include open mesh cloth at top 20 inches of curtain for room air circulation, attached to curtain as specified above.
 4. Curtain Heading: Fabric band matching curtain panel with metal grommet holes for carriers spaced 6 inches on center.
 5. Seams and Hems: Manufacturer's standard fabrication method for securely sewn and finished seams and hems.

2.04 SHOWER CURTAINS AND ACCESSORIES

- A. Shower Curtain: Finish Type SC- #, as specified below:
- B. Type SC-1:
 1. Product: Inpro; Clickeze ® Shower Curtain.
 2. Curtain Material: Heavy duty, 13 gauge, flame retardant, anti-microbial Super Bio Stat vinyl.
 - a. Polyester reinforced medical grade PVC, anti-static, antimicrobial, flame retardant, stain resistant, odor resistant, water repellent, wear resistant, scrubbable and colorfast.
 3. Pattern: As shown on the drawings.
 4. Color:
 5. Curtain Fabrication:
 - a. Curtain Width: Manufacture curtains of one piece, sized to 10% wider than the track length but no less than 1' (304.8mm) extra fullness. Width tolerance $\pm 3"$.
 - b. Curtain Height: 80 inches. Shower curtains hang 1/2" (12.7mm) above floor. Height tolerance $\pm 1/2"$.
 - c. Curtain Heading: Include 4-ounce (113.4g) nickel-plated grommets, 6" (152.4mm) on center for carriers. Top hem to be triple-turned hem over nylon tape for rugged wear.
 - d. Seams: Curtains are to be seamless when possible with sanitary "no scum" side and bottom edges. Sewing thread to be triple-ply twisted nylon.
- C. Shower Curtain Accessories:
 1. Curtain Hooks: Model #CE100800 Stainless Steel Slide Beads
 - a. Height: 2-1/2 inches.
 - b. Inside Diameter: 1-5/16 inches.
 2. Curtain Rod: Model #CE10075X:
 - a. Length: As shown on drawings.

- b. Rod Construction: Type 304 Stainless Steel Tube, 1" (25.4mm) diameter x .035" (.89mm) wall thickness (20 gauge). Finish – BS, Bright Stainless.
- c. Flange Construction: .031" (.89mm) thick, type 304 stainless steel. Includes two 3/16" (4.8mm) diameter mounting holes with formed countersink for #10 Oval Head Screws(by others).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and supports above ceiling are ready to receive work of this Section.

3.02 INSTALLATION

- A. Install curtain track to be secure, rigid, and true to ceiling line.
- B. Install end cap and stop device.
- C. Install curtains on carriers ensuring smooth operation.

END OF SECTION

SECTION 10 26 00
INTERIOR WALL PROTECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Interior surface protection, including door protection, crash rails, handrails, corner guards, and wall protection sheets

1.03 RELATED REQUIREMENTS

- Section 06 10 00 - Rough Carpentry
- Section 09 21 16 - Gypsum Board Assemblies

1.04 ACTION SUBMITTALS

- A. Product data and detailed specifications for each system component and installation accessory required, including installation methods for each type of substrate.
- B. Shop drawings showing locations, extent and installation details of crash rails. Show methods of attachment to adjoining construction.
- C. Samples for verification purposes: Submit the following samples, as proposed for this work, for verification of color, texture, pattern and end cap attachment and alignment:
 - 1. 12-inch (304.8-mm) long sample of each model specified including end cap.
- D. Product test reports from a qualified independent testing laboratory showing compliance of each component with requirements indicated.
- E. Maintenance data for wall protection system components for inclusion in the operating and maintenance manuals specified in Division 1.

1.05 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Certificates: For each impact-resistant plastic material, from manufacturer.
- C. Material Test Reports: For each impact-resistant plastic material.
- D. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each impact-resistant wall protection unit to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining optimum condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to plastic finishes and performance.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an installer who has no less than 3 years experience in installation of systems similar in complexity to those required for this project.
- B. Manufacturer's Qualifications: Not less than 5 years experience in the production of specified products and a record of successful in-service performance.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated.
- D. Code compliance: Assemblies should conform to all applicable codes.
- E. Single source responsibility: Provide all components of the wall protection system manufactured by the same company to ensure compatibility of color, texture and physical properties.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site in unopened original factory packaging clearly labeled to show manufacturer.
- B. Store materials in original, undamaged packaging in a cool, dry place out of direct sunlight and exposure to the elements.

1.09 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting installation of products.

1.10 WARRANTY

- A. Warranty: The manufacturer shall warrant the installation to be free of defects in material and workmanship for a period of one (1) year from Date of Substantial Completion.
- B. Special Warranty: Manufacturer shall warrant the products specified in this section against material defects or defects in manufacturing, for a period of five (5) years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Construction Specialties, Inc.
 - 1. Owner Standard: The product/s specified in this Section are restricted to this manufacturer. Product substitutions are not permitted.

2.02 PERFORMANCE REQUIREMENTS

- A. Materials shall meet or exceed the following performance requirements:
 - 1. Surface Burning Characteristics: Provide Class A/1 assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. Fire Resistance: Where fire rating is specified for the wall in which the guard is mounted, provide assemblies that have been tested in accordance with ASTM E119 for the same rating as the wall.
 - 3. Structural:
 - a. Resist lateral impact force of 100 lbs at any point without damage or permanent set.
 - b. Support vertical live load of 100 lb/lineal ft with deflection not to exceed 1/50 of span between supports.
 - 4. Impact strength: Provide wall protection components that have been tested in accordance with the applicable provisions of ASTM F476.
 - 5. Chemical- and Stain-Resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D543.

2.03 MATERIALS

- A. Rigid Sheet Wall Covering: Engineered PETG. Chemical and stain resistance should be per ASTM D543 standards as established by the manufacturer. Thickness as specified.
- B. Aluminum: Extruded aluminum should be 6063-T6 alloy, nominal .085-inch (2.16-mm) thickness. Minimum strength and durability properties as specified in ASTM B221.
- C. Stainless Steel: Type 304, No. 4 finish.
- D. Rubber: UV-resistant, black, uniform in color, smooth surface.
- E. Wood: Formed wood particle core with melamine wood grain finish.
- F. Adhesive: Per manufacturer requirements.
- G. Fasteners: All fasteners to be non-corrosive and compatible with aluminum components. All necessary fasteners to be supplied by the manufacturer.

2.04 INTERIOR SURFACE PROTECTION

- A. Door Protection; Finish Type DEP- #, as specified below:
 - 1. Type DEP-1:
 - a. Product: C/S; Model No. DEPU-SS
 - 1) Material: 16-gauge stainless steel, Type 304 alloy with #4 satin finish.
 - 2) Configuration: U-shaped with 1-inch (25.4-mm) legs.
 - 3) Length: Full height of edge of door.
 - b. Attachment: Adhesive or optional double-faced tape.
- B. Crash Guards, designated in the Drawings as Finish Type CRS- #, as specified below:
 - 1. Type CRS-1:
 - a. Product: C/S; Model SCR-48N-Acrovyn 4000
 - 1) Height: 6-inches.
 - 2) Length: As indicated on drawings.
 - 3) Projection From Wall: 1-1/4 inch.
- C. Corridor Handrails, designated in the Drawings as Finish Type HR- #, as specified below:
 - 1. Type HR-1:
 - a. Product: C/S; Model No. HRB-20N.
 - b. Color & Texture: As scheduled on the Interior Finish Legend.
 - c. Height: 5-5/8 -inches (142.9-mm), with 1-1/2 inch (38.1-mm) oval grip.
 - d. Length: As indicated on drawings.
 - e. Mounting:
 - 1) Clear Space From Wall: 1-1/2 inch.
 - 2) Projection From Wall to Outside of Rail: 3 inch.
 - 3) Return rail to wall.
 - 4) Mounting Height: 36-inches to top of handrail from finished floor unless indicated otherwise.
 - 5) Comply with accessibility requirements of ICC A117.1 and ADA Standards.
 - f. Options:
 - 1) HRB-20CMN - ligature resistant mounting bracket
 - 2) HRB-20HLN - high load requirements
 - 3) HRB-20CMHLN - ligature resistant mounting bracket; high load requirements

2.05 CORNER GUARDS

- A. Corner Guards, designated in the Drawings as Finish Type CG- #, and specified below:
- B. Type CG-1, CG-2, & CG-7:
 - 1. Product: C/S; Model No. SM-20AN-Acrovyn 4000, Surface-mounted corner guard.
 - a. Configuration: 90-degree corner.
 - b. Retainers: Extruded aluminum; 6063-T6 alloy, nominal .062-inch (1.57mm) thickness per ASTM B221.
 - c. Cover: Acrovyn 4000, with preformed end caps.
 - 1) Thickness: 0.078-inches (2.0-mm).
 - d. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 - e. Width of Wings: 3 inches.
 - f. Corner: Radiused 1/4-inch.
 - g. Color: As scheduled on the Interior Finish Legend in the drawings.
 - h. Length: As scheduled
 - i. Installation: Mount to wall at top of wall base.
- C. Type CG-3:
 - 1. Product: C/S; Model No. SSM-25AN-Acrovyn 4000, Surface-mounted corner guard.
 - 2. Configuration: Endwall, 90-degree corners.
 - 3. Retainers: Extruded aluminum.
 - 4. Cover: Acrovyn 4000, with preformed end caps.

- a. Material: Engineered PETG.
 - b. Thickness: 0.078-inches (2.0-mm).
 5. Endwall Cover: 0.040-inch Acrovyn sheet.
 6. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 7. Width of Wings: 2 inches.
 8. Corner: Radiused 1/4-inch.
 9. Color: As scheduled on the Interior Finish Legend.
 10. Length: Full height of wall to ceiling, less height of wall base.
 11. Installation: Mount to wall at top of wall base.
- D. Type CG-4:
1. Product: C/S; Model No. SM-20MN-Acrovyn 4000, Surface-mounted corner guard.
 2. Configuration: 135-degree corner.
 3. Retainers: Extruded aluminum; 6063-T6 alloy, nominal .062-inch (1.57mm) thickness per ASTM B221.
 4. Cover: Acrovyn 4000, with preformed end caps.
 - a. Material: Engineered PETG.
 - b. Thickness: 0.078-inches (2.0-mm).
 5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 6. Width of Wings: 3 inches by 3-inches
 7. Corner: Radiused 1/4-inch.
 8. Color: As scheduled on the Interior Finish Legend in the drawings.
 9. Length: Full height of wall to ceiling, less height of wall base.
 10. Installation: Mount to wall at top of wall base.
- E. Type CG-5:
1. Product: C/S; Model No. CO-8.
 2. Configuration: 90-degree corner.
 3. Material: Stainless steel.
 4. Width of Wings: 1-inch
 5. Corner: 3/16-inch (4.8-mm) radius.
 6. Finish: Stainless Steel: No. 4 satin finish.
 7. Length: Full height of wall to ceiling, less height of wall base.
 8. Attachment:
 - a. Adhesive: Field applied heavy duty adhesive
- F. Type CG-6:
1. Product: C/S; Model No. CO-8.
 2. Configuration: 90-degree corner.
 3. Material: Stainless steel.
 4. Width of Wings: 3-1/2 inch
 5. Corner: 3/16-inch (4.8-mm) radius.
 6. Finish: Stainless Steel: No. 4 satin finish.
 7. Length: Full height of wall to ceiling.
 8. Attachment:
 - a. Adhesive: Field applied heavy duty adhesive
- G. Type CG-7:
1. Product: C/S; Model No. SM-20AN-Acrovyn 4000, Surface-mounted corner guard.
 2. Configuration: 90-degree corner.
 3. Retainers: Extruded aluminum; 6063-T6 alloy, nominal .062-inch (1.57mm) thickness per ASTM B221.
 4. Cover: Acrovyn 4000, with preformed end caps.
 - a. Material: Engineered PETG.
 - b. Thickness: 0.078-inches (2.0-mm).

5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.
 6. Width of Wings: 3 inches.
 7. Corner: Radius 1/4-inch.
 8. Color: As scheduled on the Interior Finish Legend in the drawings.
 9. Length: Full height of wall to ceiling, less height of wall base.
 10. Installation: Mount to wall at top of wall base.
- H. Wall Protection Sheets, designated in the Drawings as Finish Type WP- #, and specified below:
1. Type WP-1, WP-2, WP-3, & WP-4:
 - a. Product: C/S; Acrovyn 4000 Sheet, High-impact wall covering.
 - 1) Material: Engineered PETG rigid sheet. Chemical and stain resistance shall comply with ASTM D543.
 - 2) Material Thickness: 0.060 inch, nominal.
 - b. Colors: As scheduled on the Interior Finish Legend in the drawings
 - c. Sheet Size: .
 - 1) Solid Colors: 4-feet by 8-feet or 4-feet by 10-feet.
 - 2) Chameleon Simulated Patterns: 4-feet by 10-feet.
 - d. Accessories;
 - 1) Trim and Joint Moldings: Extruded rigid plastic that matched sheet wall covering.
 - 2) Adhesive: Per manufacturer.
 - e. Mounting: Adhesive.
 - f. Performance: Refer to "Performance Requirements" Article this Section.

2.06 FABRICATION

- A. General: Fabricate wall covering to comply with requirements indicated for design, dimensions, detail, finish and sizes.
- B. Fabricate components with tight joints, corners and seams.
- C. Pre-drill holes for attachment.
- D. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on Drawings.

3.02 PREPARATION

- A. General: Prior to installation, clean substrate to remove dust, debris and loose particles.

3.03 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.
- B. Position corner guards at the top of the wall base.

3.04 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

SECTION 10 28 00
WASHROOM ACCESSORIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Private-use washroom accessories.
- B. Custodial accessories.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 09 21 16 - Gypsum Board Assemblies
- C. Section 09 30 00 - Tiling

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:
 - 1. Construction details and dimensions.
 - 2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
 - 3. Material and finish descriptions.
 - 4. Features that will be included for Project.
- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.
 - 1. Approved full-size Samples will be returned and may be used in the Work.
- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify products using designations indicated.

1.05 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.08 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.09 WARRANTY

- A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Specified Manufacturer: Bobrick Washroom Equipment, Inc.
- B. Other Acceptable Manufacturer's: Equivalent products of the manufacturer's listed below will be acceptable.
 - 1. American Specialties, Inc.
 - 2. Bradley Corporation.
 - 3. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
 - 4. Innotech Products Inc.

2.02 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) minimum nominal thickness unless otherwise indicated.
- B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.
- C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch (0.9-mm) minimum nominal thickness.
- D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.
- E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.
- I. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.03 WASHROOM ACCESSORIES

- A. Washroom Accessories: Accessory Type A- #, as specified below.
- B. Accessory Type A5109: Grab Bar (CFCI)
 - 1. Contractor Furnished / Contractor Installed
 - 2. Product: Bobrick B-6806.99
 - 3. Mounting: Flanges with concealed fasteners
 - 4. Material: Stainless steel, 0.05 inch (1.3 mm) thick
 - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area
 - 5. Outside Diameter: 1-1/2 inches (38 mm)
 - 6. Configuration and Length: As indicated on Drawings, in straight, bent and fold up styles
 - a. A5109a: Horizontal, 36-inches
 - b. A5109b: Horizontal, 42-inches
 - c. A5109c: Vertical, 18-inches
- C. Accessory Type A1066: Framed Mirror (CFCI)
 - 1. Contractor Furnished / Contractor Installed
 - 2. Product: Bobrick B-290 Series
 - a. Mirror: No. 1 quality, 1/4-inch (6-mm) select float glass
 - b. Frame: Stainless-steel angle, 3/4-inch x 3/4-inch (19 x 19-mm)
 - 1) Corners: Welded, ground smooth, and polished out to match #4 finish
 - c. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below
 - 1) One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts
 - 2) Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove

3. Size: As indicated on Drawings
- D. Accessory Type A1090: Framed Mirror with Shelf (CFCI)
1. Contractor Furnished / Contractor Installed
 2. Product: Bradley B-292 Series
 - a. Mirror: No. 1 quality, 1/4-inch (6-mm) select float glass
 - b. Frame: Stainless-steel angle, 3/4-inch x 3/4-inch (19 x 19-mm)
 - 1) Corners: Welded, ground smooth, and polished out to match #4 finish
 3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below
 - a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts
 - b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove
 4. Shelf: Shall be type 304, 18-gauge (0.8-mm) stainless steel with satin finish; A 3/4-inch (19-mm) return edge on front; Front and side return edges hemmed and corners welded, ground, and polished smooth. Shelf shall be welded to mirror frame.
 5. Size: As indicated on Drawings
- E. Accessory Type A5075: Soap Dispenser (OFCI)
1. Owner Furnished / Contractor Installed
 2. Product: Coordinate with Owner
- F. Accessory Type A5077: Hand Sanitizer (OFOI)
1. Owner Furnished / Owner Installed
 2. Product: Coordinate with Owner
- G. Accessory Type A5080: Paper Towel Dispenser (OFCI)
1. Owner Furnished / Contractor Installed
 2. Product: Coordinate with Owner
- H. Accessory Type A5082: Automatic Paper Towel Dispenser (OFCI)
1. Owner Furnished / Contractor Installed
 2. Product: Coordinate with Owner
- I. Accessory Type A5135: Utility Shelf with Mop/Broom Holders (CFCI)
1. Contractor Furnished / Contractor Installed
 2. Product: Bobrick; Model B-239, Utility Shelf with Mop / Broom Holders and Rag Hooks.
 - a. Description: Utility shelf shall be type-304 stainless steel with all-welded construction; exposed surfaces shall have satin finish. Shelf shall be 18 gauge (1.2mm), 8-inches (205mm) deep with 3/4-inch (19mm) return edges
 - 1) Mop/Broom Holders: Spring-loaded rubber cams with anti-slip coating. Plated steel retainers. Three (3) required.
 - 2) Hooks: 18-8, type-304, 12-gauge (2.8mm) stainless steel with satin finish. Each hook attached to mounting strip with two rivets. Four (4) required.
 3. Length: 34-inches (865 mm) .
 4. Mounting Height: 72-inches above finished floor to top of shelf.
- J. Accessory Type ____: Shower Curtains and Accessories (CFCI)
1. Contractor Furnished / Contractor Installed
 2. Refer to Section 10 21 23 for requirements

- K. Accessory Type A5180: Cubicle Curtain and Track (CFCI)
 - 1. Contractor Furnished / Contractor Installed
 - 2. Product: Refer to Section 10 21 23 for requirements
- L. Accessory Type A5180: Cubicle Curtain and Track (CFCI)
 - 1. Contractor Furnished / Contractor Installed
 - 2. Product: Refer to Section 10 21 23 for requirements
- M. Accessory Type A5106: Sharps Container (OFCI)
 - 1. Owner Furnished / Contractor Installed
 - 2. Product: Coordinate with Owner
- N. Accessory Type A5107: Glove Dispenser (OFCI)
 - 1. Owner Furnished / Contractor Installed
 - 2. Product: Coordinate with Owner

2.04 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

3.02 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Portable fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Brick and Concrete Masonry
- B. Section 06 10 00 - Rough Carpentry
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Division 21 - Fire Protection

1.04 REFERENCE STANDARDS

- A. UL 1037 - Antitheft Alarms and Devices; Current Edition, Including All Revisions.
- B. UL 1610 - Central-Station Burglar-Alarm Units; Current Edition, Including All Revisions.
- C. UL 437 - Standard for Key Locks; Current Edition, Including All Revisions.
- D. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- E. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 - 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Product Schedule: For fire protection cabinets. Coordinate final fire protection cabinet schedule with fire extinguisher schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.06 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Provide fire protection specialties produced by a single manufacturer.
- C. Provide fire extinguishers of type approved by UL, State Fire Marshal's Office, and local regulatory agencies, if any.
- D. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to fire protection cabinets including, but not limited to, the following:
 - a. Schedules and coordination requirements.

1.08 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

1.09 WARRANTY

- A. Fire Extinguishers: The manufacturer shall warrant the product/s to be free of defects in material and workmanship under conditions of normal use for a period of six (6) years from Date of Substantial Completion.
- B. All Fire Protection Products (except fire extinguishers) carry a one year warranty from the Date of Substantial Completion against defects in materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer/s:
 - 1. Fire Extinguishers: J.L. Industries.
 - 2. Fire Extinguisher Cabinets: Larsen's Manufacturing Company.
- B. Other Acceptable Manufacturer: Equivalent products of the manufacturer's listed below will be acceptable.
 - 1. Kidde (United Technologies).
 - 2. Ansul (Tyco).
 - 3. Nystrom, Inc.
 - 4. Potter-Roemer.
 - 5. Pyro-Chem (Tyco).
 - 6. Fire End & Croker Corporation

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Fire Extinguisher, Type A:
 - 1. Multi-Purpose Chemical Type: Extinguisher unit containing a fluidized and siliconized mono ammonium phosphate powder; nonconductive and nontoxic.
 - 2. Product: JLI; Cosmic Series, Model 10E
 - a. Nominal Capacity: 10 pound
 - b. Construction: Heavy duty steel cylinder with metal valve and siphon tube, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin and upright squeeze grip.
 - c. Finish: Factory powder-coated; Red.
 - d. Effectiveness (Rating): Class A, B, and C fires.
 - e. UL Rating: 4A-80B:C.
 - f. Size: 5-inch diameter / 21-inches high.
- C. Fire Extinguisher, Type K:
 - 1. Class K Wet Chemical Type: Extinguisher unit containing a low "pH" potassium acetate solution.
 - 2. Product: JLI; Saturn Series, Model 15.
 - a. Size: 1.8 gallons.
 - b. Construction: Stainless steel cylinder with protective nozzle tip orifice seal and nonmetallic nozzle tip finger guard, O-ring seal, replaceable valve stem seal, visual pressure gage, pull pin, and upright squeeze grip.
 - c. Effectiveness (Rating): Class A, K fires.
 - d. UL Rating: (C)1-A:K.
 - e. Size: 7-inch diameter / 19-1/4 inches overall height.

2.03 FIRE PROTECTION CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 - 1. Non-Fire-Rated:
 - a. Formed primed steel sheet; 0.036 inch thick base metal.
 - 2. Fire Rated Cabinet Construction: One-hour fire rated.
 - a. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- C. Cabinet Configuration: Semi-recessed type.
 - 1. Trim: Flat square edge, with ____ inch wide face.

2.04 SEMI-RECESSED FIRE PROTECTION CABINETS

- A. General Specifications:
 - 1. Cabinet Configuration: Semi-recessed type.
 - a. Sized to accommodate accessories.
 - b. Interior Dimensions of Cabinets: 9-1/2 inches wide by 24-inches high by 6-inches deep, typical unless noted otherwise.
 - c. Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.
 - d. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
 - 2. Cabinet Box:
 - a. Non-Fire-Rated Cabinets:
 - 1) Formed 0.036 inch thick steel sheet with white baked enamel finish.
 - b. Fire-Rated Cabinets:
 - 1) Construction: Shall have double wall of formed 0.036 inch thick steel sheet with white baked enamel finish. The space between the double walls shall be lined with 5/8 inch thick fire barrier material.
 - 2) Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
 - 3. Cabinet Exterior Trim and Door:
 - a. Material: Baked enamel, White color.
 - b. Door Style: Horizontal Duo.
 - c. Door Glazing:
 - 1) Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
 - d. Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 - 1) Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch (13 mm) thick.
 - 2) Fabricate door frames of one-piece construction with edges flanged.
 - 3) Miter and weld perimeter door frames.
 - 4. Door Hardware:
 - a. Catch: Self-adjusting roller catch.
 - b. Hinge: Continuous piano hinge capable of opening 180-degrees.
 - c. Door Pull: Satin finish pull handle.
 - 5. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- B. Non-Rated Semi-Recessed Cabinet, Type FEC-A:
 - 1. Product: Larsen's; "Architectural Series", Model No. 2409-6R.
 - 2. For installation in non-rated wall construction.
 - 3. Fire Extinguisher: Provide one (1) fire extinguisher, Type A per cabinet
 - 4. Cabinet trim projection from wall: 2-1/2 inches, rolled edge.
 - 5. Rough Opening Depth: 4-inches, minimum. Coordinate with wall construction for proper clearance.

- C. Semi-Recessed Cabinet, Type FEC-K, Non-Rated:
 - 1. Product: Larsen's; "Architectural Series", Model No. 2712-RL.
 - 2. For installation in non-rated wall construction.
 - 3. Fire Extinguisher: Provide one (1) fire extinguisher, Type K.
 - 4. Cabinet Trim Projection from Wall: 2-1/2 inches, rolled edge.
 - 5. Interior Dimensions of Cabinet: 12-inches wide by 27-inches high by 8-inches deep.
 - 6. Rough Opening Depth: 6-inches deep (min). Coordinate with wall construction for proper clearance.
- D. One-Hour Fire-Rated Semi-Recessed Cabinet, Type FEC-1A:
 - 1. Larsen's; "Architectural Series", Model No. FS-2409-R4.
 - 2. For installation in 1-hour fire-rated wall construction.
 - 3. Fire Extinguisher: Provide one (1) fire extinguisher, Type A.
 - 4. Cabinet trim projection from wall: 3-1/2 inches, square edge.
 - 5. Rough Opening Depth: 4-inches, minimum. Coordinate with wall construction for proper clearance.
- E. Two-Hour Fire-Rated Semi-Recessed Cabinet, Type FEC-2A:
 - 1. Larsen's; "Architectural Series", Model No. FS-2409-6R.
 - 2. For installation in 2-hour fire-rated wall construction.
 - 3. Fire Extinguisher: Provide one (1) fire extinguisher, Type A.
 - 4. Cabinet Trim Projection from Wall: 2-1/2 inches, square edge.
 - 5. Rough Opening Depth: 4-7/8 inches, minimum. Coordinate with wall construction for proper clearance.

2.05 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.

2.06 KEY LOCK BOX

- A. Manufacturer:
 - The Knox Company
 - P: 800-552-5669
 - Email: info@knoxbox.com
 - Web: www.knoxbox.com
- B. Product: Knox Box Model 3262, surface-mount key lock box with hinged door, without UL Listed Knox Tamper Alert.
 - 1. 1/4" plate steel housing.
 - 2. 1/2-inch thick steel door with interior gasket seal and stainless steel door hinge.
 - 3. Box and lock UL Listed (UL 1037, UL 1610, UL 437, UL 1332)
 - 4. Lock has 1/8" thick stainless steel dust cover with tamper seal mounting capability.
 - 5. Lock: UL Listed. Double-action rotating tumblers and hardened steel pins accessed by a biased cut key.
 - 6. Color: Black.
 - 7. Capacity: Holds up to 10 keys, access cards or entry items.
 - 8. Compliant to National Fire Code (NFPA, IFC, IBC)

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire protection cabinets. If wall thickness is not adequate for recessed cabinets, provide semi-recessed fire protection cabinets.
 2. Provide inside latch and lock for break-glass panels.
 3. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.
- C. Place extinguishers in cabinets.

3.03 FIELD QUALITY CONTROL

- A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to turnover.

END OF SECTION

SECTION 12 32 16

MANUFACTURED PLASTIC LAMINATE FACED CASEWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract (including General Conditions, Supplementary General Conditions, and Division 1 Specification Sections) shall apply to this Section.

1.02 SECTION INCLUDES

- A. Fixed modular plastic laminate clad casework and components.
- B. Plastic laminate countertops .
- C. Utility Shelving.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 06 61 16 - Solid Surface Fabrications
- C. Section 09 21 16 - Gypsum Board Assemblies
- D. Section 12 36 61 - Quartz Surfacing Fabrications
- E. Division 22 - Plumbing
- F. Division 26 - Electrical

1.04 REFERENCE STANDARDS

- A. AWI Section 400 (Architectural Cabinets)

1.05 DEFINITIONS AND ABBREVIATIONS

- A. Definitions in the AWI/AWMAC/WI's "Architectural Woodwork Standards" apply to the Work of this Section.
- B. Manufactured Plastic Laminate Faced Casework (from here on referred to as "Casework") shall refer to laminated plastic casework, cabinets, shelving, counter, counters, related hardware and items indicated on the Drawings and specified.
- C. NEMA LD3 - High Pressure Decorative Laminates (HPDL) Grades:
 - 1. Grade HGS (GP 50): Horizontal grade
 - 2. Grade VGS (GP-28): Vertical Grade
 - 3. Grade CLS (CL 20): Cabinet liner
 - 4. Grade BKL (BK 20): Backing sheet
- D. TFM: Thermally Fused Melamine-Clad Particleboard.
- E. LPDL: Low-Pressure Decorative Laminate.
- F. MDF: Medium Density Fiberboard.
- G. MR MDF: Moisture-Resistant MDF.

1.06 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that casework can be supported and installed as indicated.

1.07 QUALITY ASSURANCE

- A. Manufacturer: Minimum of 5 years experience in providing manufactured casework systems for similar types of projects, produce evidence of financial stability, bonding capacity, and adequate facilities and personnel required to perform on this project.
- B. Manufacturer: Provide products certified as meeting or exceeding ANSI-A 161.1-2000 testing standards.

- C. Single Source Manufacturer: Casework, countertops and architectural millwork products must all be engineered and built by a single source manufacturer in order to ensure consistency and quality for these related products. Splitting casework, countertops and/or architectural millwork between multiple manufacturers will not be permitted.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- E. Quality Standard: AWI standards are used to establish the minimum standard for casework construction to be provided on the project. AWI Section 400 (Architectural Cabinets) shall apply unless the indicated otherwise.
 - 1. Provide labels and certificates from AWI certification program indicating that casework, including installation, complies with requirements of grades specified.
 - 2. The following specifications are based on laminated plastic casework which shall be "Premium" grade as indicated and defined by the American Woodworking Institute (AWI).

1.08 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop drawings: Include plans, elevations, sections, details, and attachments to other work. Approved shop drawings and field verifications shall be obtained prior to fabrication.
- C. Keying Schedule: Include keying chart indicating whether cabinets, by room, are keyed alike or keyed differently and the quantity of master keys required.
- D. Samples for Verification: For the following:
 - 1. Laminate for each pattern selected.
 - 2. PVC edging for each pattern selected.
 - 3. Thermally fused melamine for each pattern selected.
 - 4. Hardware for each finish selected.
- E. Cabinet Sample: Submit full size, production type sample of a plastic laminate base cabinet showing complete construction details in accordance with the Contract Documents.
 - 1. Width: 18-inches
 - 2. Depth: 24-inches
 - 3. Height: 34-inches
 - 4. Sample shall include one drawer, one shelf, service fittings, cabinet hardware, and a plastic laminate countertop.
 - 5. Miniature "show room" type samples are not acceptable.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet minimum requirements for building conditioning for installation of finishes.
- B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install casework until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Established Dimensions: Where casework is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.
- C. Locate concealed framing, blocking, and reinforcements that support casework by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Warranty: Manufacturer shall warrant the products specified in this section against material defects or defects in manufacturing, for a period of two (2) years from Date of Substantial Completion.
- B. Installation Warranty: The Contractor shall warrant the installation to be free of defects in material and workmanship for a period of one (1) year from Date of Substantial Completion.
 - 1. Submit a written warranty to the Owner, executed by the Contractor, subcontractor, and the manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Advanced Cabinet Systems (ACS)
- B. Other Acceptable Manufacturers: Equivalent products of the manufacturer's listed below will be accepted. Additional unnamed manufacturers will be considered in accordance with the "or equal" provision specified in Section 01 60 00 - Product Requirements.
 - 1. Miller Manufacturing Cabinet & Fixture, Inc
 - 2. Royal Fixture Company
 - 3. Precision Millwork
 - 4. Fabricor, Inc
 - 5. Creative Associates
 - 6. C. S. Humphrey & Company, L.L.C.
 - 7. C & S Wood Shop, Inc.
 - 8. Stevens Industries
 - 9. LSI Corporation
 - 10. Case Systems
 - 11. TMI Systems Corporation
 - 12. FADCO
- C. Substitutions: Submit a request for substitution for any manufacturer not named, as specified in Division 1.

2.02 CASEWORK - GENERAL

- A. Quality Standard: Architectural Woodwork Standards (AWS).
- B. Grade: Premium.
- C. AWI Type of Cabinet Construction: Flush overlay (concealed hinges).
- D. Cabinet Grain Direction for Wood Grain Plastic Laminate:
 - 1. Vertical on door and drawer fronts with continuous vertical matching.
 - 2. Vertical on end panels.
 - 3. Side-to-side on bottoms and tops of units.
 - 4. Vertical on knee-space panels.
 - 5. Horizontal on aprons.

2.03 MATERIALS

- A. General: Provide materials that comply with requirements of AWI's quality standard for Premium type of woodwork and quality grade specified, unless otherwise indicated.
- B. Lumber shall be in accordance with the AWS Grade specified for the product being fabricated. Moisture content shall be 6% to 12% for boards up to 2-inches nominal thickness, and shall not exceed 19% for thicker pieces.
- C. Particle Board: ANSI A208.1, Mat-Formed Particle Board, Grade M-2, made with binder containing no urea formaldehyde.
 - 1. Density: 45-pound, minimum.
- D. Hardboard: ANSI A135.4, Class 1, Tempered.
- E. Decorative Laminates: Shall be High Pressure Decorative Laminate (HPDL):

1. Compliance: NEMA LD 3, and ANSI A161.2.
2. Grades:
 - a. VGS: Vertical Grade, 0.028-inches thick.
 - b. HGS: Horizontal Grade, 0.048-inches thick.
 - c. HGP: Horizontal Grade, Post-formed, 0.039-inches thick.
 - d. VGP: Vertical Grade, Post-Formed, 0.028-inches thick.
 - e. HGF: Horizontal application, fire retardant material.
 - f. VGF: Vertical application, fire retardant material.
 - g. CLS: Cabinet Liner, 0.020-inches thick.
 - h. BKH: Backer, 0.020-inches thick.:
 - i. TFM: Thermally Fused Melamine Laminate Panels: NEMA LD 3, Grade VGL, 100 grams. Finish shall be resistant to water and mild cleaners.
- F. Medium Density Fiberboard (MDF):
 1. Compliance: ANSI A208.2, Grade 130.
- G. Moisture-Resistant MDF (MR-MDF): Where countertops receive sinks, lavatories, or are subjected to liquids:
 1. Product: "Medex", as manufactured by Roseburg Forest Products Company.
 - a. Compliance: ANSI A208.2 - Grade 155; MR50.
 - b. Density: 48 pcf, minimum.
- H. Edgebanding: Refer to "Edgebanding" Article this Section.
- I. Glass for Glazed Doors:
 1. Standard Glazing: Clear tempered glass complying with ASTM C1048, Kind FT; not less than 1/4-inch thickness.
 2. Optional Glazing: Clear laminated tempered glass complying with ASTM C1172, Kind LT; not less than 5/16-inch thickness.
- J. Adhesives: Chemical-resistant waterproof adhesive as recommended by manufacturer of materials being joined.
 1. Do not use adhesives that contain urea formaldehyde.
- K. Joint Sealant: Mildew-resistant silicone sealant.
- L. Solid Surfacing: Refer to Section 06 61 16.
- M. Quartz Surfacing: Refer to Section 12 36 61.

2.04 SURFACES

- A. Exterior Surfaces of Cabinets:
 1. Door and Drawer Fronts: HPDL, Grade VGS. Provide balanced backing sheet (BKH) on all door and drawer fronts.
 2. Cabinet Sides: HPDL, Grade VGS.
 3. Wall Cabinets - Bottoms:
 - a. 48-inches or more above finished floor: HPDL, Grade VGS.
 - b. Less tha 48-inches above finished floor: HPDL , Grade HGS.
 4. Wall Cabinets, Tall Cabinets, and Hutches - Tops:
 - a. 80-inches or taller, and not visible from above: HPDL, Grade VGS.
 - b. Less than 80-inches tall, or visible from above: HPDL, Grade HGS.
 5. Edges: Refer to "Edgebanding" Article this Section.
- B. Interior Surfaces of Cabinets - Exposed (open interiors):
 1. Application: Any open storage unit without solid door or drawer fronts, units with glass or acrylic inserts in doors, and units with sliding doors.
 2. Open Cabinet Interior (Top, bottom, back sides, horizontal and vertical members): HPDL, Grade VGS.
 3. Open Cabinet Shelving: HPDL, Grade VGS.
 4. Edges: Refer to "Edgebanding" Article this Section.
- C. Interior Surfaces of Cabinets - Semi-Exposed (closed interiors):

1. Application: Surfaces behind opaque doors and drawers.
 2. Door and Drawer Fronts: HPDL, Grade VGS.
 3. Cabinet Interior: Top, bottom, back, sides, horizontal and vertical members: HPDL, Grade TFM; Color shall be White.
 4. Closed Cabinet Shelving: HPDL, Grade VGS.
 5. Edges: Refer to "Edgebanding" Article this Section.
- D. Concealed Surfaces of Cabinets:
1. Surfaces that are not visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets; HPDL, Grade TFM, CLS, or BKH at Manufacturer's Option.
- E. Toekicks: Resilient base (by others).
- F. Wall Shelving on Standards and Brackets: HPDL, Grade HGS.
1. Edges: Refer to "Edgebanding" Article this Section.
- G. Drawer Boxes: Clear Finish or Metabox (Contractor Option).
- H.

2.05 EDGEBANDING

- A. Edgebanding: Finish Type EB- #, as specified below.
- B. Type EB-1:
1. Manufacturer: Doellken
 2. Product: # 8707E5
 - a. Material: Rigid PVC extrusion; through color with satin finish.
 - b. Color: Walnut Heights
 3. Edgebanding Thickness:
 - a. Cabinet Box Edges: 1-mm PVC
 - b. Door and Drawer Fronts: 3-mm PVC
 - c. Adjustable Shelves - Closed Cabinets Interiors: 3-mm PVC, front edge only
 - d. Adjustable Shelves - Open Cabinet Interiors: 3-mm PVC, front edge only
 - e. Tops of Wall Cabinets, Tall Cabinets, and Hutches: 1-mm PVC
 - f. Utility Shelving - Standards & Brackets: 3-mm PVC, all four edges
 - g. Countertops and Splashes: 3-mm PVC

2.06 FABRICATION - CABINETS

- A. Cabinet Body Construction:
1. General: Balanced construction of all laminated panels is mandatory. Unfinished core stock surfaces, even on concealed surfaces (excluding edges), are not permitted.
 2. Tops, Bottoms and Side Panels:
 - a. Core Material (Typical): 3/4-inch thick particleboard core with HPDL or TFM finish depending on the exposure.
 - 1) Exception: Sink Cabinets: Core shall be 3/4-inch thick Moisture-Resistant MDF (MR-MDF) with HPDL or TFM finish depending on the exposure.
 - b. Side panels and vertical dividers shall receive adjustable shelf hardware at 32mm line boring centers. Mount door hinges, drawer slides and pull-out shelves in the line boring for consistent alignment.
 - c. Edgebanding: Refer to "Edgebanding" Article this Section.
 3. Back Panels:
 - a. Closed Cabinets: 1/2-inch thick particleboard core with HPDL or TFM finish depending on the exposure.
 - 1) Core Material (Typical): 1/2-inch thick particleboard core with TFM finish.
 - (a) Exception: Sink Cabinet shall be 1/2-inch thick Moisture-Resistant MDF (MR-MDF) with TFM finish depending on the exposure.
 - 2) Back shall be dadoed into sides, bottoms, and tops of closed cabinets.
 - b. Open Cabinets: 3/4-inch thick particleboard core with HPDL finish.

- 1) Back shall be dowelled into sides, bottoms, and tops of open cabinets.
4. Cabinet Bases:
 - a. Material: 3/4-inch, 45 pound density particle board.
 - b. Height: 4-inches, unless noted otherwise.
 - c. Base Options:
 - 1) Individual factory-applied base.
 - 2) Separate Cabinet Bases (Contractor Option): Bases to be continuous per elevation with cross members on 16-inch centers.
5. Base units, except sink base units: Full sub-top glued and doweled to cabinet sides.
 - a. Sink base units are provided with open top and a stretcher at the front, attached to the sides. Back to be split removable access panel.
- B. Adjustable Shelves in Cabinets:
 1. All shelving shall be 1-inch thick particleboard core with HPDL finish.
 2. All shelving shall be fully adjustable on 2-inch centers, with 5mm diameter holes.
 3. Edgebanding: Refer to "Edgebanding" Article this Section.
- C. Door and Drawer Fronts:
 1. 3/4-inch particleboard core with HPDL finish.
 - a. Sink Cabinets: Core shall be Moisture-Resistant MDF (MR-MDF) with HPDL finish.
 2. Edgebanding: Refer to "Edgebanding" Article this Section.
- D. Drawer Boxes:
 1. Standard: Hardwood drawer bodies, including:
 - a. Drawer sides and back shall be 1/2-inch thick hardwood, fully dovetailed front, back and sides.
 - b. Drawer bottoms shall be 1/4-inch thick tempered masonite.
 - c. Finish: All exposed top, sides, bottoms and backs of wood and masonite to have factory finish of two (2) coats lacquer.
 - d. Drawer Box Length: 21-5/8 inches unless otherwise indicated.
 2. Drawer Slides:
 - a. Standard Drawers: Full extension (KV8400).
 - b. File Drawers: Full extension (KV8505).
 - c. Testing Standards: Meet or exceed ANSI/BHMA A156.9, Grade 1.
 3. STEEL DRAWER PANS: With Owner and Architect review and approval of separate breakout pricing, provide "Metabox" steel drawer pans, as manufactured by Blum, Inc. in lieu of hardwood drawer boxes.
 - a. Standard Drawer Height: 4-5/8 inches (Type K)
 - b. Drawer Slide Operation: Self-Closing Action Drawer Slides (BLUMATIC) with full Extension Drawer Slides (330 Series).
 - c. Drawer Box Length: 21-5/8 inches.
- E. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.07 JOINERY OF CASE BODY MEMBERS

- A. Tops, exposed ends and bottoms:
 1. Stop dado, glued with pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts), or
 2. Doweled, glued with pressure; approx. 4 per foot, or
 3. European assembly screws:
 - a. Fasteners are to be used no more than 37mm from each end, with subsequent screws no more than 128-mm on-center.
 - b. Screw heads and/or plastic trim caps shall not be visible on exposed parts.
 - c. Glue is not required with this system.
- B. Cabinet Backs - Wall-Mounted:
 1. Captured in grooves on cabinets sides and bottom; securely fastened.

- C. Cabinet backs - Floor-Standing:
 - 1. Side bound, captured in grooves; securely fastened to top and bottom.

2.08 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets, except for items specified in Section 08 71 00 - Door Hardware (Scheduled by Describing Products).
- B. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Subparagraphs below are examples only. Revise to suit Project. If more than one finish is required, indicate location of each here or on Drawings. See Evaluations.
 - 2. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
 - 3. Satin Stainless Steel: BHMA 630.
- C. Concealed Hardware Finishes: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- D. Hinges:
 - 1. Frameless Concealed Hinges (European Type): BHMA A156.9, Type B01602, 170-degrees of opening, self-closing.
- E. Drawer and Door Pulls:
 - 1. Back-Mounted Pulls: BHMA A156.9, B02011.
 - 2. Wire Pulls: Back mounted, solid metal, 4 inches (100 mm) long, 5/16 inch (8 mm) in diameter.
 - 3. General:
 - a. Provide two pulls for drawers more than 27-inches wide.
 - b. Provide 1-inch long mounting screws.
- F. Door and Drawer Catches: Magnetic catches, BHMA A156.9, B03141.
- G. Shelf Supports:
 - 1. Adjustable Shelf Standards and Supports: Two-pin locking plastic shelf rests complying with BHMA A156.9, Type B04012; with shelf brackets, B04112.
- H. Shelf Rests: BHMA A156.9, B04013; metal.
- I. Drawer Slides: BHMA A156.9, B05091.
 - 1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-extension type; zinc-plated steel ball-bearing slides.
 - 2. Grades in five subparagraphs below correspond to the following initial load test requirements: Grade 2: 30 lbf (13.3 kg); Grade 1: 50 lbf (22.2 kg); Grade 1HD-100: 100 lbf (44.5 kg); Grade 1HD-200: 200 lbf (90 kg).
 - 3. Box Drawer Slides: Grade 1HD-100; for drawers not more than 6 inches (150 mm) high and 24 inches (600 mm) wide.
 - 4. File Drawer Slides: Grade 1HD-200; for drawers more than 6 inches (150 mm) high or 24 inches (600 mm) wide.
 - 5. Soiled Linen Slides: Grade 1HD-200; for trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide.
- J. Door and Drawer Locks:
 - 1. Door Locks: Codelocks, Model #KL1000
 - 2. Drawer Locks: Codelocks, Model #KL1000
 - 3. Lock Locations:
 - a. Provide locks on ALL tall storage cabinets and wardrobe cabinets, even if not shown on drawings.
 - b. Provide locks on ALL file drawers.
 - c. Provide locks on base cabinet doors and drawers as shown on drawings.
 - d. Provide locks on wall cabinet doors as shown on drawings.
 - e. Lock Keying:

- 1) Locks shall be capable of being keyed alike, keyed different and/or master keyed as directed by Owner.
 - 2) Provide 2 keys per lock and 10 master keys.
- K. Coat Rods: 1 inch diameter, 14-gauge chrome plated steel installed in captive mounting hardware.
- L. Mirrors: 1/8 inch thick mirrored acrylic, break and impact resistant.
- M. Grommets for Cable Passage through Countertops: 2-1/2 inch OD, color as selected by Architect, molded-plastic grommets and matching plastic caps with slot for wire passage.
1. Product: Subject to compliance with requirements, provide "EDP series" by Doug Mockett & Company, Inc.
- N. Trash Ring: 8 or 12 inches (305 mm) dia cut out by 3/4 inches wide surface trim by 1 inch (25 mm) deep; satin stainless steel.
1. In subparagraph below, "Model CP-2" is 12-inch (305-mm) slot; "Model CP-1" is 17-inch (432-mm) slot.
 2. Product: Subject to compliance with requirements, provide "Model TM12-SSS" by Doug Mockett & Company, Inc.

2.09 PLASTIC LAMINATE COUNTERTOPS

- A. Grade: Premium
- B. High-Pressure Decorative Laminate Grade: HGS
- C. Grain Direction: Parallel to cabinet fronts.
- D. Edge Treatment: Solid Surface Bullnose.
- E. Core Material: Particleboard or MDF, 1-1/8 inch thickness.
- F. Core Material at Wet Locations: Moisture-Resistant MDF (MR-MDF) at sink and lavatory locations, or where subjected to liquids, 1-1/8 inch thickness.
- G. Backer Sheet: Provide plastic laminate backer sheet, Grade BKH, on underside of countertop substrate.
- H. Cleats: 3/4-inch (19-mm), Grade TFM.
- I. Countertop Configuration and Sizes:
1. Thickness: 1 1/4-inches.
 2. Depth:
 - a. Base Cabinet Locations: 23-1/2 inches, unless otherwise indicated.
 - b. Work Counter Locations: 16-7/8 inches, unless otherwise indicated.
 - c. Nurse Station Work Counters: 24-inches, unless otherwise indicated.
 3. Length and Layout: As indicated on drawings.
- J. Exposed Edge Treatment:
1. Square, Self-Edge: Substrate built up to 1 1/4-inches thick; exposed faces covered with edgebanding. Refer to "Edgebanding" Article this Section.
 - a. Application of self-edge: Edge laminated before top.
- K. Back and End Splashes: Same material, same construction.
1. All other Countertops: Back and End Splashes shall be 3/4-inches thick and attached by means of screws from underside of deck through continuous bead of silicone sealant.
 - a. Exposed edges and ends of backsplash shall be covered with edgebanding. Refer to "Edgebanding" Article this Section.
 2. Backsplashes in wet areas shall be moisture-resistant MDF (Medex) with high-pressure laminate bonded to all faces, including BKL on the back.
- L. Countertop Accessories:
1. Wall-Mounted Countertop Support Brackets: Provide metal wall bracket, 1/8-inch thick, with black powder coat finish for support of countertops as shown on the Drawings.
 - a. Basis of Design Manufacturer: A&M Hardware (P: 888-647-0200 / Web: www.AandMHardware.com).

- b. Size: Sized to correspond to countertop depth.
 - c. Provide fire treated solid wood blocking to support and secure brackets when installed at metal stud walls.
 - d. Load capacity shall be 1000 lbs per bracket, minimum.
- 2. Grommets for Cable Passage through Countertops: 2-1/2 inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
 - a. Product: Subject to compliance with requirements, provide "EDP series" by Doug Mockett & Company, Inc., or approved equal.
 - b. Color: Black.

2.10 PLASTIC LAMINATE FINISH TYPES

- A. Plastic Laminate: Finish Type PL- #, as specified below.
- B. Type PL-1:
 - 1. Manufacturer: Wilsonart
 - 2. Product Code: #7965K-12
 - 3. Color: Walnut Heights
- C. Type PL-2
 - 1. Manufacturer: Formica
 - 2. Product Code: #5875-58.
 - 3. Color: Natural Weft

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of the Work.

3.02 PREPARATION:

- A. Condition casework to average prevailing humidity conditions in installation areas prior to installing.

3.03 INSTALLATION

- A. Separate Cabinet Bases: At the contractor's option, install separate cabinet bases prior to remaining casework as required to coordinate with installation of flooring and base.
- B. Provide and install scribe strips to adjoining walls, accurately fitted, installed with fastenings.
- C. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Align similar adjoining doors and drawers to a tolerance of 1/16 inch. Bolt adjacent cabinets together with joints flush, tight, and uniform.
- D. Wall Cabinets: Hang wall cabinets straight, level, and plumb. Adjust fronts and bottoms to align in a single plane or straight line. Fasten to hanging strips, masonry, framing, wood blocking, or reinforcements in walls and partitions to provide positive anchorage. Align similar adjoining doors to align in a straight line.
- E. Fasten cabinets to adjacent cabinets and to masonry, framing, wood blocking, or reinforcements in walls and partitions to comply with the AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
- F. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.
- G. Repair or remove and replace defective work as directed on completion of installation.
- H. Adjust casework and hardware so doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

3.04 CLEANING:

- A. Remove and dispose of all packing materials and related construction debris.
- B. Clean cabinets inside and out. Wipe off fingerprints, pencil marks, and surface soil etc., in preparation for final cleaning by the building owner.

3.05 PROTECTION

- A. Protect completed work from damage during remainder of construction period.
- B. DO NOT stand on the installed countertops for any reason.

END OF SECTION

SECTION 12 36 61
QUARTZ SURFACING FABRICATIONS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Quartz surfacing countertops for manufactured casework and/or architectural cabinet work, including back- and end-splashes.
- B. Installation materials.

1.03 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry
- B. Section 07 92 00 - Joint Sealants
- C. Section 12 32 16 - Manufactured Plastic Laminate Faced Casework
- D. Division 21 - Plumbing
- E. Division 26 - Electrical

1.04 SUBMITTALS

- A. Product Data: For countertop materials.
 - 1. Submit data for each specified product. Include manufacturer's technical data sheets and published installation instructions.
 - 2. Submit Safety Data Sheets (SDS) for adhesives and sealants.
- B. Shop Drawings: For countertops. Submit dimensioned shop drawings showing countertop layouts, backsplashes, vanities, joinery, edge conditions, terminations, substrate construction, cutouts, and holes.
 - 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.
 - 3. Show plumbing installation provisions.
- C. Samples: Submit selection and verification samples for each color and pattern required.
- D. Qualification Data: For fabricator.
- E. Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- F. Warranty: Submit specimen copy of specified warranty.
- G. Maintenance Data: Submit manufacturer's published maintenance and care manual. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.05 QUALITY ASSURANCE

- A. Applicable Standards
 - 1. Standards of the following, as referenced herein:
 - a. American National Standards Institute (ANSI)
 - b. American Society for Testing and Materials (ASTM)
 - c. National Electrical Manufacturers Association (NEMA)
 - d. NSF International
- B. Fire Test response characteristics
 - 1. Provide with the following Class A (Class 1) surface burning characteristics as evidenced by testing identical products against ASTM E84 (UL 723) or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Flame Spread Index: 25 or less

3. Smoke Developed Index: 450 or less
- C. Allowable Tolerances
 1. Variation in component size $\pm 1/8"$ (3mm) over a ten (10) foot length
 2. Location of openings: $\pm 1/8"$ (3mm) from indicated location
 3. Maximum $1/8"$ (3mm) clearance between quartz surfaces and each wall
- D. Regulatory Requirements
 1. Accessibility Requirements: Comply with the U.S. Architectural & Transportation Barriers Compliance Board ADA-ABA Accessibility Guidelines for Buildings and Facilities.
- E. Manufacturing Facility Qualifications: Quartz surfacing materials produced in an ISO 9001 certified facility.
- F. Fabricator Qualifications: Minimum of five years documented experience in fabricating quartz surfacing countertops similar in scope and complexity to this Project, using water-cooled cutting tools. Currently certified by the manufacturer as an acceptable fabricator.
- G. Installer Qualifications: Minimum of five years documented installation experience for projects similar in scope and complexity to this Project, and currently certified by the manufacturer as an acceptable installer.
- H. Mockups: Construct mockup (if requested by Architect) to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 1. Build mockup of typical countertop, 18-inches wide, full depth with backsplash, and partial cutout for an undermount sink.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations for shipping and handling quartz surfacing materials to preclude breakage and damage. Brace quartz surfacing units as necessary during shipment, transporting in near-vertical position with finished face towards finished face. Do not allow finished surfaces to rub during shipping and handling.
- B. Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by the manufacturer. Store quartz surfacing sheet materials on racks in near-vertical position to preclude damage. Store with finished face turned towards finished face. Prevent warpage and breakage.

1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions of countertops and openings by field measurements[after base cabinets are installed but] before countertop fabrication is complete. Show recorded measurements on shop drawings.
- B. Adhesives: Acclimate adhesives to occupancy room temperatures with maximum temperature not to exceed 75 deg F (24 deg C).

1.08 COORDINATION

- A. Coordinate field measurements and fabrication schedule with construction progress.
- B. Coordinate locations of utilities that will penetrate countertops.

1.09 WARRANTY

- A. Manufacturer's Full Lifetime Warranty: Manufacturer warrants against manufacturing defects for the lifetime of the product, commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Specified Manufacturer: Cambria
 1. Owner Standard: The solid surfacing products specified in this Section are restricted to the specified manufacturers and products unless indicated otherwise.
 - a. Substitutions: Not permitted.

2.02 QUARTZ SURFACING

- A. Quartz Surfacing, designated in the Drawings as Finish Type QTZ- #\1.
 - 1. Refer to the "Interior Finish Legend" for pertinent information on this Finish Type, including manufacturer, model/pattern, color, size, and other related information
- B. Type QTZ-1:
 - 1. Manufacturer: Cambria
 - 2. Design: Darlington
 - 3. Quartz Material Thickness: 0.80-inches (2 cm).
 - 4. Countertop Profile: Ridgeline (1/8-inch radius).
 - 5. Back- and Endsplash Profile: Ridgeline (1/8-inch radius)
 - 6. Finish: Matte.
 - 7. Conformance Standards:

2.03 FABRICATION - QUARTZ SURFACING

- A. General: Fabricate components in shop, to greatest extent practicable, in sizes and shapes indicated according to approved shop drawings and in accordance with industry practice.
 - 1. Tools: Quartz fabrication shall include a CNC machine.
- B. Joints: Fabricate countertops in sections for joining in field.
 - 1. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.
- C. Joint Seams: Form joint seams between quartz surfacing components with specified seam adhesive. Completed joints inconspicuous in appearance and without voids. Provide joint reinforced if required by manufacturer for particular installation conditions.
- D. Cutouts and Holes: Provide holes and cutouts for lavatories, sinks, fittings, service fixtures and similar countertop-mounted items as indicated.
 - 1. Form cutouts to required template or pattern, with smooth, even curves, eased edges, and radiused inside corners. Inside corners shall be reinforced in an acceptable manner to prevent cracking.
 - 2. All internal cutout corners must have a minimum 1/4-inch (6.35mm) radius.
 - 3. Top and bottom of edge profiles and cutouts are recommended to have a minimum 1/16-inch (1.58mm) radius or chamfer.
- E. Countertops:
 - 1. Countertops shall be constructed of 2 cm (0.79 inch) thick quartz material over a 3/4-inch substrate, for a total thickness of 1-1/2 inches
 - 2. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 3. Laminations: Laminate layers of quartz surfacing as required to create built-up edges, trim, and other areas requiring additional thickness.
 - 4. Supporting Countertop Overhangs:
 - a. Overhangs equal to or less than 12 inches: No support required.
 - b. Overhangs greater than 12-inches, but less than 18-inches: Support brackets required.
 - c. Overhangs greater than 18-inches, and up to 24-inches: Support brackets, supporting substrate, and support legs required.
 - 5. Support Brackets:
 - a. Spacing of brackets: 24-inches on-center (maximum).
 - b. Place brackets 12-inches (304.8mm) from open ends, and against wall ends.
 - c. Brackets must be mounted to studs or high strength frame support.
 - 6. Supporting Substrate: 3/4-inch (19.05mm) underlayment is required, support for underlayment can be affixed to cabinet
 - 7. Support Legs: Shall be evenly installed at 36-inches (914.4mm) on-center, maximum.
- F. Backsplashes:

1. Thickness: 2 cm (0.79 inch).
2. Fabrication:
 - a. Field Applied Backsplashes: Provide loose fabrications to be field set.
 - 1) Backsplashes and returns are attached to countertop with specified construction adhesive.
- G. End Splash: Match backsplash.
- H. Transaction Tops: Same as countertops.
- I. Identification: Material shall be labeled with slab information and imprinted with a manufacturer's identifying mark on the back.

2.04 INTEGRAL SOLID SURFACE SINKS

- A. Refer to Section 06 61 16 - Solid Surface Fabrications

2.05 INSTALLATION MATERIALS

- A. Mounting Adhesive: Provide structural-grade silicone or epoxy adhesives as recommended by manufacturer for application and per conditions of use.
 1. Provide spacers, if required, of type recommended by adhesive manufacturer.
- B. Joint Adhesive: Methacrylate-based adhesive for chemically bonding quartz surfacing seams. Color complementary to quartz surfacing sheet material. UL 2818 GREENGUARD Gold certified and complying with SCAQMD Rule 1168.
 1. Adhesives shall have a VOC content of 70 g/L or less.
- C. Elastomeric Joint Sealant (Silicone): Mildew-resistant silicone sealant for filling gaps between countertops and terminating substrates in wet environment applications. Complies with ASTM C920, Type S (single component), Grade NS (nonsag).
 1. Color: Complementary to quartz surfacing color.
- D. Siliconized Acrylic Joint Sealant: Siliconized acrylic latex sealant. For general applications to fill gaps between countertops and at terminating substrates. Complies with ASTM C 384, Type OP, Grade NF, and SCAQMD Rule 1168.
 1. Color: Complementary to quartz surfacing color.
- E. Construction Adhesive: Countertop manufacturer's recommended silicone-based construction adhesive for backsplashes, endsplashes, and other applications according to manufacturer's published fabrication instructions.
- F. Solvent: Product recommended by adhesive manufacturer to clean surface of quartz surfacing to assure adhesion of adhesives and sealants.
- G. Cleaning Agents: Non-abrasive, low pH cleansers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates to receive quartz countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops. Substrates must be sound, flat, smooth, and free from dust or other surface contaminants.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install quartz surfacing components plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Use woodworking and specialized fabrication tools acceptable to the manufacturer.
 1. Fasten quartz surfacing components to base cabinets or other supporting substrates with suitable adhesives acceptable to manufacturer.
- B. Form joint seams with specified seam adhesive. Seams to be inconspicuous in completed work. Seams in locations shown on approved shop drawings and acceptable to manufacturer. Promptly remove excess adhesive.

1. Clamp or brace quartz surfaces in position until adhesive sets.
- C. Sinks:
 1. Install undermount sinks or bowls to countertops using appropriate adhesive, sealant and mounting hardware.
- D. Fill gaps between countertop and terminating substrates with specified sealant.
- E. Install backsplashes and endsplashes where indicated on Drawings. Adhere to countertops with specified construction adhesive.

3.03 REPAIRS

- A. Minor surface marring for quartz surfacing components may be repaired according to manufacturer's published installation instructions.
- B. Remove and replace quartz surfacing components that are damaged and cannot be satisfactorily repaired.

3.04 CLEANING

- A. Clean quartz surfacing components according to manufacturer's published maintenance instructions.
- B. Completely remove excess adhesives and sealants from finished surfaces.

3.05 PROTECTION

- A. Protect completed work from damage during remainder of construction period.
- B. DO NOT stand on the installed countertops for any reason.

END OF SECTION

SECTION 13 49 00
RADIATION PROTECTION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Lead sheet, strip, and plate.
 - 2. Lead glass.
 - 3. Lead-lined building materials and products including the following:
 - a. Gypsum board
 - b. Steel hollow-metal door frames
 - c. Wood doors.
 - d. Observation-window frames.
 - 4. Informational signs.
- B. Related Sections:
 - 1. Division 08 Section "Door Hardware" for door hardware for lead-lined steel hollow-metal doors.
 - 2. Division 09 Section "Gypsum Veneer Plastering" for metal framing and furring for lead-lined gypsum base and for gypsum veneer plaster, accessories, and trim applied to lead-lined gypsum base.
 - 3. Division 09 Section "Gypsum Board" for metal framing and furring for lead-lined gypsum board and for finishing materials, accessories, and trim applied to lead-lined gypsum board.
 - 4. Division 09 Sections "Interior Painting" for field finishing doors and frames.

1.03 DEFINITIONS

- A. Lead Equivalence: The thickness of lead that provides the same attenuation (reduction of radiation passing through) as the material in question under the specified conditions.
 - 1. Lead equivalence specified for materials used in diagnostic x-ray rooms is as measured at 100 kV unless otherwise indicated.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide materials and workmanship, including joints and fasteners, that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.
 - 1. Materials, thicknesses, and configurations indicated are based on radiation protection design prepared by Owner's radiation health physicist. This design is available to Contractor on request.
- B. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in doors, door frames, window frames, penetration shielding, joint strips, film transfer cabinets, and other items located in lead-lined assemblies not less than that indicated for assemblies in which they are installed.
- C. Lead Glazing: Unless otherwise indicated, provide lead equivalence not less than that indicated for assembly in which glazing is installed.

1.05 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show layout of radiation-protected areas. Indicate lead thickness or lead equivalence of components. Show components and installation conditions not fully dimensioned or detailed in product data.

1. Show ducts, pipes, conduit, and other objects that penetrate radiation protection; include details of penetrations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Other Action Submittals:
 1. Schedule: Provide a schedule of observation windows, doors and frames prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

1.06 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.
- C. Warranty: Sample of special warranty.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For neutron-shielding doors to include in operation and maintenance manuals.

1.08 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products.
- B. Source Limitations: Obtain each type of radiation protection product from single source from single manufacturer.
- C. Glazing: Comply with requirements in Division 08 Section "Glazing."
- D. 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.
- E. Preinstallation Conference: Conduct conference at Project site

1.09 DELIVERY, STORAGE, HANDLING

- A. Lead-Lined Gypsum Panels: Neatly stack panels flat to prevent deformation.
- B. Lead-Lined Steel Doors and Frames: Comply with requirements in Division 08 Section "Hollow Metal Doors and Frames" for delivery, storage, and handling.
- C. Lead-Lined Steel Doors and Frames: Deliver doors and frames cardboard wrapped or crated to provide protection during delivery and storage. Inspect for damage on delivery. Minor damage may be repaired provided the refinished repair matches new work and is approved by Architect; otherwise, remove and replace damaged items as directed.
- D. Lead-Lined Wood Doors: Comply with requirements in Division 08 Section "Flush Wood Doors" for delivery, storage, and handling.
- E. Lead-Lined Wood Doors: Comply with manufacturer's written instructions and requirements in WDMA I.S.1-A.

1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install radiation protection until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.11 WARRANTY

- A. Comply with requirements in Division 08 Section "Flush Wood Doors."

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lead Sheet, Strip, and Plate: ASTM B 749, alloy UNS No. L51121 (chemical-copper lead).

- B. Lead Glass: Lead-barium, polished float glass containing not less than 60 percent heavy metal oxides, including not less than 48 percent lead oxide by weight.
 - 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. Amerope Enterprises, Inc.
 - b. McGrory Glass, Inc.
 - c. Schott North America, Inc.
 - 2. Safety Glass: Fully tempered float glass.
 - a. Outer Lite: Clear float glass; thickness as indicated.
 - b. Interlayer: Clear polyvinyl butyral or cured resin of manufacturer's standard thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - c. Inner Lite: Lead-barium, polished float glass; thickness as indicated.
- C. Lead-Lined Gypsum Board: 5/8-inch- (16-mm-) thick gypsum board complying with Division 09 Section "Gypsum Board," of width and length required for support spacing and to prevent cracking during handling, and with a single sheet of lead laminated to the back of the board.
 - 1. Provide lead sheet lining the full width of board and length necessary to extend from floor to 84 inches (2133 mm) above floor.
 - 2. Provide 3-inch- (75-mm-) wide lead strips for wrapping metal stud flanges.
 - 3. Provide 2-inch- (50-mm-) wide lead strips for backing joints.
 - 4. Provide 5/8-inch (16-mm) lead disks for covering screw heads.
 - 5. Provide lead-headed nails for fastening gypsum board, accessories, and trim to wood members.
- D. Accessories and Fasteners: Provide manufacturer's standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.
- E. Asphalt Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- F. Asphalt Felt: ASTM D 226.

2.02 LEAD LINED STEEL HOLLOW METAL DOOR FRAMES

- A. General: Steel door frames complying with ANSI/NAAMM-HMMA 861, and lined with lead sheet of thickness not less than that required for doors and walls where frames are used.
 - 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. Deronde Products.
 - b. Karpen Steel Custom Doors & Frames.
 - c. Accurate Radiation Shielding, Inc.
 - d. A & L Shielding Inc.
 - e. El Dorado Metals, Inc.
 - f. Fluke Biomedical; Radiation Management Services.
 - g. Mayco Industries; a Metalico company.
 - h. NELCO, Inc.
 - i. New Shield.
 - j. Radiation Protection Products, Inc.
 - k. Ray-Bar Engineering Corp.
 - 2. Provide additional reinforcements and internal supports to adequately carry the weight of lead-lined doors. Install reinforcements and supports before installing lead lining.
 - 3. Form lead sheet to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Fabricate lead lining wide enough to maintain an effective lap with lead of adjacent shielding.
 - 4. Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

2.03 LEAD-LINED WOOD DOORS

- A. Wood Door Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.
- B. General: Flush solid-core wood doors with lead lining, thickness not less than that required for partition in which door is installed.
 - 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. V-T Industries Inc.
 - b. Marshfield-Algoma, Inc.
 - c. Eggers Industries; Architectural Door Div.
 - 2. Door Construction: HPDL face thermally fused to five ply veneer with bonded particleboard core. Mineral Core door if required for fire rated opening protection.
 - 3. Lead Lining: One or more continuous sheets of lead extending from top to bottom and edge to edge, constructed either in the core or between the core and faces, at manufacturer's option.
 - 4. Comply with Division 08 Section "Flush Wood Doors" for grade, faces, veneer matching, fabrication, finishing, and other requirements unless otherwise indicated.
 - 5. Quality Standard: WDMA I.S.1-A, "Architectural Wood Flush Doors."
 - 6. Grade: Premium.
 - 7. Substrate Veneer Species and Cut: Manufacturer's standard.
 - 8. Faces: Plastic laminate complying with NEMA LD 3, Grade HGS.
 - a. Color, Patterns, and Finishes: shall match that of adjacent door finishes this area, colors as Approved by Architect.
 - 9. Vertical Edges: 3mm PVC edging thermally fused to door substrate
 - a. Color, Patterns, and Finishes: Manufacturer's standard to match door finish, color as Approved by Architect.
 - 10. Top and bottom edges: Plastic laminate complying with NEMA LD 3, Grade HGS.
 - a. Color, Patterns, and Finishes: shall match that of door finish.
 - 11. Shield cutouts for locksets with lead sheet of same thickness used in door. Lap lining of cutouts with door lining.
 - 12. Factory fit doors to suit frame openings indicated with 1/16-inch (1.5-mm) clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.

2.04 LEAD-LINED OBSERVATION WINDOW FRAMES

- A. General: Fabricate from 0.043-inch- (1.1-mm-) thick, formed-steel sheet or 0.064-inch- (1.6-mm-) thick aluminum extrusions with mitered corners, welded or bolted with concealed fasteners.
 - 1. Line with lead sheet formed to match frame contour, continuous in each jamb and across head and sill, lapping the stops, and fabricated wide enough to maintain an effective lap with lead of adjoining assemblies.
 - 2. Construct so lead lining overlaps glazing material perimeter by at least 3/8 inch (9.5 mm) and provide removable stops.
 - 3. Form sill with an opening for sound transmission. Offset sound passage to make opening lightproof and to maintain required lead equivalence at all points and in all directions.

2.05 INFORMATIONAL SIGNS

- A. Informational Signs, General:
 - 1. Provide copy indicated or as directed. Provide signs 3 x 4 inch metal plate, attached to each wall with the location and amount of shielding inscribed.
 - 2. Indicate lead equivalence in millimeters and heights of radiation protection in inches (millimeters).

2.06 DOOR AND DOOR FRAME FABRICATION

- A. Hardware Preparation: Factory prepare doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

2.07 SCHEDULE

- A. Lead thicknesses and equivalencies shall be as specified and scheduled by the "Hospital's Physicist" for each room and radiation source. Figure 1/16" lead minimum in all rooms until final Physicist Report is issued].

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates in areas to receive radiation protection, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF LEAD-LINED GYPSUM BOARD

- A. Install with long edge parallel to supports and lead lining facing supports. Provide blocking at end joints.
- B. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum board manufacturer. Install lead strips covering face of framing and wrap around flange to cover points of screws.
 - 1. Where possible, install lead-lined gypsum board before installing gypsum board on other side of partition, and do not fold lead strips back over inside of flange until after lead-lined gypsum board is applied.
 - 2. Apply lead disks recessed flush with surface of board over heads of screws securing trim.
- C. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum board manufacturer. Apply lead disks over screw heads and recess flush with surface of board.
 - 1. Install lead strips, 1-1/2 inches (38 mm) wide minimum and same thickness as lead lining, to face of supports and blocking where joints occur. Secure lead strips with construction adhesive. Provide shims at intermediate supports.
 - 2. Apply lead disks recessed flush with surface of board over heads of screws securing trim.
- D. Openings: Extend lead-lined gypsum board into frames of openings, lapping lead lining with lead frames or frame linings at least 1 inch (25 mm). Arrange board around openings so neither horizontal nor vertical joints occur at corners of openings.
- E. Install control and expansion joints where indicated, with appropriate trim accessories. Install lead strip on face of framing, extending across joint, and lap with lead lining of gypsum board.

3.03 INSTALLATION OF LEAD-LINED DOORS AND FRAMES

- A. Install lead-lined steel door frames according to Division 08 Section "Hollow Metal Doors and Frames."
 - 1. Apply a coat of asphalt mastic or paint to lead lining in door frames where lead will come in contact with masonry or grout.
- B. Install lead-lined wood doors according to Division 08 Section "Flush Wood Doors."
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with door manufacturer's written instructions.
- D. Frames: Comply with HMMA 840 unless otherwise indicated. Except for frames located in existing walls or partitions, place frames before constructing walls. Set frames accurately in position, plumb, and brace securely until permanent anchors are set.

1. Provide three anchors per jamb, located adjacent to hinge on hinge jamb and at corresponding heights on strike jamb.
 2. In masonry construction, use wire or T-strap anchors and apply a coat of asphalt mastic or paint to lead lining where lead will come in contact with masonry or grout.
 3. In metal stud construction, use wall anchors attached to studs with screws.
 4. In wood stud construction, use strap anchors attached to studs with screws.
- E. Lap lead lining of frames over lining in walls at least 1 inch (25 mm).
- F. Lead Lining of Frames: Line inside of frames with lead of thickness not less than that required in doors and walls where frames are used. Form lead to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch (25 mm).
- G. Install doors in frames level and plumb, aligned with frames and with uniform clearance at each edge.
- H. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Division 08 Section "Door Hardware" for other installation requirements.
- I. Touch up damaged finishes with compatible coating after sanding smooth.
- J. Operation: Rehang or replace doors that do not swing or operate freely. Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.04 INSTALLATION OF LEAD-LINED OBSERVATION WINDOWS

- A. Install observation windows according to manufacturer's written installation instructions.
1. Apply a coat of asphalt mastic or paint to lead lining in frames where lead will come in contact with masonry or grout.
- B. Install windows level, plumb, square, true to line, and anchored securely in place to structural support.
- C. Install leaded side of frame on radiation side of wall. Lap lead lining of frames over lining in walls at least 1 inch (25 mm).
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with manufacturer's written instructions.

3.05 INSTALLATION OF PENETRATING ITEMS

- A. At penetrations of lead linings, provide lead shields to maintain continuity of protection.
- B. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in assembly being penetrated.
- C. Secure shields at penetrations using adhesive or wire ties but not penetrating fasteners unless indicated on Drawings.
- D. Outlet Boxes and Conduit: Cover or line with lead sheet lapped over adjacent lead lining at least 1 inch (25 mm). Wrap conduit with lead sheet for a distance of not less than 10 inches (250 mm) from box.
- E. Duct Openings: Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition/ceiling equal to three times the largest opening dimension. Lap lead sheet with adjacent lead lining at least 1 inch (25 mm).
- F. Piping: Unless otherwise indicated, wrap piping with lead sheet for a distance of not less than 10 inches (250 mm) from point of penetration.

3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections after radiology equipment has been installed and placed in operating condition.

- B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.

END OF SECTION

SECTION 21 05 00
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Mechanical sleeve seals.
 - 3. Sleeves.
 - 4. Escutcheons.
 - 5. Grout.
 - 6. Coordination drawings.
 - 7. Project record drawings.
 - 8. TMS Asset Forms
 - 9. Trenching, excavating and backfilling.
 - 10. Fire-suppression equipment and piping demolition.
 - 11. Equipment installation requirements common to equipment sections.
 - 12. Painting and finishing.
 - 13. Concrete bases.
 - 14. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:

1. Mechanical sleeve seals.
2. Escutcheons.

1.05 QUALITY ASSURANCE

- A. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a results of these modifications shall be borne by the contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of fire suppression systems with exterior underground and overhead utilities and service. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- G. Sequence, coordinate, and integrate removal of existing equipment and material as required to maintain services for existing building and for portions of remodeled areas at all times.

1.08 SCHEDULING AND PHASING

- A. All fire suppression work shall be scheduled to meet project completion data. Fire suppression work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps as required to support phasing. Refer to phasing schedule on drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.

2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.04 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 1. Acceptable Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.

2.06 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

- B. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- C. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- D. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- E. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.07 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.08 COORDINATION DRAWINGS

- A. The Contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:
 - 1. Fire suppression piping routing including locations of valves, drops to sprinkler heads, risers, etc.
 - 2. Fire suppression equipment locations and clearances required.
- B. The Contractor shall submit the CAD generated drawings to HVAC contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by HVAC Contractor.
- C. The Contractor shall participate in coordination meetings when requested by HVAC Contractor.
- D. See General Conditions for additional coordination drawing requirements.

2.09 PROJECT RECORD DRAWINGS

- A. See General Conditions for project record drawings requirements.

2.10 TMS ASSET FORMS

- A. The Contractor shall populate and update Owner's TMS Asset forms for all areas renovated. This shall include listing information for all new equipment installed, existing equipment that is reused and deleting equipment removed during construction.

PART 3 - EXECUTION

3.01 TRENCHING, EXCAVATING AND BACKFILLING

- A. Excavate to required dimensions and depth. The trench excavation shall be in open cut from surface and shall be minimum width necessary to permit the placing of the pipe as required. Excess excavation shall be backfilled with crusher run rock. Such rocks shall be placed at the Contractor's expense. Lines shall be used to lay out trenches.
- B. All excavations shall be properly protected by the necessary bracing and timbers, to prevent any cave-ins or injury to adjacent improvements. The sides of the excavations shall be securely held by bracing or sheathing, which bracing or sheathing shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. Where adjacent improvements might be injured by the removal of such bracing, the braces shall be left in place to prevent such injury. The thickness of the sheathing and dimensions of the brass braces, shoes and miscellaneous supports to be used by the Contractor shall be of the type required to properly protect the sides of the trench and to prevent injurious cave-ins or erosions.
- C. The Contractor shall do all pumping and bailing necessary to keep all excavations free of water and shall provide for the uninterrupted flow of the surface water adjacent to the line of the work during the progress of the work. The Contractor shall inspect the ground where excavation is

required to ascertain the structure of the soil. Additional consideration will not be allowed for encountering rock, stone, old foundations or other unfavorable excavating conditions.

- D. The Contractor shall replace all existing walks, roads, street pavements, curbs, retaining walls, steps and miscellaneous work removed or damaged in connection with the utility service installation, whether or not the improvement is shown on the drawings. Such repairs shall be done to the satisfaction of the Architect. All street cuts shall be repaired in a manner meeting the approval of the Owner.
- E. In cases where existing water, sewer, electric, steam or other pipes are encountered, they shall not be displaced or disturbed unless necessary, in which case they shall promptly be replaced in good condition. All water, sewer, steam or electric lines damaged or disturbed in the construction shall be replaced or repaired at the Contractor's expense, unless, in the option of the Architect, such damage was caused through no fault of the Contractor.
- F. Contractor shall provide all temporary bridges, steel plates, barricades, lanterns, and such other signs and signals by day as shall be necessary to warn the public of and protect the public from the dangers caused by excavations and other obstructions, day and night.
- G. The backfilling of trenches shall be carried out as rapidly as the testing and acceptance of the finished sections of the installation will permit. The trench shall be backfilled in layers of not to exceed eight inches (8") with good selected clean earth, thoroughly tamped with mechanical tamper to a 95% optimum compaction. Density shall be tested by an approved laboratory, using a standard method. Tests shall be made for each 2 ft. depth on the basis of one test per 1000 sq. ft. of fill area. Last 12" of backfill (except under streets, drives, and walks) shall be made with good clean top soil. Contractor shall obtain and pay for tests. Submit five (5) copies of tests for approval. Note: Broken stones, cinders, wood and rubbish are not acceptable for backfilling. Backfill all street cuts in a manner meeting the approval of the Architect.
- H. In spaces between walls and line of excavation, fill with thin layers of selected clean earth; thoroughly tamp in eight inches (8") thick layers and bring up to a finished level of established grades. All wood and foreign materials shall be removed from excavation prior to backfilling.
- I. After backfilling, all surplus excavated materials shall be removed from the property.
- J. The work shall be executed so that existing culverts, walks, retaining walls, steps, fences or any permanent structure along and adjacent to the new work are properly protected. Any damage occurring to these structures shall be repaired by the Contractor at his own expense.
- K. The Contractor shall make a field inspection of the location along which the underground piping is to be constructed, and note all obstructions and improvements at the surface and overhead which may affect the method of operation in the construction of these lines. Such overhead wires and underground pipes or conduits which may exist, or which may be encountered, shall be protected by the Contractor during this construction. Any expense or inconvenience caused by their existence and the necessary protection for utilities adjacent thereto shall be considered as covered and included in the contract, without additional cost to the Owner.

3.02 FIRE-SUPPRESSION DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Generally remove piping up to existing mains or valves.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.03 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- 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 minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. 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. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, stamped-steel type with polished chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 2. Existing Piping: Use the following:

- a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - d. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - e. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" and General Conditions for additional requirements.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.04 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.05 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.08 GROUTING

- A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 21 05 48

VIBRATION AND SEISMIC CONTROLS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Restrained elastomeric isolation mounts.
 - 4. Restraining braces.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - 2. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- C. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC and NFPA 13 unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall be pre-approved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If pre-approved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- B. Pads Type A.1: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene or rubber.
- C. Mounts Type A.2: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Spring Isolators Type B.1: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to ¼-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. Elastomeric Hangers Type B.4: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

- F. Pipe Riser Resilient Support Type D.1: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of ½-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- G. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of ½-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 VIBRATION ISOLATION EQUIPMENT BASES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- B. Steel Base Type E.1: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base Type E.2: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 SEISMIC-RESTRAINT DEVICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.

2. Cooper B-Line, Inc.; a division of Cooper Industries.
 3. Hilti, Inc.
 4. Kinetics Noise Control.
 5. Mason Industries.
 6. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- E. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- F. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- G. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- H. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- I. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.04 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by providing required submittals for component.
- B. Piping Restraints:
 - 1. Comply with requirements in MSS SP-127 and NFPA 13.
 - 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 - 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- H. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE FOR SLAB ON GRADE LOCATED EQUIPMENT

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Fire Pumps	Floor	All sizes	E.1	A.2	0.25"
Piping – Horizontal	Suspended	All sizes	--	B.4	0.25"
Piping – Vertical	Floor	All sizes	--	D.1	0.25"
Notes: 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer. 2. Isolators indicated for horizontal piping is only for three (3) hangers on discharge/outlet and three (3) hangers on suction/inlet pipes for pumps, air compressors, vacuum pumps, and equipment mounted on type "B" isolators. Remaining piping does not require isolation.					

3.05 VIBRATION ISOLATOR AND SEISMIC – RESTRAINT SCHEDULE FOR EQUIPMENT LOCATED ABOVE GRADE

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Fire Pumps	Floor	All sizes	E.2	B.1	1"
Piping – Horizontal	Suspended	All sizes	--	B.4	0.25"
Piping – Vertical	Floor	All sizes	--	D.1	0.25"
Notes: 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer. 2. Isolators indicated for horizontal piping is only for three (3) hangers on discharge/outlet and three (3) hangers on suction/inlet pipes for pumps, air compressors, vacuum pumps, and equipment mounted on type "B" isolators. Remaining piping does not require isolation.					

END OF SECTION

SECTION 21 13 13
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Pipes, fittings, and specialties.
 - 2. Fire-protection valves.
 - 3. Fire-department connections.
 - 4. Sprinklers.
 - 5. Excess-pressure pumps.
 - 6. Alarm devices.
 - 7. Manual control stations.
 - 8. Control panels.
 - 9. Pressure gages.
- B. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Standpipes" for standpipe piping.
 - 2. Division 21 Section "Dry-Pipe Sprinkler Systems" for dry-pipe sprinkler piping.

1.03 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.05 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Contractor shall obtain fire-hydrant flow test records from authorities having jurisdiction.
- C. Sprinkler system design shall be approved by authorities having jurisdiction.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications According to NFPA 13 Unless Otherwise Noted:
 - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
 - b. Building Service Areas: Ordinary Hazard, Group 1.
 - c. Churches: Light Hazard.

- d. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
- e. General Storage Areas: Ordinary Hazard, Group 1.
- f. Libraries except Stack Areas: Light Hazard.
- g. Library Stack Areas: Ordinary Hazard, Group 2.
- h. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- i. Office and Public Areas: Light Hazard.
- j. Repair Garages: Ordinary Hazard, Group 2.
- k. Restaurant Service Areas: Ordinary Hazard, Group 1.
- 3. Minimum Density for Automatic-Sprinkler Piping Design According to NFPA 13 Unless Noted Otherwise:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 4. Minimum Density for Deluge-Sprinkler Piping Design:
 - a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over entire area.
 - b. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over entire area.
 - c. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over entire area.
 - d. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over entire area.
 - e. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 5. Maximum Protection Area per Sprinkler According to NFPA 13 Unless Noted Otherwise:
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
- 6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
- D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to minimum 1/4" scale, on CAD generated drawings. Refer to Section "Common Work Results for Fire Suppression".
- E. Qualification Data: For qualified Installer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
- G. Fire-hydrant flow test report.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping".
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13, "Installation of Sprinkler Systems".

1.08 PROJECT CONDITIONS

- A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:
 - 1. Notify Owner no fewer than ten days in advance of proposed interruption of sprinkler service.
 - 2. Do not proceed with interruption of sprinkler service without Owner's written permission.
 - 3. Contractor shall coordinate interruption of service with Owner on a daily basis.

1.09 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies. Refer to Section "Common Work Results for Fire Suppression" for details.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.01 PIPING MATERIALS

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

2.02 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, standard-weight, seamless steel pipe with threaded ends.
- C. Uncoated, Steel Couplings: ASTM A 865, threaded.
- D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- E. Malleable- or Ductile-Iron Unions: UL 860.
- F. Cast-Iron Flanges: ASME 16.1, Class 125.
- G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- I. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- J. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.03 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.04 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
 - 1. Valves shall be UL listed or FM approved.

2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
3. Minimum Pressure Rating for High-Pressure Piping: 250 psig.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Anvil International, Inc.
 2. Clow Valve Company; a division of McWane, Inc.
 3. Crane Co.; Crane Valve Group; Crane Valves.
 4. Fire Protection Products, Inc.
 5. Globe Fire Sprinkler Corporation.
 6. Kennedy Valve; a division of McWane, Inc.
 7. Metraflex, Inc.
 8. Milwaukee Valve Company.
 9. Mueller Co.; Water Products Division.
 10. NIBCO INC.
 11. Potter Roemer.
 12. Reliable Automatic Sprinkler Co., Inc.
 13. Tyco Fire & Building Products LP.
 14. Victaulic Company.
 15. Viking Corporation.
 16. Watts Water Technologies, Inc.
- C. Ball Valves:
 1. Standard: UL 1091 except with ball instead of disc.
 2. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
 3. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
 4. Valves NPS 3: Ductile-iron body with grooved ends.
- D. Bronze Butterfly Valves:
 1. Standard: UL 1091.
 2. Pressure Rating: 175 psig.
 3. Body Material: Bronze.
 4. End Connections: Threaded.
- E. Iron Butterfly Valves:
 1. Standard: UL 1091.
 2. Pressure Rating: 175 psig.
 3. Body Material: Cast or ductile iron.
 4. Style: Lug or wafer.
 5. End Connections: Grooved.
- F. Check Valves:
 1. Standard: UL 312.
 2. Pressure Rating: 250 psig minimum.
 3. Type: Swing check.

4. Body Material: Cast iron.
5. End Connections: Flanged or grooved.
- G. Bronze OS&Y Gate Valves:
 1. Standard: UL 262.
 2. Pressure Rating: 175 psig.
 3. Body Material: Bronze.
 4. End Connections: Threaded.
- H. Iron OS&Y Gate Valves:
 1. Standard: UL 262.
 2. Pressure Rating: 250 psig minimum.
 3. Body Material: Cast or ductile iron.
 4. End Connections: Flanged or grooved.
- I. Indicating-Type Butterfly Valves:
 1. Standard: UL 1091.
 2. Pressure Rating: 175 psig minimum.
 3. Valves NPS 2 and Smaller:
 - a. Valve Type: Ball or butterfly.
 - b. Body Material: Bronze.
 - c. End Connections: Threaded.
 4. Valves NPS 2-1/2 and Larger:
 - a. Valve Type: Butterfly.
 - b. Body Material: Cast or ductile iron.
 - c. End Connections: Flanged, grooved, or wafer.
 5. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.
- J. NRS Gate Valves:
 1. Standard: UL 262.
 2. Pressure Rating: 250 psig minimum.
 3. Body Material: Cast iron with indicator post flange.
 4. Stem: Nonrising.
 5. End Connections: Flanged or grooved.

2.05 SPECIALTY VALVES

- A. General Requirements:
 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 2. Pressure Rating:
 - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
 3. Body Material: Cast or ductile iron.
 4. Size: Same as connected piping.
 5. End Connections: Flanged or grooved.

- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc.
 - 3. Tyco Fire & Building Products LP.
 - 4. Victaulic Company.
 - 5. Viking Corporation.
- C. Alarm Valves:
 - 1. Standard: UL 193.
 - 2. Design: For horizontal or vertical installation.
 - 3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
 - 4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
 - 5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

2.06 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
 - 1. Standard: UL 213.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 4. Type: Mechanical-T and -cross fittings.
 - 5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 7. Branch Outlets: Grooved, plain-end pipe, or threaded.
- B. Flow Detection and Test Assemblies:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
 - 4. Size: Same as connected piping.
 - 5. Inlet and Outlet: Threaded.
- C. Branch Line Testers:
 - 1. Standard: UL 199.
 - 2. Pressure Rating: 175 psig.
 - 3. Body Material: Brass.
 - 4. Size: Same as connected piping.
 - 5. Inlet: Threaded.
 - 6. Drain Outlet: Threaded and capped.
 - 7. Branch Outlet: Threaded, for sprinkler.

- D. Sprinkler Inspector's Test Fittings:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Body Material: Cast- or ductile-iron housing with sight glass.
 - 4. Size: Same as connected piping.
 - 5. Inlet and Outlet: Threaded.
- E. Adjustable Drop Nipples:
 - 1. Standard: UL 1474.
 - 2. Pressure Rating: 250 psig minimum.
 - 3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
 - 4. Size: Same as connected piping.
 - 5. Length: Adjustable.
 - 6. Inlet and Outlet: Threaded.

2.07 SPRINKLERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Globe Fire Sprinkler Corporation.
 - 2. Reliable Automatic Sprinkler Co., Inc.
 - 3. Tyco Fire & Building Products LP.
 - 4. Victaulic Company.
 - 5. Viking Corporation.
- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Type: All sprinklers shall be quick response type.
 - 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.
- D. Open Sprinklers with Heat-Responsive Element Removed: UL 199.
 - 1. Characteristics:
 - a. Nominal 1/2-inch Orifice: With Discharge Coefficient K between 5.3 and 5.8.
- E. Sprinkler Finishes:
 - 1. Chrome plated.
 - 2. Bronze.
 - 3. Painted.

- F. Special Coatings:
 - 1. Wax.
 - 2. Lead.
 - 3. Corrosion-resistant paint.
- G. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- H. Sprinkler Guards:
 - 1. Standard: UL 199.
 - 2. Type: Wire cage with fastening device for attaching to sprinkler.

2.08 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm Bell:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 - 2. Standard: UL 464.
 - 3. Type: Vibrating, metal alarm bell.
 - 4. Size: 6-inch minimum diameter.
 - 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Water-Flow Indicators:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 - f. Watts Industries (Canada) Inc.
 - 2. Standard: UL 346.
 - 3. Water-Flow Detector: Electrically supervised.
 - 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 - 5. Type: Paddle operated.
 - 6. Pressure Rating: 250 psig.
 - 7. Design Installation: Horizontal or vertical.

D. Pressure Switches:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Detroit Switch, Inc.
 - b. Potter Electric Signal Company.
 - c. System Sensor; a Honeywell company.
 - d. Tyco Fire & Building Products LP.
 - e. United Electric Controls Co.
 - f. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

E. Valve Supervisory Switches:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

F. Indicator-Post Supervisory Switches:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Potter Electric Signal Company.
 - b. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled indicator-post valve is in other than fully open position.

2.09 PRESSURE GAGES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AMETEK; U.S. Gauge Division.
 2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.

- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 250 psig.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" and "DATE" label on dial face.

2.10 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One-Piece, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with set-screws.
- C. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One-Piece, Stamped-Steel Escutcheons: Chrome-plated finish with set-screw or spring clips.
- E. Split-Casting, Cast-Brass Escutcheons: Polished chrome-plated or rough-brass finish with concealed hinge and set-screw.
- F. Split-Plate, Stamped-Steel Escutcheons: Chrome-plated finish with concealed hinge, set-screw or spring clips.
- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 SLEEVES

- A. Cast-Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set-screws.

2.12 SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 2. Pressure Plates: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.13 GROUT

- A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping. Comply with requirements for interior piping in Division 22 Section "Domestic Water Piping."
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping. Comply with requirements for backflow preventers in Division 22 Section "Domestic Water Piping Specialties."
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

3.3 PIPING INSTALLATION

- A. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- B. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Pressurize and check preaction sprinkler system piping and air-pressure maintenance devices.
- N. Fill sprinkler system piping with water.

- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Division 21 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Division 21 Section "Fire-Suppression Systems Insulation."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. 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.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- L. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- M. 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.
- N. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.05 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.7 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish or stamped steel with set-screw or spring clips.
 5. Bare Piping in Equipment Rooms: One piece, cast brass stamped steel with set-screw or spring clips.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
- C. Escutcheons for Existing Piping:
 1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass rough-brass finish plate, stamped steel with concealed hinge and set-screw or spring clips.
 6. Bare Piping in Equipment Rooms: Split casting, cast brass plate, stamped steel with set-screw or spring clips.
 7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.8 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
 - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
 - 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
 - 4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE or Galvanized-steel pipe.
 - 5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - 6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- L. 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 firestop materials and installations in Division 07 Section "Penetration Firestopping."

3.9 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.10 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Install self-adhesive, preprinted vinyl labels on ceiling grid to identify location of fire sprinkler valves and miscellaneous equipment above. All fire sprinkler system labels shall be red in color with black lettering matching the Owner's standards.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Start and run excess-pressure pumps.
 - 6. Coordinate with fire-alarm tests. Operate as required.
 - 7. Coordinate with fire-pump tests. Operate as required.
 - 8. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.

3.13 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.14 PIPING SCHEDULE

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Copper-tube, extruded-tee connections may be used for tee branches in copper tubing instead of specified copper fittings. Branch-connection joints must be brazed.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.

3. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 4. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- E. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:
1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 2. Standard-weight, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 3. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.15 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright sprinklers.
 2. Rooms with Suspended Ceilings: Concealed sprinklers.
 3. Wall Mounting: Sidewall sprinklers.
 4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
 5. Special Applications: Extended-coverage, flow-control, sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 4. Upright, Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Coordination drawings.
 - 9. Project record drawings.
 - 10. TMS Asset Forms
 - 11. Trenchings, excavating and backfilling.
 - 12. Plumbing demolition.
 - 13. Equipment installation requirements common to equipment sections.
 - 14. Painting and finishing.
 - 15. Concrete bases.
 - 16. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
 - 2. CPVC: Chlorinated polyvinyl chloride plastic.
 - 3. PE: Polyethylene plastic.
 - 4. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a result of these modifications shall be borne by the Contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.
- C. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- D. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

- F. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- G. Sequence, coordinate, and integrate removal of existing equipment and material as required to maintain services for existing building and for portions of remodeled areas at all times.

1.08 SCHEDULING AND PHASING

- A. All plumbing work shall be scheduled to meet project completion date. Plumbing work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps as required to support phasing. Refer to phasing schedule on drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.
 - 2. CPVC Piping: ASTM F 493.
 - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 4. PVC to ABS Piping Transition: ASTM D 3138.

- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.04 TRANSITION FITTINGS

- A. Acceptable Manufacturers:
 - 1. Cascade Waterworks Mfg. Co.
 - 2. Dresser Industries, Inc.; DMD Div.
 - 3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - 4. JCM Industries.
 - 5. Smith-Blair, Inc.
 - 6. Viking Johnson.
- B. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 - 2. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 - 3. Aboveground Pressure Piping: Pipe fitting.
- C. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- E. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
- F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Acceptable Manufacturers:
 - 1. Capitol Manufacturing Co.
 - 2. Calpico, Inc.
 - 3. Epco Sales, Inc.
 - 4. Hart Industries, International, Inc.
 - 5. Lochinvar Corp.
 - 6. Watts Industries, Inc.; Water Products Div.
 - 7. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

- F. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Acceptable Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.08 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 COORDINATION DRAWINGS

- A. The contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:
 - 1. Plumbing piping routing including locations of valves, drops to fixtures, risers, etc.
 - 2. Plumbing equipment locations and clearances required.
 - 3. Medical gas piping routing including locations of zone valves, area valves, drops to outlets, risers, etc.
 - 4. Medical gas equipment locations and clearances required.
- B. The contractor shall submit the CAD generated drawings to mechanical contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by HVAC Contractor.
- C. The contractor shall participate in coordination meetings when requested by HVAC Contractor.
- D. See General Conditions for project coordination drawing requirements.

2.11 PROJECT RECORD DRAWINGS

- A. See General Conditions for project record drawings requirements.

2.12 TMS ASSET FORMS

- A. The Contractor shall populate and update Owner's TMS Asset forms for all areas renovated. This shall include listing information for all new equipment installed, existing equipment that is reused and deleting equipment removed during construction.

PART 3 - EXECUTION

3.01 TRENCHING, EXCAVATING AND BACKFILLING

- A. Excavate to required dimensions and depth. The trench excavation shall be in open cut from surface and shall be minimum width necessary to permit the placing of the pipe as required. Excess excavation shall be backfilled with crusher run rock. Such rocks shall be placed at the Contractor's expense. Lines shall be used to lay out trenches.
- B. All excavations shall be properly protected by the necessary bracing and timbers, to prevent any cave-ins or injury to adjacent improvements. The sides of the excavations shall be securely held by bracing or sheathing, which bracing or sheathing shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. Where adjacent improvements might be injured by the removal of such bracing, the braces shall be left in place to prevent such injury. The thickness of the sheathing and dimensions of the brass braces, shoes and miscellaneous supports to be used by the Contractor shall be of the type required to properly protect the sides of the trench and to prevent injurious cave-ins or erosions.

- C. The Contractor shall do all pumping and bailing necessary to keep all excavations free of water and shall provide for the uninterrupted flow of the surface water adjacent to the line of the work during the progress of the work. The Contractor shall inspect the ground where excavation is required to ascertain the structure of the soil. Additional consideration will not be allowed for encountering rock, stone, old foundations or other unfavorable excavating conditions.
- D. The Contractor shall replace all existing walks, roads, street pavements, curbs, retaining walls, steps and miscellaneous work removed or damaged in connection with the utility service installation, whether or not the improvement is shown on the drawings. Such repairs shall be done to the satisfaction of the Architect. All street cuts shall be repaired in a manner meeting the approval of the Owner.
- E. In cases where existing water, sewer, electric, steam or other pipes are encountered, they shall not be displaced or disturbed unless necessary, in which case they shall promptly be replaced in good condition. All water, sewer, steam or electric lines damaged or disturbed in the construction shall be replaced or repaired at the Contractor's expense, unless, in the opinion of the Architect, such damage was caused through no fault of the Contractor.
- F. Contractor shall provide all temporary bridges, steel plates, barricades, lanterns, and such other signs and signals by day as shall be necessary to warn the public of and protect the public from the dangers caused by excavations and other obstructions, day and night.
- G. The backfilling of trenches shall be carried out as rapidly as the testing and acceptance of the finished sections of the installation will permit. The trench shall be backfilled in layers of not to exceed eight inches (8") with good selected clean earth, thoroughly tamped with mechanical tamper to a 95% optimum compaction. Density shall be tested by an approved laboratory, using a standard method. Tests shall be made for each 2 ft. depth on the basis of one test per 1000 sq. ft. of fill area. Last 12" of backfill (except under streets, drives, and walks) shall be made with good clean top soil. Contractor shall obtain and pay for tests. Submit five (5) copies of tests for approval. Note: Broken stones, cinders, wood and rubbish are not acceptable for backfilling. Backfill all street cuts in a manner meeting the approval of the Architect.
- H. In spaces between walls and line of excavation, fill with thin layers of selected clean earth; thoroughly tamp in eight inches (8") thick layers and bring up to a finished level of established grades. All wood and foreign materials shall be removed from excavation prior to backfilling.
- I. After backfilling, all surplus excavated materials shall be removed from the property.
- J. The work shall be executed so that existing culverts, walks, retaining walls, steps, fences or any permanent structure along and adjacent to the new work are properly protected. Any damage occurring to these structures shall be repaired by the Contractor at his own expense.
- K. The Contractor shall make a field inspection of the location along which the underground piping is to be constructed, and note all obstructions and improvements at the surface and overhead which may affect the method of operation in the construction of these lines. Such overhead wires and underground pipes or conduits which may exist, or which may be encountered, shall be protected by the Contractor during this construction. Any expense or inconvenience caused by their existence and the necessary protection for utilities adjacent thereto shall be considered as covered and included in the contract, without additional cost to the Owner.

3.02 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
 - 1. Piping to be Removed: Removed portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Generally remove piping up to existing mains or valves.

2. Piping to be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Cap behind walls, chases, or shafts or flush with floor. Patch surfaces to match existing adjacent surfaces.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment from project site.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.03 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- 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 minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access. In general install piping tight to slab, beams, joists and structural members if possible.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. 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 with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.

- f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Draining and Refilling of Systems: Provide all shutoff valves, drain valves, pipe, fittings, and miscellaneous material required to drain each existing system as required for new work. After new work is completed, tested, and found tight, refill each system as required. Time for shutting down existing system for draining shall be coordinated with all other work and with Owner's representative. Cost for all chemicals and additives for refill shall be borne by the Contractor.

3.04 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic 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. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. 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.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.05 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.07 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.08 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete".

3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.10 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 22 05 23
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Bronze ball valves.
 - 3. Iron, single-flange butterfly valves.
 - 4. Bronze swing check valves.
 - 5. Iron swing check valves.
 - 6. Iron, center-guided check valves.
 - 7. Bronze globe valves.
 - 8. Chainwheels.
- B. Related Sections:
 - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
 - 3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.03 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.
- G. SWP: Steam working pressure.

1.04 SUBMITTALS

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

1.05 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 B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than 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 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
 - 4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every ten (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 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. Grooved: With grooves according to AWWA C606.
 - 3. Solder Joint: With sockets according to ASME B16.18.
 - 4. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE ANGLE VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Co., Crane Valve Group
 - 2. Hammond Valve.
 - 3. Milwaukee Valve Company.
 - 4. NIBCO Inc.
- B. Class 150, Bronze Angle Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - 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.

2.03 BRONZE BALL VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve, Inc.
 - 2. Conbraco Industries, Inc.; Apollo Valves.
 - 3. Crane Co.; Crane Valve Group; Crane Valves.
 - 4. Hammond Valve.
 - 5. Milwaukee Valve Company.
 - 6. NIBCO INC.
 - 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
 - 1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.04 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Conbraco Industries, Inc.; Apollo Valves.
 - 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 3. Crane Co.; Crane Valve Group; Stockham Division.
 - 4. DeZurik Water Controls.
 - 5. Hammond Valve.
 - 6. Milwaukee Valve Company.
 - 7. NIBCO INC.
 - 8. Spence Strainers International; a division of CIRCOR International, Inc.
 - 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated or -coated ductile iron.

2.05 BRONZE SWING CHECK VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve, Inc.
 - 2. Crane Co.; Crane Valve Group; Crane Valves.
 - 3. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4. Crane Co.; Crane Valve Group; Stockham Division.
 - 5. Hammond Valve.
 - 6. Milwaukee Valve Company.

7. NIBCO Inc.
8. Powell Valves.
9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 150, Bronze Swing Check Valves with Bronze Disc:
 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.06 IRON SWING CHECK VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Division.
 4. Hammond Valve.
 5. Milwaukee Valve Company.
 6. NIBCO Inc.
 7. Powell Valves.
 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, Iron Swing Check Valves with Metal Seats:
 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
- C. Class 250, Iron Swing Check Valves with Metal Seats:
 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

2.07 IRON, CENTER-GUIDED CHECK VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anvil International, Inc.
 - 2. Hammond Valve.
 - 3. Metraflex, Inc.
 - 4. Milwaukee Valve Company.
 - 5. Mueller Steam Specialty; a division of SPX Corporation.
 - 6. NIBCO INC.
 - 7. Spence Strainers International; a division of CIRCOR International, Inc.
 - 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: Bronze.
- C. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - d. Style: Compact wafer.
 - e. Seat: EPDM or NBR.

2.08 BRONZE GLOBE VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Crane Co.; Crane Valve Group; Stockham Division.
 - 3. Hammond Valve.
 - 4. Milwaukee Valve Company.
 - 5. NIBCO Inc.
 - 6. Powell Valves.
 - 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.

- d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- C. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - 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: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- D. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - 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.

2.09 CHAINWHEELS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile iron of type and size required for valve. Include zinc coating.
 - 4. Chain: Hot-dip, galvanized steel of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves 6 inches and larger and more than 96 inches above floor. Extend chains to 60 inches 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. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.03 ADJUSTING

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

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, gate, or plug valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service: Globe or angle, ball, or butterfly valves.
 - 4. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 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.
 - c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.
- B. Pressure ratings for valves shall not be less than as required by system pressures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- D. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 and Larger: Flanged ends.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

3.05 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 150, bronze disc.
 - 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 4. Bronze Swing Check Valves: Class 150, bronze disc.
 - 5. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze or ductile-iron disc.
 - 2. Iron Swing Check Valves: Class 150 or Class 250, metal seats.
 - 3. Iron, Center-Guided Check Valves: Class 150, compact-wafer, metal or resilient seat.
 - 4. Iron Globe Valves: Class 150 or Class 250.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Pipe positioning systems.
 - 10. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.
 - 3. Division 22 Section "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
 - 4. Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.03 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.
 - 5. Pipe positioning systems.
- B. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Acceptable Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Carpenter & Paterson, Inc.
 - 3. Empire Industries, Inc.
 - 4. Globe Pipe Hanger Products, Inc.
 - 5. Grinnell Corp.
 - 6. GS Metals Corp.
 - 7. National Pipe Hanger Corporation.
 - 8. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.03 TRAPEZE PIPE HANGERS

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

2.04 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
 - 1. Acceptable Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Champion Fiberglass, Inc.
 - c. Cope, T. J., Inc.; Tyco International, Ltd.
 - d. Unistrut Corp.; Tyco International, Ltd.
- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
 - 1. Acceptable Manufacturers:
 - a. Plasti-Fab, Inc.

2.05 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Acceptable Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. GS Metals Corp.
 - 3. Power-Strut Div.; Tyco International, Ltd.
 - 4. Thomas & Betts Corporation.
 - 5. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 FIBERGLASS STRUT SYSTEMS

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.
- B. Acceptable Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Champion Fiberglass, Inc.
 - 3. Cope, T. J., Inc.; Tyco International Ltd.

2.07 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Acceptable Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. PHS Industries, Inc.
 - 3. Pipe Shields, Inc.
 - 4. Rilco Manufacturing Company, Inc.
 - 5. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.08 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Acceptable Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.09 PIPE STAND FABRICATION

- A. Pipe Stands, General: 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 or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Base: Plastic or Stainless steel.
 - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Bases: One or more plastic.
 - 2. Vertical Members: Two or more protective-coated-steel channels.
 - 3. Horizontal Member: Protective-coated-steel channel.
 - 4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.10 PIPE POSITIONING SYSTEMS

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

2.11 EQUIPMENT SUPPORTS

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

2.12 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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

3.01 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 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 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. 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 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- I. 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.
- J. 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.
- K. 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 absorb 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 absorb 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 absorb 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- G. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. 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.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. 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.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- Q. Insulated Piping: Comply with the following:
 - 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 according to 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: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

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

3.06 PAINTING

- A. Touch Up: 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 minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 22 05 48

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Freestanding spring isolators.
 - 4. Elastomeric hangers.
 - 5. Spring hangers.
 - 6. Pipe riser resilient supports.
 - 7. Resilient pipe guides.
 - 8. Seismic snubbers.
 - 9. Restraining braces and cables.
 - 10. Steel and inertia, vibration isolation equipment bases.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
 - 2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- C. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall be preapproved by agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. Kinetics Noise Control.
 3. Mason Industries.
 4. Vibration Eliminator Co., Inc.
 5. Vibration Isolation.
 6. Vibration Mountings & Controls, Inc.
- B. Pads Type A.1: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 1. Resilient Material: Oil- and water-resistant neoprene or rubber.

- C. Mounts Type A.2: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Spring Isolators Type B.1: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. Elastomeric Hangers Type B.4: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.
- F. Spring Hangers Type B.5: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- G. Pipe Riser Resilient Support Type D.1: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

- H. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 VIBRATION ISOLATION EQUIPMENT BASES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- B. Steel Base Type E.1: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base Type E.2: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 SEISMIC-RESTRAINT DEVICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 3. Hilti, Inc.

4. Kinetics Noise Control.
 5. Mason Industries.
 6. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four (4) times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.04 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment Restraints:
 1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches.
 3. Install seismic-restraint devices using methods approved by authorities having jurisdiction providing required submittals for component.
- B. Piping Restraints:
 1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install seismic-restraint devices using methods approved by authorities having jurisdiction providing required submittals for component.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

3.05 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of sprint isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.06 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE FOR SLAB ON GRADE LOCATED EQUIPMENT

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Hot Water Heaters (Vertical or Horizontal)	Floor	All sizes	--	A.1	0.25"
Water Softening/RO System/ DI System Equipment	Floor	All sizes	--	A.1	0.25"
Centrifugal Pumps, Booster Pumps	Floor	Up to 10 HP	E.1	A.2	0.25"
	Floor	Above 10 HP	E.2	B.1	0.75"
	Suspended	All sizes	--	B.5	0.25"
Air Compressors	Floor	All sizes	E.1	B.1	1.0"
Vacuum Pumps	Floor	All sizes	E.1	B.1	1.0"
Piping – Horizontal	Suspended	All sizes	--	B.4	0.25"
Piping – Vertical	Floor	All sizes	--	D.1	0.25"
Notes: 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer. 2. Isolators indicated for horizontal piping is only for three (3) hangers on discharge/outlet and three (3) hangers on suction/inlet pipes for pumps, air compressors, vacuum pumps, and equipment mounted on type "B" isolators. Remaining piping does not require isolation.					

3.07 VIBRATION ISOLATOR AND SEISMIC – RESTRAINT SCHEDULE FOR EQUIPMENT LOCATED ABOVE GRADE

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Hot Water Heaters (Vertical or Horizontal)	Floor	All sizes	--	A.1	0.25"
Water Softening/RO System/ DI System Equipment	Floor	All sizes	--	A.1	0.25"
Centrifugal Pumps, Booster Pumps	Floor	All sizes	E.2	B.1	1"
	Suspended	All sizes	-	B.5	0.25"
Air Compressors	Floor	All sizes	E.2	B.2	1.0"
Vacuum Pumps	Floor	All sizes	E.2	B.2	1.0"
Piping – Horizontal	Suspended	All sizes	--	B.4	0.25"
Piping – Vertical	Floor	All sizes	--	D.1	0.25"
Notes: 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer. 2. Isolators indicated for horizontal piping is only for three (3) hangers on discharge/outlet and three (3) hangers on suction/inlet pipes for pumps, air compressors, vacuum pumps, and equipment mounted on type "B" isolators. Remaining piping does not require isolation.					

END OF SECTION

SECTION 22 05 53
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 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.

1.04 COORDINATION

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

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 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.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/2 inch 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 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 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.

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/2 inch 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 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.

2.03 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 partially cover 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 high.

2.04 STENCILS

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

2.05 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch 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 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.

2.06 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches.
 - 2. Fasteners: Reinforced grommet and wire or string.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

2.07 CEILING GRID LABELS

- A. Self-Adhesive Vinyl Labels for valves and equipment: Minimum 1/2" preprinted, flexible label to match Owner's standards. Color as directed.

PART 3 - EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

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

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "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 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment and within mechanical rooms, boiler rooms, chiller rooms, etc.
 7. On piping above removable acoustical ceilings.
- D. Pipe Label Color Schedule:
1. Low-Pressure, Compressed-Air Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: White.
 2. Medium-Pressure, Compressed-Air Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: White.
 3. Domestic Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 4. Sanitary Waste and Storm Drainage Piping:
 - a. Background Color: Black.
 - b. Letter Color: White.

3.04 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, round.
 - b. Hot Water: 1-1/2 inches.
 - c. Low-Pressure Compressed Air: 1-1/2 inches.
 - d. High-Pressure Compressed Air: 1-1/2 inches.
 2. Valve-Tag Color:
 - a. Cold Water: Natural.
 - b. Hot Water: Natural.
 - c. Low-Pressure Compressed Air: Natural.
 - d. High-Pressure Compressed Air: Natural.

3. Letter Color:
 - a. Cold Water: Black.
 - b. Hot Water: Black.
 - c. Low-Pressure Compressed Air: Black.
 - d. High-Pressure Compressed Air: Black.

3.05 WARNING-TAG INSTALLATION

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

3.06 CEILING GRID LABELS

- A. Install ceiling grid labels for all equipment located above ceilings such as domestic water valves, medical gas valves and miscellaneous equipment. Color of labels shall match owner's standards.

END OF SECTION

SECTION 22 07 00
PLUMBING INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Cellular glass.
 - b. Flexible elastomeric.
 - c. Mineral fiber.
 - d. Molded Close Cell.
 - 2. Insulating cements.
 - 3. Adhesives.
 - 4. Mastics.
 - 5. Lagging adhesives.
 - 6. Sealants.
 - 7. Factory-applied jackets.
 - 8. Field-applied fabric-reinforcing mesh.
 - 9. Field-applied cloths.
 - 10. Field-applied jackets.
 - 11. Tapes.
 - 12. Securements.
 - 13. Corner angles.
- B. Related Sections include the following:
 - 1. Division 21 Section "Fire-Suppression Systems Insulation."
 - 2. Division 23 Section "HVAC Insulation."

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, 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 attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.
 - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 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. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cell-U-Foam Corporation.
 - b. Pittsburgh Corning Corporation.
 - 2. Block Insulation: ASTM C 552, Type I.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 8. Density: 7.5 lbs/cu. ft.
 - 9. Thermal Conductivity: Not exceeding 0.30 BTU – in/hour sq. ft. °F at 75°F mean temperature.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. NOMACO Insulation.
 - 2. Thermal Conductivity: Not exceeding 0.25 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- 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 equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning; Fiberglas Corp.
 - 2. Density: 3 lbs/cu. ft.
 - 3. Thermal Conductivity: Not exceeding 0.23 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- I. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville.

- b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning Fiberglas Corp.
 - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 3. Thermal Conductivity: Not exceeding 0.23 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- J. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning Fiberglas Corp.
 - 2. Density: 2.5 lbs/cu. ft.
 - 3. Thermal Conductivity: Not exceeding 0.27 BTU-in/hour °F at 75°F mean temperature.
- K. Molded Close Cell Insulation: Soft resilient molded vinyl with internal ribs complying with ASTM G21 and G22 for bacteria/fungus growth.
- 1. Acceptable Manufacturers: Subject to compliance with requirements provide product by IFS Corporation; Truebro.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. Foster Products Corporation, H. B. Fuller Company.
 - c. Marathon Industries, Inc.
 - d. Mon-Eco Industries, Inc.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LCC.
 - c. Foster Products Corporation, H. B. Fuller Company.
 - d. RBX Corporation.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. Foster Products Corporation, H. B. Fuller Company.
 - c. ITW TACC, Division of Illinois Tool Works.
 - d. Marathon Industries, Inc.
 - e. Mon-Eco Industries, Inc.
 - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. Foster Products Corporation, H. B. Fuller Company.
 - c. ITW TACC, Division of Illinois Tool Works.
 - d. Marathon Industries, Inc.
 - e. Mon-Eco Industries, Inc.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. Johns-Manville; Zeston Perma-Weld.
 - c. P.I.C. Plastics, Inc.
 - d. Speedline Corporation.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-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. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Childers Products, Division of ITW.
 - 2. Foster Products Corporation, H. B. Fuller Company.
 - 3. ITW TACC, Division of Illinois Tool Works.
 - 4. Marathon Industries, Inc.
 - 5. Mon-Eco Industries, Inc.
- C. Vapor-Barrier Mastic: Water or solvent based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.05 perm at 43-mi dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 3. Solids Content: 63 percent by volume and 73 percent by weight.
 - 4. Color: White.

2.05 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
 - 1. 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. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. Foster Products Corporation, H. B. Fuller Company.
 - c. Marathon Industries, Inc.
 - d. Mon-Eco Industries, Inc.
 - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
 - 4. Service Temperature Range: Minus 50 to plus 180 deg F.
 - 5. Color: White.

2.06 SEALANTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Childers Products, Division of ITW.
 - 2. Foster Products Corporation, H. B. Fuller Company.
 - 3. Marathon Industries, Inc.
 - 4. Mon-Eco Industries, Inc.
 - 5. Pittsburgh Corning Corporation.

- B. Joint Sealants for Cellular-Glass:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Permanently flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 - 4. Color: White or gray.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. FSK and Metal Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: Aluminum.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 2. Fire- and water-resistant, flexible, elastomeric sealant.
 - 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 4. Color: White.
 - 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM 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.

2.08 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

2.09 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. 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. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville.
 - b. P.I.C. Plastics, Inc.

- c. Proto PVC Corporation.
 - d. Speedline Corporation.
 - 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.
 - 5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. PABCO Metals Corporation.
 - c. RPR Products, Inc.
 - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and Kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and Kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 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.
 - 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and Kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and Kraft paper.

e. Factory-Fabricated Fitting Covers:

- 1) Same material, finish, and thickness as jacket.
- 2) Preformed 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.

2.10 TAPES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Avery Dennison Corporation, Specialty Tapes Division.
 2. Compac Corp.
 3. Ideal Tape Co., Inc., an American Biltrite Company.
 4. Venture Tape.
- B. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- C. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

2.11 SECUREMENTS

- A. Bands:
1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 3. 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-diameter shank, length to suit depth of insulation indicated.
 - 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment 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.

3.02 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.
- 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.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and 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-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape as recommended by insulation material manufacturer 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 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. Manholes.
 - 5. Handholes.
 - 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at 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.
 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 Division 07 Section "Penetration 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 Division 07 Section "Penetration Firestopping."

3.05 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, 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, vessels, and equipment. 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.

3.06 CELLULAR-GLASS INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 - 1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 - 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 - 3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.
 - 4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but 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, 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.

3.07 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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.

3.08 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.09 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 - 1. Draw jacket material smooth and tight.
 - 2. Install lap or joint strips with same material as jacket.
 - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch 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 overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Inspect field-insulated equipment, 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 (1) location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three (3) locations of straight pipe, locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 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.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water and Domestic Chilled Water (Potable):
 - 1. NPS 2 and Smaller: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
 - 2. NPS 2-1/2 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- C. Stormwater and Overflow:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 1 inch thick.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Molded Closed Cell: 1/2 inch thick.
- F. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
- G. Condensate, Drinking Fountain Waste and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- H. Floor Drains/Floor Sinks Bodies and Traps Located in Mechanical Rooms, and Sanitary Drain Piping, from these drains/sinks, up to main risers:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- B. Domestic Hot and Recirculated Hot Water:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

- C. Sanitary Waste Piping Where Heat Tracing Is Installed:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.15 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Loose-fill insulation, for belowground piping, is specified in Division 33 piping distribution Sections.

3.16 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. Equipment, Concealed:
 - 1. None.
- D. Equipment, Exposed:
 - 1. None.
- E. Piping, Concealed:
 - 1. None.
- F. Piping, Exposed:
 - 1. Aluminum, Smooth: 0.016 inch thick.
 - 2. Stainless Steel, Type 304, Smooth 2B Finish: 0.016 inch thick, for piping located in kitchen areas.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
 - 1. None.
- D. Equipment, Exposed:
 - 1. Aluminum, Corrugated with Z-Shaped Locking Seam: 0.016 inch thick.
- E. Piping, Concealed:
 - 1. None.
- F. Piping, Exposed:
 - 1. Aluminum, Corrugated with Z-Shaped Locking Seam: 0.016 inch thick.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Specialty valves.
 - 2. Flexible connectors.
 - 3. Escutcheons.
 - 4. Sleeves and sleeve seals.
 - 5. Wall penetration systems.

1.03 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Escutcheons.
 - 6. Sleeves and sleeve seals.
 - 7. Water penetration systems.

- B. Field quality-control reports.

1.04 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.

1.05 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 - 1. Notify Architect no fewer than seven (7) days in advance of proposed interruption of water service.
 - 2. Do not proceed with interruption of water service without Architect's written permission.

1.06 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.01 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.

2.02 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
 - 5. Copper-Tube Extruded-Tee Connections:
 - a. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) T-DRILL Industries Inc.
 - b. Description: Tee formed in copper tube according to ASTM F 2014.
 - 6. Grooved-Joint Copper-Tube Appurtenances:
 - a. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Anvil International.
 - 2) Shurjoint Piping Products.
 - 3) Victaulic Company.
 - b. Copper Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 - c. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, EPDM-rubber gaskets suitable for hot and cold water, and bolts and nuts.
- B. Soft Copper Tube: ASTM B 88, Type K and ASTM B 88, Type L water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.03 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; 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. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.04 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- C. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve, Inc.
 - 2. Asahi/America, Inc.
 - 3. Fischer, George Inc.
 - 4. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - 5. McDonald, A.Y. Mfg. Co.
 - 6. NIBCO INC.
 - 7. Sloane, George Fischer, Inc.
 - 8. Spears Manufacturing Company.
 - 9. Thermoplastic Valves Inc.

2.05 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dresser, Inc.; Dresser Piping Specialties.
 - b. Ford Meter Box Company, Inc. (The).
 - c. JCM Industries.
 - d. Viking Johnson; c/o Mueller Co.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
 - 1. Description: PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.06 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Calpico, Inc.
 - 2. Capitol Manufacturing Company.
 - 3. Central Plastics Company.

4. EPCO Sales, Inc.
 5. Hart Industries International, Inc.
 6. Lochinvar Corp.
 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 8. Zurn Plumbing Products Group; Wilkins Water Control Products.
- C. Dielectric Unions:
1. Description:
 - a. Pressure Rating: 150 psig at 180 deg F.
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- D. Dielectric Flanges:
1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig.
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- E. Dielectric-Flange Kits:
1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig.
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- F. Dielectric Couplings:
1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- G. Dielectric Nipples:
1. Description:
 - a. Electroplated steel nipple complying with ASTM F 1545.
 - b. Pressure Rating: 300 psig at 225 deg F.
 - c. End Connections: Male threaded or grooved.
 - d. Lining: Inert and noncorrosive, propylene.
- 2.07 ESCUTCHEONS**
- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
 - B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
 - C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
 - D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
 - E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
 - F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.

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

2.08 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.09 SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex, Inc.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe 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: Carbon steel.
 - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

PART 3 - EXECUTION

3.01 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 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 in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- D. Install shutoff valve immediately upstream of each dielectric fitting.
- E. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.
- F. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- G. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- I. 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.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- K. Install piping adjacent to equipment and specialties to allow service and maintenance.
- L. Install piping to permit valve servicing.
- M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than 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 unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.02 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: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: 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. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. 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.
- G. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.
- H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.03 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.
- E. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.04 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.05 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.06 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
 - 1. Vertical Piping: MSS Type 8 or 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
 - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
 - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
 - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.
- F. Install supports for vertical copper tubing every 10 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 3. NPS 2: 10 feet with 3/8-inch rod.
 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
 7. NPS 6: 12 feet with 3/4-inch rod.
 8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
 2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
 4. NPS 6: 48 inches with 3/4-inch rod.
 5. NPS 8: 48 inches with 7/8-inch rod.
- J. Install supports for vertical PVC piping every 48 inches.
- K. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.07 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3.08 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw.
 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:

1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with polished chrome-plated finish.
6. Bare Piping in Equipment Rooms: Split plate, stamped steel with set screw or spring clips.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.09 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
 - a. Extend sleeves 2 inches above finished floor level.
 - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
 - a. Galvanized-steel sheet sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
 - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.
5. Sleeves for Piping Passing through Exterior Concrete Walls:
 - a. Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
 - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
 - d. Do not use sleeves when wall penetration systems are used.
6. Sleeves for Piping Passing through Interior Concrete Walls:
 - a. PVC pipe or Steel pipe sleeves for pipes smaller than NPS 6.
 - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. 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 in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.10 SLEEVE SEAL INSTALLATION

- A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.
- B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.11 WALL PENETRATION SYSTEM INSTALLATION

- A. Install wall penetration systems in new, exterior concrete walls.
- B. Assemble wall penetration system components with sleeve pipe. Install so that end of sleeve pipe and face of housing are flush with wall. Adjust locking devices to secure sleeve pipe in housing.

3.12 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.13 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 2. 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:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. 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.
3. 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.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
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 for corrective action required.

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

E. Prepare test and inspection reports.

3.14 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.15 CLEANING

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

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

- b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-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 procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.16 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. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.

3.17 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 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
 - 2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
 - 3. Hot-Water Circulation Piping, Balancing Duty: Calibrated or Memory-stop balancing valves.
 - 4. 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

SECTION 22 13 16
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
 - 3. Encasement for underground metal piping.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

1.04 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.
 - 2. Sanitary Sewer, Force-Main Piping: 50 psig.

1.05 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- C. Shop Drawings:
 - 1. Design Calculations: Signed and sealed by a qualified professional engineer for selecting seismic restraints.
 - 2. Solvent Drainage System: Include plans, elevations, sections, and details.
- D. Field quality-control inspection and test reports.

1.06 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

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

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

2.04 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. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
 - 2. Heavy-Duty, Shielded, Cast-Iron Couplings: ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve.

PART 3 - EXECUTION

3.01 EXCAVATION

- A. Refer to Section "Common Work Results for Plumbing" for excavating, trenching, and backfilling.

3.02 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 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 shielded, stainless-steel couplings; and hubless-coupling joints.
 - 3. Steel pipe, drainage fittings, and threaded joints.
 - 4. Stainless-steel pipe and fittings, gaskets, and gasketed joints.
 - 5. Copper DWV tube, copper drainage fittings, and soldered joints.
 - 6. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- C. Aboveground, soil and waste piping NPS 5 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 shielded, stainless-steel couplings; and hubless-coupling joints.

3. Steel pipe, drainage fittings, and threaded joints.
 4. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- D. Aboveground, vent piping NPS 4 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 shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Stainless-steel pipe and fittings gaskets, and gasketed joints.
 5. Copper DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type L; copper pressure fittings; and soldered joints.
 6. Dissimilar Pipe-Material Couplings: Flexible, Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Aboveground, vent piping NPS 5 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; and heavy-duty shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Steel pipe, drainage fittings, and threaded joints.
 4. Dissimilar Pipe-Material Couplings: Flexible, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- F. Underground, soil, waste, and vent piping shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

3.03 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install seismic restraints on piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- G. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- H. 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.

- I. 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 2 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.
- J. 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, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- K. 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 and smaller; 1 percent downward in direction of flow for piping NPS 4 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.
- L. Install engineered soil and waste drainage and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.04 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. 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.
- C. 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.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- F. Grooved Joints: Assemble joint with keyed coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.05 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Install gate valve for piping NPS 2-1/2 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 sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.06 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Install individual, straight, horizontal piping runs according to the following:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch 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: 60 inches with 3/8-inch rod.
 - 2. NPS 3: 60 inches with 1/2-inch rod.
 - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
 - 4. NPS 6: 60 inches with 3/4-inch rod.
 - 5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
 - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
 - 3. NPS 2: 10 feet with 3/8-inch rod.
 - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
 - 5. NPS 3: 12 feet with 1/2-inch rod.
 - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.
- I. Install supports for vertical steel piping every 15 feet.
- J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 2: 84 inches with 3/8-inch rod.
 2. NPS 3: 96 inches with 1/2-inch rod.
 3. NPS 4: 108 inches with 1/2-inch rod.
 4. NPS 6: 10 feet with 5/8-inch rod.
- K. Install supports for vertical stainless-steel piping every 10 feet.
- L. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
 5. NPS 6: 10 feet with 5/8-inch rod.
 6. NPS 8: 10 feet with 3/4-inch rod.
- M. Install supports for vertical copper tubing every 10 feet.
- N. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 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. 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 and larger.

3.08 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. 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. 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.

3.09 CLEANING

- 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.

END OF SECTION

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
 - 1. Faucets for lavatories, bathtub/showers and sinks.
 - 2. Laminar-flow faucet-spout outlets.
 - 3. Flushometers.
 - 4. Toilet seats.
 - 5. Protective shielding guards.
 - 6. Fixture supports.
 - 7. Water closets.
 - 8. Urinals.
 - 9. Lavatories.
 - 10. Commercial sinks.
 - 11. Individual showers.
 - 12. Janitor's sinks.
- B. Related Sections include the following:
 - 1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
 - 2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
 - 3. Division 22 Section "Domestic Water Filtration Equipment" for water filters.
 - 4. Division 22 Section "Healthcare Plumbing Fixtures."
 - 5. Division 22 Section "Emergency Plumbing Fixtures."
 - 6. Division 22 Section "Drinking Fountains and Water Coolers."
 - 7. Division 31 Section "Facility Water Distribution Piping" for exterior plumbing fixtures and hydrants.

1.03 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.

- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.04 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 5. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 6. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 7. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
 - 8. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 9. Vitreous-China Fixtures: ASME A112.19.2M.
 - 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
 - 12. Whirlpool Bathtub Fittings: ASME A112.19.8M.

- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.
 - 9. Pipe Threads: ASME B1.20.1.
 - 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 11. Supply Fittings: ASME A112.18.1.
 - 12. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
 - 1. Atmospheric Vacuum Breakers: ASSE 1001.
 - 2. Brass and Copper Supplies: ASME A112.18.1.
 - 3. Manual-Operation Flushometers: ASSE 1037.
 - 4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Dishwasher Air-Gap Fittings: ASSE 1021.
 - 2. Flexible Water Connectors: ASME A112.18.6.
 - 3. Floor Drains: ASME A112.6.3.
 - 4. Grab Bars: ASTM F 446.
 - 5. Pipe Threads: ASME B1.20.1.
 - 6. Plastic Toilet Seats: ANSI Z124.5.
 - 7. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures of unit shell.
 - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
 - 2. Warranty Period for Commercial Applications: One (1) year from date of final acceptance by Owner.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed, but less than 2.
 - 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than 2.
 - 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.
 - 4. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.
 - 5. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.
 - 6. Toilet Seats: Equal to 5 percent of amount of each type installed, but not less than 2.

PART 2 - PRODUCTS

2.01 FAUCETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Standard Companies, Inc.
 - 2. Bradley Corporation.
 - 3. Chicago Faucets.
 - 4. Delta Faucet Company.
 - 5. Eljer.
 - 6. Kohler Co.
 - 7. Moen, Inc.
 - 8. Royal Brass Mfg. Co.
 - 9. Speakman Company.
 - 10. T & S Brass and Bronze Works, Inc.
 - 11. Zurn Industries, LLC; Commercial Brass Operation.
- B. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
 - 1. Body Material: Commercial, solid brass.
 - 2. Finish: Polished chrome plate.
 - 3. Maximum Flow Rate: 2.5 gpm unless rated otherwise.

2.02 LAMINAR-FLOW FAUCET-SPOUT OUTLETS

- A. Laminar-Flow Faucet-Spout Outlets:
 - 1. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating, laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.03 FLUSHOMETERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Delta Faucet Company.
 - 2. MOCA, Inc.

3. Sloan Valve Company.
 4. TOTO USA, Inc.
 5. Zurn Industries, LLC; Commercial Brass Operation.
- B. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

2.04 TOILET SEATS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard Companies, Inc.
 2. Bemis Manufacturing Company.
 3. Church Seats.
 4. Eljer.
 5. Kohler Co.
 6. Olsonite Corp.
 7. Sanderson Plumbing Products, Inc.; Beneke Div.
 8. Zurn Industries, LLC; Commercial Fixtures.
- B. Description: Toilet seat for water-closet-type fixture.
1. Material: Molded, solid plastic with antimicrobial agent.
 2. Configuration: Open front with cover.
 3. Size: Elongated.
 4. Hinge Type: Stainless steel, self-sustaining, external check.
 5. Color: White, unless noted otherwise.

2.05 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - b. McGuire Manufacturing Co., Inc.
 - c. TRUEBRO, Inc.
 - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
 2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.
 - b. Sloan Valve Co.
 2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.06 FIXTURE SUPPORTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Josam Company.
 - 2. Smith, Jay R. Mfg. Co.
 - 3. Tyler Pipe; Wade Div.
 - 4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 - 5. Zurn Industries, LLC; Specification Drainage Operation.
- B. Water-Closet Supports:
 - 1. Description: Combination carrier designed for mounting height of wall-mounting or floor mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space. Support shall be designed to withstand minimum 300 lbs. weight on fixture.
- C. Lavatory Supports:
 - 1. Description: Type for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 - 2. Accessible-Fixture Support: Include rectangular steel uprights.

2.07 WATER CLOSETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Plumbing, L.L.C./Fiat Products.
 - 2. American Standard Companies, Inc.
 - 3. Eljer.
 - 4. Kohler Co.
 - 5. TOTO USA, Inc.
 - 6. Zurn Industries, LLC; Commercial Fixtures.
- B. Description Wall/Floor-mounting, back/floor-outlet, vitreous-china fixture designed for operation. Minimum 300 lbs. weight capacity. Fixture shall be ADA compatible where specified.
 - 1. Bowl Type: Elongated with siphon-jet design.
 - 2. Design Consumption: Maximum 1.6 gal./flush.
 - 3. Color: White, unless noted otherwise.

2.08 LAVATORIES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Standard Companies, Inc.
 - 2. Eljer.
 - 3. Crane Plumbing, L.L.C./Fiat Products.
 - 4. Gerber Plumbing Fixtures LLC.
 - 5. Kohler Co.
 - 6. TOTO USA, Inc.
 - 7. Zurn Industries, LLC; Commercial Fixtures.

- B. Description: Wall or Counter -mounting, vitreous-china fixture.
 - 1. Color: White, unless noted otherwise.

2.09 COMMERCIAL SINKS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Standard Co., Inc.
 - 2. Elkay Manufacturing Co.
 - 3. Just Manufacturing Company.
 - 4. Kohler Co.
 - 5. Marlo Manufacturing.
- B. Description: Counter-mounting/Wall mounting, stainless-steel commercial sink fixture.
 - 1. Material: 18 gauge, type 304. Stainless steel with satin finish.
 - 2. Type: Self-rimming for counter mounting, with back-splash for wall mounting.
 - 3. Number of Compartment: As shown on drawings.

2.10 INDIVIDUAL SHOWERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aqua Glass Corporation.
 - 2. Best Bath Systems.
 - 3. Clarion Bathware.
 - 4. Crane Plumbing, L.L.C./Fiat Products.
 - 5. Florestone Products Co., Inc.
 - 6. Jacuzzi, Inc.
 - 7. Kohler Co.
- B. Description: Shower enclosure with slip-resistant bathing surface and shower rod with curtain.
 - 1. Color: White, unless noted otherwise.
 - 2. Accessibility Options: Include grab bar and bench.

2.11 JANITOR'S SINKS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Acorn Engineering Company.
 - 2. Crane Plumbing, L.L.C./Fiat Products.
 - 3. Florestone Products Co., Inc.
 - 4. Precast Terrazzo Enterprises, Inc.
 - 5. Stern-Williams Co., Inc.
 - 6. Zurn Industries, LLC; Light Commercial Operation.
- B. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install toilet seats on water closets.
- N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- Q. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers/hot-water dispensers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

3.06 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 43 00
HEALTHCARE PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following medical plumbing fixtures and related components:
 - 1. Faucets for lavatories, showers and sinks.
 - 2. Laminar-flow, faucet-spout outlets.
 - 3. Flushometers.
 - 4. Toilet seats.
 - 5. Protective shielding guards.
 - 6. Fixture supports.
 - 7. Bedpan washers.
 - 8. Water closets.
 - 9. Lavatories.
 - 10. Clinical sinks.
 - 11. Bedpan washing equipment.
- B. Related Sections include the following:
 - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
 - 2. Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.
 - 3. Division 22 Section "Plumbing Fixtures" for conventional plumbing fixtures.
 - 4. Division 22 Section "Emergency Plumbing Fixtures."

1.03 DEFINITIONS

- A. Accessible Medical Plumbing Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the medical plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads, drains and tailpieces, and traps and waste pipes.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.

1.04 SUBMITTALS

- A. Product Data: For each type of medical plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For medical plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain medical plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
 - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- 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. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for medical plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Shower Enclosures: ANSI Z124.2.
 - 3. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 4. Vitreous-China Fixtures: ASME A112.19.2M.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 3. Faucets: ASME A112.18.1.
 - 4. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 5. Hose-Coupling Threads: ASME B1.20.7.
 - 6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 7. NSF Materials: NSF 61.
 - 8. Pipe Threads: ASME B1.20.1.
 - 9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 - 10. Supply Fittings: ASME A112.18.1.
 - 11. Brass Waste Fittings: ASME A112.18.2.
- I. Comply with the following applicable standards and other requirements specified for bathtub and shower faucets:
 - 1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
 - 2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
 - 3. Faucets: ASME A112.18.1.
 - 4. Hand-Held Showers: ASSE 1014.

5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
 6. Hose-Coupling Threads: ASME B1.20.7.
 7. Manual-Control Antiscald Faucets: ASTM F 444.
 8. Pipe Threads: ASME B1.20.1.
 9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
 6. Brass Waste Fittings: ASME A112.18.2.
- K. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Grab Bars: ASTM F 446.
 2. Hose-Coupling Threads: ASME B1.20.7.
 3. Off-Floor Fixture Supports: ASME A112.6.1M.
 4. Pipe Threads: ASME B1.20.1.
 5. Plastic Toilet Seats: ANSI Z124.5.
 6. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.06 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed, but not less than 2.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed, but not less than 2.
 3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 6 of each type.
 4. Toilet Seats: Equal to 5 percent of amount of each type installed, but not less than 2.

PART 2 - PRODUCTS

2.01 FAUCETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard Companies, Inc.
 2. Bradley Corporation.
 3. Chicago Faucets.
 4. Delta Faucet Company.
 5. Eljer.

6. Kohler Co.
7. Moen, Inc.
8. Royal Brass Mfg. Co.
9. Speakman Company.
10. T & S Brass and Bronze Works, Inc.
11. Zurn Industries, LLC; Commercial Brass Operation.

- B. Description: Faucet for lavatory-type medical plumbing fixture. Coordinate faucet inlets with supplies, connectors, and fixture holes; coordinate outlet with spout and fixture receptor.

1. Maximum Flow Rate: 2.2 gpm unless noted otherwise.
2. Body Material: Solid brass.
3. Finish: Polished chrome plate.
4. Temperature Indicators: Color-coded for hot and cold water.

2.02 LAMINAR-FLOW FAUCET-SPOUT OUTLETS

- A. Description: Chrome-plated-brass faucet-spout outlet that produces non-aerating laminar stream. Include male or female thread that mates with faucet outlet for attachment to faucets where indicated and flow-rate range that includes flow of faucet.

2.03 FLUSHOMETERS

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

1. Delta Faucet Company.
2. Moen, Inc.
3. Sloan Valve Company.
4. TOTO USA, Inc.
5. Zurn Industries, LLC; Commercial Brass Operation.

- B. Description: Flushometer for clinical-sink or urinal or water-closet-type medical plumbing fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, and copper or brass tubing, and polished chrome-plated finish on exposed parts.

1. Internal Design: Diaphragm operation.
2. Consumption: 1.6 gal./flush unless noted otherwise.
3. Integral Bedpan Washer: Where shown on drawings.

2.04 TOILET SEATS

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

1. Bemis Manufacturing Company.
2. Church Seats.
3. Olsonite Corp.
4. Sanderson Plumbing Products, Inc.; Beneke Div.
5. Zurn Industries, LLC; Commercial Fixtures.

- B. Description: Plastic toilet seat for water-closet-type medical plumbing fixture.

1. Material: Molded, solid plastic with antimicrobial agent.
2. Configuration: Open front with cover.

3. Size: Elongated, unless otherwise indicated.
4. Class: Heavy-duty commercial.
5. Hinge Type: Stainless-steel SC, self-sustaining check.
6. Color: White.

2.05 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - b. McGuire Manufacturing Co., Inc.
 - c. TRUEBRO, Inc.
 - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering medical plumbing fixture and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. TRUEBRO, Inc.
 - b. Sloan Valve Co.
2. Description: Manufactured plastic enclosure for covering medical plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.06 FIXTURE SUPPORTS

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

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Industries, LLC; Specification Drainage Operation.

B. Water-Closet Supports:

1. Description: Combination carrier designed for mounting height of wall-mounting or floor mounting, water-closet-type medical plumbing fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space. Support shall be designed to withstand minimum 500 lbs. weight on fixture.

C. Lavatory Supports:

1. Description: Type for wall-mounting, lavatory-type medical plumbing fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Sink Supports:

1. Description: Type for sink-type medical plumbing fixture. Include steel uprights with feet.

2.07 BEDPAN WASHERS

- A. Bedpan Washers:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard Companies, Inc.
 - b. Chicago Faucets.
 - c. Crane Plumbing, L.L.C./Fiat Products.
 - d. Delta Faucet Company.
 - e. Eljer.
 - f. Kohler Co.
 - g. T & S Brass and Bronze Works, Inc.
 - h. Zurn Industries, LLC; Commercial Brass Operation.
 - 2. Description: Wall-mounting, hand-held, single-pedal, foot-control, medical plumbing fixture.
 - a. Hose: 48-inch- long rubber or vinyl hose with spray nozzle, wall bracket, and hook.
 - b. Self-closing valve.
 - c. Loose-key supply stop.
 - d. Vacuum Breaker: Wall mounting, atmospheric.
 - e. Finish: Polished, chrome-plated finish on metal parts exposed after installation.

2.08 WATER CLOSETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Standard Companies, Inc.
 - 2. Crane Plumbing, L.L.C./Fiat Products.
 - 3. Eljer.
 - 4. Kohler Co.
 - 5. Zurn Industries, LLC; Commercial Fixtures.
- B. Description: Wall/Floor-mounting, back/floor-outlet, vitreous-china medical plumbing fixture designed for bedpan washing (where specified), flushometer valve operation and minimum 500 lbs. weight capacity. Fixture shall be ADA compatible where specified.
 - 1. Style: Flushometer valve.
 - a. Bowl Type: Elongated with siphon-jet design and bedpan lugs or slots.
 - b. Design Consumption: 1.6 gal./flush.
 - c. Color: White unless noted otherwise.

2.09 LAVATORIES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Standard Companies, Inc.
 - 2. Crane Plumbing, L.L.C./Fiat Products.
 - 3. Eljer.
 - 4. Gerber Plumbing Fixtures LLC.

5. Kohler Co.
 6. Zurn Industries, LLC; Commercial Fixtures.
- B. Description: Wall-mounting, vitreous-china medical plumbing fixture.
1. Color: White, unless noted otherwise.

2.10 SINKS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard Co., Inc.
 2. Elkay Manufacturing Co.
 3. Just Manufacturing Company.
 4. Kohler Co.
 5. Marlo Manufacturing.
- B. Description: Counter-mounting/Wall mounting, stainless-steel sink fixture.
1. Material: 18 gauge, type 304. Stainless steel with satin finish.
 2. Type: Self-rimming for counter mounting, with back-splash for wall mounting.
 3. Number of Compartment: As shown on drawings.

2.11 CLINICAL SINKS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Standard Companies, Inc.
 2. Crane Plumbing, L.L.C./Fiat Products.
 3. Eljer.
 4. Kohler Co.
 5. Zurn Industries, LLC; Commercial Fixtures.
- B. Description: Wall-mounting, back-outlet, vitreous-china, flushing-rim, service-sink-type medical plumbing fixture.
1. Color: White.
 2. Rim Guard: Stainless steel on front and also on sides if flat rim.

2.12 OUTLET BOXES

- A. Dialysis Equipment Outlet Boxes:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Bradley Corporation.
 - c. Metcraft Industries Inc.
 - d. Whitehall Manufacturing; a division of Acorn Manufacturing Company.
 2. Description: Recessed-mounting outlet box with water supply and drain connections.
 - a. Box and Faceplate: Stainless steel.
 - b. Supply Fitting(s): NPS 1/2 PVC ball valve(s) and adapter with male hose-thread outlet.
 - c. Drain: NPS 2 standpipe, P-trap, and direct waste connection to drainage piping.

3. Reinforcement: 2-by-4-inch fire-retardant-treated-wood blocking between studs. Fire-retardant-treated wood blocking is specified in Division 06 Section "Rough Carpentry."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine roughing-in for medical plumbing fixtures to verify actual locations of piping connections before fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Assemble medical plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings.
- H. Install water-supply piping with stop on each supply to each fixture to be connected to domestic water piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
 1. Exception: Use ball, gate, or globe valve if stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- I. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- J. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install shower flow-control fittings with specified maximum flow rates in shower arms.
- N. Install traps on fixture outlets.
 1. Exception: Omit trap on fixtures with integral traps.
- O. Install escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- P. Set showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

- Q. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect water supplies from domestic water piping to medical plumbing fixtures.
- C. Connect drain piping from medical plumbing fixtures to sanitary waste and vent piping.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Verify that installed medical plumbing fixtures are categories and types specified for locations where installed.
- B. Check that medical plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed medical plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.05 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning medical plumbing fixtures, fittings, and controls.
- B. Adjust water pressure at faucets, shower valves and flushometer valves to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

3.06 CLEANING

- A. Clean medical plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
 - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
 - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of medical plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 62 13

VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Medical surgical vacuum piping and specialties, designated "medical vacuum" operating at 20 inches mercury.
 - 2. Waste anesthetic gas disposal piping and specialties, designated "WAGD evacuation" operating at 15 inches mercury.
 - 3. Dental vacuum piping and specialties, designated "dental vacuum" operating at 12 inches mercury.
 - 4. Healthcare laboratory vacuum piping and specialties, designated "medical laboratory vacuum" operating at 20 inches mercury.
- B. Related Sections include the following:
 - 1. Division 12 Section "Healthcare Casework" for vacuum outlets in metal medical casework.
 - 2. Division 22 Section "Vacuum Equipment for Laboratory and Healthcare Facilities" for medical and dental vacuum producers.

1.03 DEFINITIONS

- A. D.I.S.S.: Diameter-index safety system.
- B. HVE: High-volume (oral) evacuation.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. WAGD: Waste anesthetic gas disposal.
- E. Medical vacuum piping systems include medical vacuum, WAGD evacuation, dental vacuum and medical laboratory vacuum piping systems.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Vacuum pipes, tubes and fittings.
 - 2. Vacuum valves and valve boxes.
 - 3. Medical vacuum service connections and vacuum-bottle brackets.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Piping Material Certification: Signed by Installer certifying that medical vacuum piping materials comply with NFPA 99 requirements.
- D. Qualification Data: For Installer.
- E. Brazing certificates.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Medical Vacuum Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010.
 - 2. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.
 - 3. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
- C. Source Limitations: Obtain vacuum service connections of same type and from same manufacture as service connections provided for in Division 22 Section "Gas Piping for Laboratory and Healthcare Facilities."
- D. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- E. 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.
- F. Comply with ASME B31.9, "Building Services Piping," for vacuum piping in laboratory facilities.
- G. NFPA Compliance: Comply with NFPA 99, "Health Care Facilities," for medical vacuum system materials and installation in healthcare facilities.

1.06 PROJECT CONDITIONS

- A. Interruption of Existing Laboratory and Medical Vacuum Service(s): Do not interrupt laboratory or medical vacuum service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of laboratory and medical vacuum service(s).
 - 2. Do not proceed with interruption of laboratory and medical vacuum service(s) without Architect's written permission.

1.07 COORDINATION

- A. Coordinate medical vacuum service connections with other service connections. Medical compressed-air service connections are specified in Division 22 Section "Compressed-Air Piping for Laboratory and Healthcare Facilities," and medical gas service connections are specified in Division 22 Section "Gas Piping for Laboratory and Healthcare Facilities."

1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.
 - a. Medical Vacuum Service Connections: Equal to 10 percent of amount installed, but no fewer than two units.
 - b. WAGD Evacuation Service Connections: Equal to 10 percent of amount installed, but no fewer than two units.
 - 2. D.I.S.S. Connections: Furnish complete noninterchangeable medical vacuum suction inlets complying with CGA V-5.
 - a. Medical Vacuum D.I.S.S. No. 1220: Equal to 10 percent of amount installed, but no fewer than two units.
 - b. WAGD Evacuation D.I.S.S. No. 2220: Equal to 10 percent of amount installed, but no fewer than two units.
 - 3. Medical Vacuum Bottle Brackets: Equal to 10 percent of amount installed, but no fewer than two units.

PART 2 - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.
 - 1. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
 - 2. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
 - 3. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - 4. Press-Type Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- B. Copper Water Tube: ASTM B 88, Type M, seamless, drawn temper.
 - 1. Cast-Copper Fittings: ASME B16.18, solder-joint pressure type.
 - 2. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type.
 - 3. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.
 - 4. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - 5. Press-Type Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- C. Extruded-Tee Outlets: ASTM F 2014 procedure for making branch outlets in copper tube.

- D. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

2.02 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- C. Threaded-Joint Tape: PTFE.
- D. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

2.03 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
 - 1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.
- B. Copper-Alloy Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.
 - 2. Pressure Rating: 300 psig minimum.
 - 3. Ball: Full-port, chrome-plated brass.
 - 4. Seats: PTFE or TFE.
 - 5. Handle: Lever type with locking device.
 - 6. Stem: Blowout proof with PTFE or TFE seal.
 - 7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
- C. Bronze Check Valves: In-line pattern.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Healthcare Products, Inc.; Chemetron Div.
 - b. Amico Corporation.
 - c. BeaconMedaes.
 - d. Squire-Cogswell/Aeros Instruments, Inc.
 - 2. Pressure Rating: 300 psig minimum.
 - 3. Operation: Spring loaded.
 - 4. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
- D. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.

2. Pressure Rating: 300 psig minimum.
 3. Ball: Full-port, chrome-plated brass.
 4. Seats: PTFE or TFE.
 5. Handle: Lever type with locking device.
 6. Stem: Blowout proof with PTFE or TFE seal.
 7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 8. Vacuum Gage: Manufacturer installed on one copper-tube extension.
- E. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with vacuum gages and in sizes required to permit manual operation of valves.
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.
 2. Interior Finish: Factory-applied white enamel.
 3. Cover Plate: Aluminum or extruded-anodized aluminum with frangible or removable windows.
 4. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- F. Safety Valves: Bronze-body, ASME-construction, pressure-relief type with settings to match system requirements.
- G. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket where wall mounting is indicated.

2.04 MEDICAL VACUUM SERVICE CONNECTIONS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amico Corporation.
 2. BeaconMedaes.
- B. Connection Devices: For specific medical vacuum service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.
1. Roughing-in Assembly:
 - a. Steel outlet box for recessed mounting and concealed piping.
 - b. Brass-body inlet block.
 - c. Seals that will prevent vacuum leakage.
 - d. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.
 2. Finishing Assembly:
 - a. Brass housing with primary check valve.
 - b. Seals that will prevent vacuum leakage.
 - c. Cover plate with gas-service label.

3. Quick-Coupler Service Connections: Suction inlets for medical vacuum and WAGD evacuation service outlets with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.
4. D.I.S.S. Service Connections: Suction inlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.
 - a. Medical Vacuum Service Connections: CGA V-5, D.I.S.S. No. 1220.
 - b. WAGD Evacuation Service Connections: CGA V-5, D.I.S.S. No. 2220.
5. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.
6. Cover Plates: One piece, anodized aluminum and permanent, color-coded, identifying label matching corresponding service.

2.05 MEDICAL VACUUM PIPING ALARM SYSTEMS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amico Corporation.
 2. BeaconMedaes.
- B. Panels for medical vacuum piping systems may be combined in single panels with medical compressed-air and medical gas piping systems.
- C. Components: Designed for continuous service and to operate on power supplied from 120-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
- D. Vacuum Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
 1. Vacuum Operating Range: 0- to 30-in. Hg.
- E. General Requirements for Medical Vacuum Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
 1. Mounting: Recessed installation.
 2. Enclosures: Fabricated from minimum 0.047-inch- thick steel or minimum 0.05-inch- thick aluminum, with knockouts for electrical and piping connections.
- F. Master Alarm Panels: With separate trouble alarm signals, vacuum gages, and indicators for medical vacuum piping systems.
 1. Include alarm signals when the following conditions exist:
 - a. Medical Vacuum: Vacuum drops below 12-in. Hg and backup vacuum pump is in operation.
 - b. WAGD Evacuation: Vacuum drops below 12-in. Hg.
 - c. Dental Vacuum: Vacuum drops below 6-in. Hg and backup vacuum producer is in operation.
 - d. Medical Laboratory Vacuum: Vacuum drops below 10-in. Hg.

- G. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - 1. Include alarm signals when the following conditions exist:
 - a. Medical Vacuum: Vacuum drops below 12-in. Hg.
 - b. WAGD Evacuation: Vacuum drops below 12-in. Hg.
- H. Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - 1. Include alarm signals when the following condition exists:
 - a. Medical Vacuum: Vacuum drops below 12-in. Hg.
- I. Dental Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - 1. Include alarm signals when the following conditions exist:
 - a. Dental Vacuum: Vacuum drops below 6-in. Hg and backup vacuum producer is in operation.
- J. Medical Laboratory Area Alarm Panels: Separate trouble alarm signals; vacuum gages; and indicators for medical vacuum piping systems.
 - 1. Include alarm signals when the following condition exists:
 - a. Medical Vacuum: Vacuum drops below 12-in. Hg.

2.06 FLEXIBLE PIPE CONNECTORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexicraft Industries.
 - 3. Hyspan Precision Products, Inc.
 - 4. Metraflex, Inc.
 - 5. Universal Metal Hose; a Hyspan Co.
- B. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 - 1. Working-Pressure Rating: 200 psig minimum.
 - 2. End Connections: Threaded copper pipe or plain-end copper tube.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.08 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

- C. One-Piece, Cast-Brass Escutcheons: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast iron.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.09 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 NITROGEN

- A. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:
 - 1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
 - 2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.02 PIPING APPLICATIONS

- A. Connect new copper tubing to existing tubing with memory-metal couplings.
- B. Medical Vacuum Piping: Use one of the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
 - 2. NPS 4 and Smaller: Type L, copper medical gas tube; press-type fittings; and pressure-sealed joints.
 - 3. NPS 5 to NPS 8: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

- C. WAGD Evacuation Piping: Use one of the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
 - 2. NPS 4 and Smaller: Type L, copper medical gas tube; press-type fittings; and pressure-sealed joints.
 - 3. NPS 5 to NPS 8: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- D. Dental Vacuum Piping: Use one of the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Type L, copper medical gas tube; wrought-copper fittings; and brazed or soldered joints.
 - 2. NPS 4 and Smaller: Type L, copper medical gas tube; press-type fittings; and pressure-sealed joints.
 - 3. NPS 5 to NPS 8: Type L, copper medical gas tube; wrought-copper fittings; and brazed or soldered joints.
- E. Medical Laboratory Vacuum Piping: Use one of the following piping materials for each size range:
 - 1. NPS 4 and Smaller: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
 - 2. NPS 4 and Smaller: Type L, copper medical gas tube; press-type fittings; and pressure-sealed joints.
 - 3. NPS 5 to NPS 8: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.
- F. Drain Piping: Use one of the following piping materials:
 - 1. Copper water tube, cast- or wrought-copper fittings, and soldered joints.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Comply with ASSE Standard #6010 for installation of vacuum piping.
- C. Install piping concealed from view and protected from physical contact by building occupants 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 and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install vacuum and drain piping with 1 percent slope downward in direction of flow.
- H. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications below unless otherwise indicated.
- I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.
- J. Provide drain leg and drain trap at end of each main and branch and at low points.

- K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping."
- L. Install piping to permit valve servicing.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.
- O. Install medical vacuum piping to medical vacuum service connections specified in this Section and to equipment specified in other Sections requiring medical vacuum service.
- P. Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- Q. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- R. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.
- S. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.
- T. Install unions, in copper vacuum tubing adjacent to each valve and at final connection to each piece of equipment, machine, and specialty.

3.04 VALVE APPLICATIONS

- A. Valves for Copper Vacuum Tubing: Use copper alloy ball and bronze check types.

3.05 VALVE INSTALLATION

- A. Install shutoff valve at each connection to and from vacuum equipment and specialties.
- B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install safety valves on vacuum receivers, where required by NFPA 99, and where recommended by specialty manufacturers.
- F. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain, so contents spill over or into it.
- G. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.06 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Apply appropriate tape to external pipe threads.
- E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.
- F. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.

- G. Extruded-Tee Outlets: Form branches in copper tube according to ASTM F 2104, with tools recommended by procedure manufacturer.
- H. Flanged Joints:
 - 1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
 - 2. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.
- I. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.
- J. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.

3.07 MEDICAL VACUUM PIPING ALARM SYSTEM INSTALLATION

- A. Panels for medical vacuum piping systems may be combined in single panels with medical compressed-air piping systems and medical gas piping systems.
- B. Install medical vacuum piping system alarm system components in locations required by and according to NFPA 99.
- C. Install medical vacuum piping system area and master alarm panels where indicated.
- D. Install computer interface cabinet with connection to medical vacuum piping alarm system and to facility computer.

3.08 SLEEVE INSTALLATION

- A. Sleeves are not required for core-drilled holes.
- B. Permanent sleeves are not required for holes formed by removable PE sleeves.
- C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe, stack sleeve fittings.
 - 1. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
 - 2. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- D. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- E. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - 1. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - 2. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum board partitions.
 - 3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - a. Seal space outside of sleeve fittings with grout.
- F. 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 in Division 07 Section "Penetration Firestopping."

3.09 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
 - d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish stamped steel with set screw or spring clips.
 - e. Bare Piping in Equipment Rooms: One piece, cast brass/stamped steel with set screw or spring clips.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 - 2. Existing Piping:
 - a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - b. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with rough-brass finish/plate, stamped steel with concealed hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: Split casting, cast brass/plate, stamped steel with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.10 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- B. Vertical Piping: MSS Type 8 or 42, clamps.
- C. Individual, Straight, Horizontal Piping Runs:
 - 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
 - 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.
- D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- E. Base of Vertical Piping: MSS Type 52, spring hangers.
- F. Support horizontal piping within 12 inches of each fitting and coupling.
- G. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.

3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 4: 16 feet with 1/2-inch rod.
11. NPS 5: 18 feet with 1/2-inch rod.
12. NPS 6: 20 feet with 5/8-inch rod.
13. NPS 8: 23 feet with 3/4-inch rod.

- I. Install supports for vertical copper tubing every 10 feet.

3.11 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 1. Medical Vacuum: Black letters on white background.
 2. WAGD: White letters on violet background.
 3. Dental Vacuum: Black boxed letters on white-and-black diagonal stripe background.
 4. Medical Laboratory Vacuum: Black boxed letters on white-and-black checkerboard background.

3.12 FIELD QUALITY CONTROL FOR LABORATORY FACILITY NONMEDICAL VACUUM PIPING

- A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of vacuum piping in nonmedical laboratory facilities.
- B. Perform tests and inspections of vacuum piping in nonmedical laboratory facilities.
- C. Tests and Inspections:
 1. Piping Leak Tests for Vacuum Piping: Test new and modified parts of existing piping. Cap and fill vacuum piping with oil-free, dry nitrogen. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - a. Test Pressure for Copper Tubing: 100 psig.
 2. Repair leaks and retest until no leaks exist.
 3. Inspect filters for proper operation.
- D. Prepare test reports.

3.13 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and prepare test reports.

- B. Perform tests and inspections of medical vacuum piping systems in healthcare facilities and prepare test reports.
- C. Tests and Inspections:
 - 1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.
 - 2. Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blow down.
 - b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for vacuum systems.
 - f. Repair leaks and retest until no leaks exist.
 - 3. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical vacuum piping systems and perform the following tests and inspections:
 - a. Standing pressure test.
 - b. Individual-pressurization or pressure-differential cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Final tie-in test.
 - g. Operational vacuum test.
 - h. Verify correct labeling of equipment and components.
 - 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- D. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.14 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain medical vacuum alarm systems. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 22 63 13

GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Carbon dioxide piping and specialties designated "medical carbon dioxide" operating at 50 to 55 psig.
 - 2. Helium piping, designated "medical helium" operating at 50 to 55 psig.
 - 3. Nitrogen piping and specialties designated "medical nitrogen" operating at 160 to 185 psig.
 - 4. Nitrous oxide piping and specialties designated "medical nitrous oxide" operating at 50 to 55 psig.
 - 5. Oxygen piping and specialties designated "medical oxygen" operating at 50 to 55 psig.
 - 6. Other specialty gas piping and specialties as designated on drawings operating at 50 to 55 psig.
- B. Owner-Furnished Material:
 - 1. Medical gas manifolds.
 - 2. Ceiling columns.
 - 3. Bulk gas storage tanks.
 - 4. Owner will furnish gases for medical gas concentration testing specified in this Section.
- C. Related Sections include the following:
 - 1. Division 22 Section "Compressed-Air Piping for Laboratory and Healthcare Facilities" for compressed-air piping systems for laboratory and healthcare facilities.
 - 2. Division 22 Section "Vacuum Piping for Laboratory and Healthcare Facilities" for vacuum piping systems for laboratory and healthcare facilities.

1.03 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. D.I.S.S.: Diameter-index safety system.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- D. Medical gas piping systems include nonflammable gas for healthcare facility patient care or for healthcare laboratory applications.
- E. Specialty Gas: Gas, other than medical gas, for nonmedical laboratory facility applications.

1.04 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Gas manifolds and piping 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 the seismic forces specified."

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Tubes and fittings.
 - 2. Valves and valve boxes.
 - 3. Medical gas service connections.
 - 4. Electrical service connections.
 - 5. Medical nitrogen pressure control panels.
 - 6. Ceiling hose assemblies. Include integral service connections.
 - 7. Gas manifolds.
 - 8. Medical gas alarm system components.
 - 9. Gas cylinder storage racks.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Piping Material Certification: Signed by Installer certifying that medical gas piping materials comply with NFPA 99 requirements.
- D. Qualification Data: For Installer.
- E. Brazing certificates.
- F. Manufacturer Seismic Qualification Certification: Submit certification that gas manifolds, accessories, and components will withstand seismic forces defined in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment." Include the following:
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
- G. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.
- H. Field quality-control test reports.
- I. Operation and Maintenance Data: For medical gas piping specialties to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Medical Gas Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010 for installers.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.
- C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- D. 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.
- E. ASME Compliance: Fabricate and label bulk medical gas storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

- F. NFPA Compliance:
 - 1. Comply with NFPA 50, "Bulk Oxygen Systems at Consumer Sites," for bulk oxygen storage tanks.
 - 2. Comply with NFPA 99, "Health Care Facilities," for medical gas piping system materials and installation.
- G. CGA Compliance: Comply with CGA G-8.1, "Nitrous Oxide Systems at Consumer Sites," for bulk nitrous oxide storage tanks.
- H. UL Compliance:
 - 1. Comply with 498, "Attachment Plugs and Receptacles," for electrical service connections.
 - 2. Comply with UL 544, "Medical and Dental Equipment," for medical gas specialties.

1.07 PROJECT CONDITIONS

- A. Interruption of Existing Medical Gas Service(s): Do not interrupt medical gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of medical gas service(s).
 - 2. Do not proceed with interruption of medical gas service(s) without Architect's written permission.

1.08 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate medical gas service connections with other service connections. Compressed-air service connections are specified in Division 22 Sections "Compressed-Air Piping for Laboratory and Healthcare Facilities" and "Vacuum Piping for Laboratory and Healthcare Facilities."

1.09 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical gas pressure outlets and suction inlets.
 - a. Medical Air: Equal to ten percent of amount installed, but no fewer than two units.
 - b. Medical Oxygen: Equal to ten percent of amount installed, but no fewer than two units.
 - c. Medical Vacuum: Equal to ten percent of amount installed, but no fewer than two units.
 - 2. D.I.S.S. Service Connections: Furnish complete noninterchangeable medical gas pressure outlets and suction inlets complying with CGA V-5.
 - a. Instrument Air D.I.S.S. No. 1160: Equal to ten percent of amount installed, but no fewer than two units.
 - b. Medical Air D.I.S.S. No. 1160: Equal to ten percent of amount installed, but no fewer than two units.
 - c. Medical Oxygen D.I.S.S. No. 1240: Equal to ten percent of amount installed, but no fewer than two units.

- d. Medical Vacuum D.I.S.S. No. 1220: Equal to ten percent of amount installed, but no fewer than two units.
- 3. Vacuum Bottle Brackets: Equal to ten percent of amount installed, but no fewer than two units.

PART 2 - PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

- A. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.
 - 1. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.
 - 2. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.
 - 3. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.
 - 4. Press-Type Fittings:
 - a. NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
 - b. NPS 2-1/2 to NPS 4: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
 - 5. Memory-Metal Couplings: Cryogenic compression fitting made of ASTM F 2063, nickel-titanium, shape-memory-alloy, and that has been manufacturer cleaned, purged, and sealed for oxygen service according to CGA G-4.1.

2.02 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.
- B. Threaded-Joint Tape: PTFE.

2.03 VALVES

- A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.
- B. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.
 - 2. Pressure Rating: 300 psig minimum.
 - 3. Ball: Full-port, chrome-plated brass.
 - 4. Seats: PTFE or TFE.
 - 5. Handle: Lever type with locking device.
 - 6. Stem: Blowout proof with PTFE or TFE seal.
 - 7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

- C. Check Valves: In-line pattern, bronze.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.
 - 2. Pressure Rating: 300 psig minimum.
 - 3. Operation: Spring loaded.
 - 4. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
- D. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.
 - 2. Pressure Rating: 300 psig minimum.
 - 3. Ball: Full-port, chrome-plated brass.
 - 4. Seats: PTFE or TFE.
 - 5. Handle: Lever type with locking device.
 - 6. Stem: Blowout proof with PTFE or TFE seal.
 - 7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.
 - 8. Pressure Gage: Manufacturer-installed on one copper-tube extension.
- E. Zone Valve Boxes: Formed steel with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amico Corporation.
 - b. BeaconMedaes.
 - 2. Interior Finish: Factory-applied white enamel.
 - 3. Cover Plate: Aluminum or extruded-anodized aluminum with frangible or removable windows.
 - 4. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.
- F. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.
- G. Pressure Regulators: Bronze body and trim; spring-loaded, diaphragm-operated, relieving type; manual pressure-setting adjustment; rated for 250-psig minimum inlet pressure; and capable of controlling delivered gas pressure within 0.5 psig for each 10-psig inlet pressure.

2.04 MEDICAL GAS PIPING ALARM SYSTEMS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amico Corporation.
 - 2. BeaconMedaes.

- B. Panels for medical gas piping systems may be combined in single panels with medical compressed-air and medical vacuum piping systems.
- C. Components: Designed for continuous service and to operate on power supplied from 120-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.
- D. Pressure Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.
 - 1. Low-Pressure Operating Range: 0- to 100-psig.
 - 2. High-Pressure Operating Range: Up to 250-psig.
- E. General Requirements for Medical Gas Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.
 - 1. Mounting: Recessed installation.
 - 2. Enclosures: Fabricated from minimum 0.047-inch-thick steel or minimum 0.05-inch-thick aluminum, with knockouts for electrical and piping connections.
- F. Area Alarm Panels: Separate trouble alarm signals; pressure and vacuum gages; and indicators for medical gas piping systems.
 - 1. Include alarm signals when the following conditions exist:
 - a. Oxygen: Pressure drops below 40 psig or rises above 60 psig.

2.05 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.06 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast iron.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction, perform the following procedures:
 - 1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."
 - 2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb of chemical to 3 gal. of water.
 - a. Scrub to ensure complete cleaning.
 - b. Rinse with clean, hot water to remove cleaning solution.

3.02 PIPING APPLICATIONS

- A. Medical Gas Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

3.03 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Comply with ASSE Standard #6010 for installation of medical gas piping.
- C. Install piping concealed from view and protected from physical contact by building occupants 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 and coordinate with other services occupying that space.
- F. Install piping adjacent to equipment and specialties to allow service and maintenance.
- G. Install nipples, unions, and special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications below unless otherwise indicated.
- H. Install piping to permit valve servicing.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.
- L. Install seismic restraints on gas piping. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- M. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.
- N. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.

- O. Install unions, in copper tubing adjacent to each valve and at final connection to each piece of equipment and specialty.

3.04 VALVE INSTALLATION

- A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.
- B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.
- C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.
- D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.
- E. Install pressure regulators on gas piping where reduced pressure is required.
- F. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve and with ball valve and check valve in supply main from bulk oxygen storage tank.

3.05 JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.
- B. Threaded Joints: Apply appropriate tape to external pipe threads.
- C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.
- D. Pressure-Sealed Joints: Join copper tube and press-type fittings with tools recommended by fitting manufacturer.
- E. Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of memory-metal coupling joints.

3.06 MEDICAL GAS PIPING ALARM SYSTEM INSTALLATION

- A. Install medical gas alarm system components in locations required by and according to NFPA 99.
- B. Install medical gas area and master alarm panels where indicated.

3.07 SLEEVE INSTALLATION

- A. Sleeves are not required for core-drilled holes.
- B. Permanent sleeves are not required for holes formed by removable PE sleeves.
- C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe, galvanized-steel sheet, stack sleeve fittings.
 - 1. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.
 - 2. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- D. Install sleeves in new walls and slabs as new walls and slabs are constructed.
- E. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - 1. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - 2. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum board partitions.

3. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - a. Seal space outside of sleeve fittings with grout.
- F. 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 in Division 07 Section "Penetration Firestopping."

3.08 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
 - d. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish/stamped steel with set screw or spring clips.
 - e. Bare Piping in Equipment Rooms: One piece, cast brass/stamped steel with set screw or spring clips.
 - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.
 2. Existing Piping:
 - a. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
 - b. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with rough-brass finish/plate, stamped steel with concealed hinge and set screw or spring clips.
 - f. Bare Piping in Equipment Rooms: Split casting, cast brass/plate, stamped steel with set screw or spring clips.
 - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.09 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.
- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.
- C. Vertical Piping: MSS Type 8 or 42, clamps.
- D. Individual, Straight, Horizontal Piping Runs:
 1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
 2. Longer Than 100 Feet: MSS Type 43, adjustable, roller hangers.

- E. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.
- F. Base of Vertical Piping: MSS Type 52, spring hangers.
- G. Support horizontal piping within 12 inches of each fitting and coupling.
- H. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1/4: 60 inches with 3/8-inch rod.
 - 2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
 - 3. NPS 3/4: 84 inches with 3/8-inch rod.
 - 4. NPS 1: 96 inches with 3/8-inch rod.
 - 5. NPS 1-1/4: 108 inches with 3/8-inch rod.
 - 6. NPS 1-1/2: 10 feet with 3/8-inch rod.
 - 7. NPS 2: 11 feet with 3/8-inch rod.
 - 8. NPS 2-1/2: 13 feet with 1/2-inch rod.
 - 9. NPS 3: 14 feet with 1/2-inch rod.
 - 10. NPS 4: 16 feet with 1/2-inch rod.
 - 11. NPS 5: 18 feet with 1/2-inch rod.
 - 12. NPS 6: 20 feet with 5/8-inch rod.
 - 13. NPS 8: 23 feet with 3/4-inch rod.
- J. Install supports for vertical copper tubing every 10 feet.

3.10 LABELING AND IDENTIFICATION

- A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:
 - 1. Oxygen: White letters on green background or green letters on white background.

3.11 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

- A. Testing Agency: Engage qualified testing agency to perform field tests and inspections of specialty gas piping for nonhealthcare laboratory facilities and prepare test reports.
- B. Perform field tests and inspections of specialty gas piping for nonhealthcare laboratory facilities and prepare test reports.
- C. Tests and Inspections:
 - 1. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
 - 2. Repair leaks and retest until no leaks exist.
 - 3. Inspect specialty gas regulators for proper operation.

3.12 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical gas piping systems in healthcare facilities and prepare test reports.
- B. Perform tests and inspections of medical gas piping systems in healthcare facilities and prepare test reports.
- C. Tests and Inspections:
 - 1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.
 - 2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:
 - a. Initial blow down.
 - b. Initial pressure test.
 - c. Cross-connection test.
 - d. Piping purge test.
 - e. Standing pressure test for positive pressure medical gas piping.
 - f. Standing pressure test for vacuum systems.
 - g. Repair leaks and retest until no leaks exist.
 - 3. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical gas piping systems and perform the following tests and inspections:
 - a. Standing pressure test.
 - b. Individual-pressurization or pressure-differential cross-connection test.
 - c. Valve test.
 - d. Master and area alarm tests.
 - e. Piping purge test.
 - f. Piping particulate test.
 - g. Piping purity test.
 - h. Final tie-in test.
 - i. Operational pressure test.
 - j. Medical gas concentration test.
 - k. Medical air purity test.
 - l. Verify correct labeling of equipment and components.
 - m. Verify the following source equipment:
 - 1) Medical gas supply sources.
 - 4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.

- D. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.13 DEMONSTRATION

- A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain medical gas alarm system. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Mechanical sleeve seals.
 - 5. Sleeves.
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Coordination drawings.
 - 9. Project Record Drawings.
 - 10. TMS Asset Forms
 - 11. Trenching, excavating and backfilling.
 - 12. HVAC demolition.
 - 13. Equipment installation requirements common to equipment sections.
 - 14. Painting and finishing.
 - 15. Concrete bases.
 - 16. Supports and anchorages.

1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, 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.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
 - 1. CPVC: Chlorinated polyvinyl chloride plastic.
 - 2. PE: Polyethylene plastic.
 - 3. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.
- B. Welding certificates.

1.05 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a result of these modifications shall be borne by the contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.07 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

- G. Sequence, coordinate, and integrate removal of existing equipment and material as required to maintain services for existing building and for portions of remodeled areas at all times.

1.08 SCHEDULING AND PHASING

- A. All HVAC work shall be scheduled to meet project completion date. HVAC work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps, and dampers as required to support phasing. Refer to phasing schedule on drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 TRANSITION FITTINGS

- A. Acceptable Manufacturers:
 - 1. Eslon Thermoplastics.
 - 2. NIBCO, Inc.
 - 3. Thompson Plastics, Inc.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

2.05 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Acceptable Manufacturers:
 - 1. Capitol Manufacturing Co.
 - 2. Capico Inc.
 - 3. Epco Sales, Inc.
 - 4. Hart Industries, International, Inc.
 - 5. Watts Industries, Inc.; Water Products Div.
 - 6. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.06 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Acceptable Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.07 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.08 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated or Rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.09 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.10 COORDINATION DRAWINGS

- A. The contractor shall prepare CAD generated overall coordination drawings (min 1/4" scale) to coordinate HVAC systems installation with other trades. Following systems/items shall be indicated and co-coordinated, but not limited to, with each other based on input from installers of these systems:
 - 1. Ceiling layout.
 - 2. Sheet metal ductwork including locations of boxes, diffusers, grilles/registers, duct risers, fire/smoke dampers, etc.
 - 3. HVAC piping routing including locations of valves, expansion loops, risers, etc.
 - 4. Fire suppression piping mains, sprinkler heads, flow switches, etc.
 - 5. Plumbing piping routing including locations of valves, drops to fixtures, risers, etc.

6. Medical gas piping routing including locations of zone valves, drops to outlets/headwalls, etc.
 7. Electrical systems including locations of light fixtures, routing of main feeders/conduits larger than 3" dia., routing of cable tray, etc.
- B. Contractor shall obtain information of other systems from General Contractor, Electrical Contractor, Fire Suppression Contractor, Plumbing Contractor and others as required for incorporation in the coordination drawings.
 - C. Contractor shall arrange coordination meeting with other contractors, whose systems need coordination, to resolve conflicts.
 - D. See General Conditions for project coordination drawing requirements.
- 2.11 PROJECT RECORD DRAWINGS**
- A. See General Conditions for project record drawings requirements.
- 2.12 TMS ASSET FORMS**
- A. The Contractor shall populate and update Owner's TMS Asset forms for all areas renovated. This shall include listing information for all new equipment installed, existing equipment that is reused and deleting equipment removed during construction.

PART 3 - EXECUTION

3.01 HVAC DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material. Generally remove piping up to existing mains or valves.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material. Cap behind walls, chases, shafts or flush with floor. Patch surfaces to match existing adjacent surfaces.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material. Generally remove ducts up to existing mains or shut-off dampers.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- 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 minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. 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 with spring clips.
 - 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 or split-casting, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - h. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - j. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - 2. Existing Piping: Use the following:
 - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.

- d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
 - h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed hinge and set screw or spring clips.
 - i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Draining and Refilling of Systems: Provide all shutoff valves, drain valves, pipe, fittings, and miscellaneous material required to drain each existing system as required for new work. After new work is completed, tested, and found tight, refill each system as required. Time for shutting down existing system for draining shall be coordinated with all other work and with Owner's representative. Fill glycol system with type and percentage solutions as directed by Owner.

3.03 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic 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. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. 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.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.04 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete".

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.10 GROUTING

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

- A. Motors ½ HP and Larger: Three phase, unless shown otherwise.
- B. Motors Smaller than ½ HP: Single phase, unless shown otherwise.
- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- G. 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.
- H. Enclosure: Open drip-proof.

2.03 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: Separate winding for each speed.

- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F unless otherwise noted.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Motors under 100 hp – Provide shaft grounding ring on either the drive end or non-drive end of the motor in accordance with manufacturer's recommendations.
 - 6. Motors 100 hp and above – Provide ceramic bearing or bearing journal on non-drive end of the motor and shaft grounding ring on the opposite end in accordance with manufacturer's recommendations.
- C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.05 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.

- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 23
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Bronze angle valves.
 - 2. Brass ball valves.
 - 3. Bronze ball valves.
 - 4. Iron, single-flange butterfly valves.
 - 5. Iron, grooved-end butterfly valves.
 - 6. High-performance butterfly valves.
 - 7. Bronze lift check valves.
 - 8. Bronze swing check valves.
 - 9. Iron swing check valves.
 - 10. Iron, grooved-end swing-check valves.
 - 11. Iron, center-guided check valves.
 - 12. Bronze gate valves.
 - 13. Iron gate valves.
 - 14. Bronze globe valves.
 - 15. Iron globe valves.
 - 16. Chainwheels.
- B. Related Sections:
 - 1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
 - 2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.03 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.
- G. SWP: Steam working pressure.

1.04 SUBMITTALS

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

1.05 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 B31.1 for power piping valves.
 - 3. ASME B31.9 for building services piping valves.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle, gate, and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than 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 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 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 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. Grooved: With grooves according to AWWA C606.

3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

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

2.02 BRONZE ANGLE VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Crane Co.; Crane Valve Group.
 2. Hammond Valve.
 3. Milwaukee Valve Company.
 4. NIBCO INC.
- B. Class 150, Bronze Angle Valves with Bronze Disc:
1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - 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.

2.03 BRONZE BALL VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Valve, Inc.
 2. Conbraco Industries, In.; Apollo Valves.
 3. Crane Co.; Crane Valve Group; Crane Valves.
 4. Hammond Valve.
 5. Milwaukee Valve Company.
 6. NIBCO INC.
 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
1. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Stainless steel.
 - i. Ball: Stainless steel, vented.
 - j. Port: Full.

2.04 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Conbraco Industries, Inc.; Apollo Valves.
 - 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 3. Crane Co.; Crane Valve Group; Stockham Division.
 - 4. DeZurik Water Controls.
 - 5. Hammond Valve.
 - 6. Milwaukee Valve Company.
 - 7. NIBCO INC.
 - 8. Spence Strainers International; a division of CIRCOR International, Inc.
 - 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. 150 CWP, Iron, Single-Flange Butterfly Valves with EPDM or NBR Seat and Stainless-Steel Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 150 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM or NBR Seat and Stainless-Steel Disc:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM or NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Stainless steel.

2.05 IRON, GROOVED-END BUTTERFLY VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Co.; Crane Valve Group; Stockham Division.
 - 2. Hammond Valve.
 - 3. Kennedy Valve; a division of McWane, Inc.
 - 4. NIBCO INC.

- 5. Tyco Fire Products LP; Grinnell Mechanical Products.
- 6. Victaulic Company.
- B. 175 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 175 psig.
 - c. Body Material: Coated, ductile iron.
 - d. Stem: Two-piece stainless steel.
 - e. Disc: Coated, ductile iron.
 - f. Seal: EPDM.

- C. 300 CWP, Iron, Grooved-End Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. NPS 8 and Smaller CWP Rating: 300 psig.
 - c. NPS 10 and Larger CWP Rating: 200 psig.
 - d. Body Material: Coated, ductile iron.
 - e. Stem: Two-piece stainless steel.
 - f. Disc: Coated, ductile iron.
 - g. Seal: EPDM.

2.06 HIGH-PERFORMANCE BUTTERFLY VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bray Controls; a division of Bray International.
 - 2. Crane Co.; Crane Valve Group; Flowseal.
 - 3. Crane Co.; Crane Valve Group; Stockham Division.
 - 4. DeZurik Water Controls.
 - 5. Hammond Valve.
 - 6. Jamesbury; a subsidiary of Metso Automation.
 - 7. Milwaukee Valve Company.
 - 8. NIBCO INC.
 - 9. Tyco Valves & Controls; a unit of Tyco Flow Control.
- B. Class 150, Single-Flange, High-Performance Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 285 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, ductile iron, or stainless steel.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.

- g. Disc: Carbon steel.
 - h. Service: Bidirectional.
 - C. Class 300, Single-Flange, High-Performance Butterfly Valves:
 - 1. Description:
 - a. Standard: MSS SP-68.
 - b. CWP Rating: 720 psig at 100 deg F.
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: Carbon steel, cast iron, or ductile iron.
 - e. Seat: Reinforced PTFE or metal.
 - f. Stem: Stainless steel; offset from seat plane.
 - g. Disc: Carbon steel.
 - h. Service: Bidirectional.

2.07 BRONZE LIFT CHECK VALVES

- A. Acceptable Manufactures: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve, Inc.
 - 2. Crane Co.; Crane Valve Group; Crane Valves.
 - 3. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4. Crane Co.; Crane Valve Group; Stockham Division.
 - 5. Hammond Valve.
 - 6. Milwaukee Valve Company.
 - 7. NIBCO INC.
 - 8. Powell Valves.
 - 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, Lift Check Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.
- C. Class 125, Lift Check Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 61 or ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: NBR, PTFE, or TFE.

2.08 BRONZE SWING CHECK VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve, Inc.
 - 2. Crane Co.; Crane Valve Group; Crane Valves.
 - 3. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 4. Crane Co.; Crane Valve Group; Stockham Division.
 - 5. Hammond Valve.
 - 6. Milwaukee Valve Company.
 - 7. NIBCO INC.
 - 8. Powell Valves.
 - 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 150, Bronze Swing Check Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 300 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.09 IRON SWING CHECK VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 3. Crane Co.; Crane Valve Group; Stockham Division.
 - 4. Hammond Valve.
 - 5. Milwaukee Valve Company.
 - 6. NIBCO INC.
 - 7. Powell Valves.
 - 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, Iron Swing Check Valves with Metal Seats:
 - 1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

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

1. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Design: Clear or full waterway.
 - e. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - f. Ends: Flanged.
 - g. Trim: Bronze.
 - h. Gasket: Asbestos free.

2.10 IRON, GROOVED-END SWING CHECK VALVES

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

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Tyco Fire Products LP; Grinnell Mechanical Products.
 - c. Victaulic Company.
2. Description:
 - a. CWP Rating: 300 psig.
 - b. Body Material: ASTM A 536, ductile iron.
 - c. Seal: EPDM.
 - d. Disc: Spring operated, ductile iron or stainless steel.

2.11 IRON, CENTER-GUIDED CHECK VALVES

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

1. Anvil International, Inc.
2. DFT Inc.
3. Hammond Valve.
4. Metraflex, Inc.
5. Milwaukee Valve Company.
6. Mueller Steam Specialty; a division of SPX Corporation.
7. NIBCO INC.
8. Spence Strainers International; a division of CIRCOR International, Inc.
9. Watts Regular Co.; a division of Watts Water Technologies, Inc.

B. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:

1. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.

- e. Style: Compact wafer.
 - f. Seat: Bronze.
 - C. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Metal Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer, spring loaded.
 - f. Seat: Bronze.
 - D. Class 125, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer.
 - f. Seat: EPDM or NBR.
 - E. Class 150, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 300 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 250 psig.
 - d. Body Material: ASTM A 395/A 395M or ASTM A 536, ductile iron.
 - e. Style: Compact wafer.
 - f. Seat: EPDM or NBR.
 - F. Class 250, Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat:
 - 1. Description:
 - a. Standard: MSS SP-125.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 400 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron.
 - e. Style: Compact wafer, spring loaded.
 - f. Seat: EPDM or NBR.
- 2.12 BRONZE GATE VALVES**
- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. American Valve, Inc.
 - 2. Crane Co.; Crane Valve Group; Crane Valves.
 - 3. Crane Co.; Crane Valve Group; Jenkins Valves.

4. Crane Co.; Crane Valve Group; Stockham Division.
 5. Hammond Valve.
 6. Milwaukee Valve Company.
 7. NIBCO INC.
 8. Powell Valves.
 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 150, NRS Bronze Gate Valves:
1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- C. Class 150, RS Bronze Gate Valves:
1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
 - d. Ends: Threaded.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.13 IRON GATE VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Crane Co.; Crane Valve Group; Crane Valves.
 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 3. Crane Co.; Crane Valve Group; Stockham Division.
 4. Hammond Valve.
 5. Milwaukee Valve Company.
 6. NIBCO INC.
 7. Powell Valves.
 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, NRS, Iron Gate Valves:
1. Description:
 - a. Standard: MSS SP-70, Type I.

- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.
- C. Class 125, OS&Y, Iron Gate Valves:
 - 1. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 150 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.
- D. Class 250, NRS, Iron Gate Valves:
 - 1. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.
- E. Class 250, OS&Y, Iron Gate Valves:
 - 1. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. NPS 2-1/2 to NPS 12, CWP Rating: 500 psig.
 - c. NPS 14 to NPS 24, CWP Rating: 300 psig.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Disc: Solid wedge.
 - h. Packing and Gasket: Asbestos free.

2.14 BRONZE GLOBE VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Crane Co.; Crane Valve Group; Stockham Division.
 - 3. Hammond Valve.
 - 4. Milwaukee Valve Company.
 - 5. NIBCO INC.
 - 6. Powell Valves.
 - 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, Bronze Globe Valves with Bronze Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron.
- C. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig.
 - 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: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.
- D. Class 150, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 300 psig.
 - 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.

2.15 IRON GLOBE VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Crane Co.; Crane Valve Group; Crane Valves.
 - 2. Crane Co.; Crane Valve Group; Jenkins Valves.
 - 3. Crane Co.; Crane Valve Group; Stockham Division.
 - 4. Hammond Valve.
 - 5. Milwaukee Valve Company.
 - 6. NIBCO INC.
 - 7. Powell Valves.
 - 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- B. Class 125, Iron Globe Valves:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.
- C. Class 250, Iron Globe Valves:
 - 1. Description:
 - a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 500 psig.
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.16 CHAINWHEELS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babbitt Steam Specialty Co.
 - 2. Roto Hammer Industries.
 - 3. Trumbull Industries.
- B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
 - 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.01 EXAMINATION

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

3.02 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves 6 inches and larger and more than 96 inches above floor. Extend chains to 60 inches 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. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.

3.03 ADJUSTING

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

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly, or gate valves.
 - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
 - 3. Throttling Service except Steam: Globe or angle, ball, or butterfly valves.
 - 4. Throttling Service, Steam: Globe or butterfly valves.
 - 5. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided, metal or resilient-seat check valves.
- B. Pressure ratings for valves shall not be less than as required for system pressures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- D. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 and Larger: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 4. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 5. For Grooved-End Copper Tubing and Steel Piping except Steam and Steam Condensate Piping: Valve ends may be grooved.
- E. Ball valves used in steam or steam condensate service shall be rated for steam application.

3.05 CHILLED-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 150, bronze or nonmetallic disc.
 - 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 4. Bronze Swing Check Valves: Class 150, bronze disc.
 - 5. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, ductile-iron or stainless-steel disc.
 - 2. Iron, Single-Flange Butterfly Valves, NPS 14 and Larger: 150 CWP, EPDM or NBR seat, ductile-iron or stainless-steel disc.
 - 3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 or 300 CWP.
 - 4. High-Performance Butterfly Valves: Class 150 or Class 300, single flange.
 - 5. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
 - 6. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
 - 7. Iron, Center-Guided Check Valves: Class 125 or Class 150 or Class 250, compact-wafer, metal or resilient seat.
 - 8. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
 - 9. Iron Globe Valves: Class 125 or Class 250.

3.06 CONDENSER-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Bronze Angle Valves: Class 150, bronze or nonmetallic disc.
 - 3. Ball Valves: Two piece, full port, stainless-steel trim.
 - 4. Bronze Swing Check Valves: Class 150, bronze disc.
 - 5. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, stainless-steel disc.

2. Iron, Single-Flange Butterfly Valves, NPS 14 and Larger: 150 CWP, EPDM or NBR seat, stainless-steel disc.
3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 or 300 CWP.
4. High-Performance Butterfly Valves: Class 150 or Class 300, single flange.
5. Iron Swing Check Valves: Class 125 or Class 250, metal or nonmetallic-to-metal seats.
6. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
7. Iron, Center-Guided Check Valves, NPS 2-1/2 to NPS 24: Class 150 or Class 250, metal or resilient seat.
8. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
9. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125 or Class 250.

3.07 HEATING-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 150, bronze or nonmetallic disc.
 3. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 4. Bronze Swing Check Valves: Class 150, bronze disc.
 5. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM or NBR seat, ductile-iron or stainless-steel disc.
 2. Iron, Single-Flange Butterfly Valves, NPS 14 and Larger: 150 CWP, EPDM or NBR seat, ductile-iron or stainless-steel disc.
 3. Iron, Grooved-End Butterfly Valves, NPS 2-1/2 to NPS 12: 175 or 300 CWP.
 4. High-Performance Butterfly Valves: Class 150 or Class 300, single flange.
 5. Iron Swing Check Valves: Class 250, metal seats.
 6. Iron, Grooved-End Check Valves, NPS 3 to NPS 12: 300 CWP.
 7. Iron, Center-Guided Check Valves: Class 150 or Class 250, compact-wafer, metal or resilient seat.
 8. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
 9. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125 or Class 250.

3.08 LOW-PRESSURE STEAM VALVE SCHEDULE (15 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
1. Bronze Angle Valves: Class 150, bronze disc.
 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 3. Bronze Swing Check Valves: Class 150, bronze disc.
 4. Bronze Globe Valves: Class 150, bronze disc.
- B. Pipe NPS 2-1/2 and Larger:
1. High-Performance Butterfly Valves: Class 150 or Class 300, single flange.
 2. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
 3. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
 4. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125 or Class 250.

3.09 HIGH-PRESSURE STEAM VALVE SCHEDULE (MORE THAN 15 PSIG)

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Angle Valves: Class 150, bronze or nonmetallic disc.
 - 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves Class 150, bronze disc.
 - 4. Globe Valves 150, bronze, bronze disc.
- B. Pipe Sizes NPS 2-1/2 and Larger:
 - 1. High-Performance Butterfly Valves: Class 150 or Class 300, single flange.
 - 2. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
 - 3. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
 - 4. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125 or Class 250.

3.10 STEAM-CONDENSATE VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze Angle Valves: Class 150, bronze or nonmetallic disc.
 - 2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
 - 3. Bronze Swing Check Valves: Class 150, bronze or nonmetallic disc.
 - 4. Bronze Globe Valves: Class 150, bronze or nonmetallic disc.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. High-Performance Butterfly Valves: Class 150 or Class 300, single flange.
 - 2. Iron Swing Check Valves: Class 125 or Class 250, metal seats.
 - 3. Iron Gate Valves: Class 125 or Class 250, NRS or OS&Y.
 - 4. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125 or Class 250.

END OF SECTION

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 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
 - 1. Steel pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Fiberglass pipe hangers.
 - 4. Metal framing systems.
 - 5. Fiberglass strut systems.
 - 6. Thermal-hanger shield inserts.
 - 7. Fastener systems.
 - 8. Pipe stands.
 - 9. Equipment supports.
- B. Related Sections include the following:
 - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-protection piping.
 - 3. Division 23 Section "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
 - 4. Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation devices.
 - 5. Division 23 Section(s) "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Fiberglass pipe hangers.
 - 3. Thermal-hanger shield inserts.
 - 4. Powder-actuated fastener systems.
- B. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
 - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Acceptable Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Carpenter & Paterson, Inc.
 - 3. Empire Industries, Inc.
 - 4. Globe Pipe Hanger Products, Inc.
 - 5. Grinnell Corp.
 - 6. GS Metals Corp.
 - 7. National Pipe Hanger Corporation.
 - 8. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

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

2.4 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers: Similar to MSS Type 1, steel pipe hanger except hanger is made of fiberglass and continuous-thread rod and nuts are made of polyurethane or stainless steel.
 - 1. Acceptable Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Champion Fiberglass, Inc.
 - c. Cope, T. J., Inc.; Tyco International, Ltd.
 - d. Unistrut Corp.; Tyco International, Ltd.
- B. Strap-Type, Fiberglass Pipe Hangers: Made of fiberglass loop with stainless-steel continuous-thread rod, nuts, and support hook.
 - 1. Acceptable Manufacturers:
 - a. Plasti-Fab, Inc.

2.5 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Acceptable Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. GS Metals Corp.
 - 3. Power-Strut Div.; Tyco International, Ltd.
 - 4. Thomas & Betts Corporation.
 - 5. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 FIBERGLASS STRUT SYSTEMS

- A. Description: Shop- or field-fabricated pipe-support assembly, similar to MFMA-3, made of fiberglass channels and other components.
- B. Acceptable Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. Champion Fiberglass, Inc.
 - 3. Cope, T. J., Inc.; Tyco International Ltd.

2.7 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Acceptable Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. PHS Industries, Inc.
 - 3. Pipe Shields, Inc.
 - 4. Rilco Manufacturing Company, Inc.
 - 5. Value Engineered Products, Inc.

- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Acceptable Manufacturers:
 - a. B-Line Systems, Inc.; a division of Cooper Industries.
 - b. Empire Industries, Inc.
 - c. Hilti, Inc.
 - d. ITW Ramset/Red Head.
 - e. MKT Fastening, LLC.
 - f. Powers Fasteners.

2.9 PIPE STAND FABRICATION

- A. Pipe Stands, General: 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.
 - 1. Acceptable Manufacturers:
 - a. ERICO/Michigan Hanger Co.
 - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 1. Base: Plastic or Stainless steel.
 - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
 - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 - 1. Bases: One or more plastic.
 - 2. Vertical Members: Two or more protective-coated-steel channels.
 - 3. Horizontal Member: Protective-coated-steel channel.
 - 4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

- F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.10 EQUIPMENT SUPPORTS

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

2.11 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, 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 APPLICATIONS

- A. Specific hanger and support requirements are specified 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 padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
 11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
 12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
 16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
 17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 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 20, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. 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 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

- I. 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.
- J. 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.
- K. 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 absorb 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 absorb 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 absorb 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.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel 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 building structure.
- B. 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 above for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- H. Pipe Stand Installation:
 - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- P. Insulated Piping: Comply with the following:
 - 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 according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

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

3.6 PAINTING

- A. Touch Up: 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 minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Housed spring mounts.
 - 5. Elastomeric hangers.
 - 6. Spring hangers.
 - 7. Spring hangers with vertical-limit stops.
 - 8. Pipe riser resilient supports.
 - 9. Resilient pipe guides.
 - 10. Restrained vibration isolation roof-curb rails.
 - 11. Seismic snubbers.
 - 12. Restraining braces and cables.
 - 13. Steel and inertia, vibration isolation equipment bases.

1.03 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
 - 4. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 5. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

6. Seismic- and Wind-Restraint Details:

- a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
- B. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
- C. Welding certificates.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall be preapproved by agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. Kinetics Noise Control.
 3. Mason Industries.
 4. Vibration Eliminator Co., Inc.
 5. Vibration Isolation.
 6. Vibration Mountings & Controls, Inc.
- B. Pads Type A.1: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
1. Resilient Material: Oil- and water-resistant neoprene or rubber.

- C. Mounts Type A.2: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.
- D. Spring Isolators Type B.1: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 - 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. Restrained Spring Isolators Type B.2: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
 - 1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 - 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 - 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- F. Housed Spring Mounts Type B.3: Housed spring isolator with integral seismic snubbers.
 - 1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
 - 2. Base: Factory drilled for bolting to structure.
 - 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.
- G. Elastomeric Hangers Type B.4: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

- H. Spring Hangers Type B.5: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 - 7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- I. Spring Hangers with Vertical-Limit Stop Type B.6: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
 - 1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 - 8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.
- J. Thrust Limits – Type C.1: Combination coil spring and elastomeric insert with spring and insert in compression with a load stop. Include rod and angle-iron brackets for attaching to equipment.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 - 7. Coil Spring: Factory set and field adjustable for a maximum of ¼-inch movement at start and stop.

- K. Pipe Riser Resilient Support - Type D.1: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch-thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.
- L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch-thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Thybar Corporation.
 - 5. Vibration Eliminator Co., Inc.
 - 6. Vibration Isolation.
 - 7. Vibration Mountings & Controls, Inc.
- B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic and wind forces.
- C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic and wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
- D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch-thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - 1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or wind restraint.
 - a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - a. Resilient Material: Oil- and water-resistant standard neoprene or natural rubber.
- E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
- F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.03 VIBRATION ISOLATION EQUIPMENT BASES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. Kinetics Noise Control.
 3. Mason Industries.
 4. Vibration Eliminator Co., Inc.
 5. Vibration Isolation.
 6. Vibration Mountings & Controls, Inc.
- B. Steel Base – Type E.1: Factory-fabricated, welded, structural-steel bases and rails.
 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
- C. Inertia Base – Type E.2: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.04 SEISMIC-RESTRAINT DEVICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Amber/Booth Company, Inc.
 2. Cooper B-Line, Inc.; a division of Cooper Industries.

3. Hilti, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as acceptable to authorities having jurisdiction.
 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
 3. Maximum 1/4-inch air gap, and minimum 1/4-inch-thick resilient cushion.
- D. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- E. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- F. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- G. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- H. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.
- I. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- J. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- K. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.05 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 1. Install seismic snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
 2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 3. Install seismic-restraint devices using methods approved by authorities having jurisdiction providing required submittals for component.
- C. Piping Restraints:
 1. Comply with requirements in MSS SP-127.
 2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 3. Brace a change of direction longer than 12 feet.
- D. Install cables so they do not bend across edges of adjacent equipment or building structure.
- E. Install seismic-restraint devices using methods approved by authorities having jurisdiction providing required submittals for component.
- F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Division 22 Section "Hydronic Piping" for piping flexible connections.

3.05 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

3.06 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust air-spring leveling mechanism.
- D. Adjust active height of spring isolators.
- E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.07 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE FOR SLAB ON GRADE LOCATED EQUIPMENT

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Centrifugal fans	Floor	Up to 60 HP	E.1	A.2	0.25"
	Floor	75 HP and above	E.1	B.1	0.75"
Inline fans	Floor	Up to 40 HP	E.1	A.2	0.25"
	Suspended	All sizes	--	B.5	0.75"
Utility sets	Floor/Roof	All sizes	--	A.2	0.25"

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
	Suspended	All sizes	E.1	B.4	0.75"
Air Handling units	Floor	Up to 5" SP	--	A.1	0.25"
	Floor	Above 5" SP	--	A.1	0.25"
	Suspended	All sizes	--	B.5	0.75"
Centrifugal Chillers	Floor	All sizes	--	A.1	0.25"
Absorption Chillers	Floor	All sizes	--	A.1	0.25"
Reciprocating Chillers	Floor	All sizes	--	A.1	0.25"
Centrifugal Pumps	Floor	Up to 50 HP	E.1	A.2	0.25"
	Floor	Above 50 HP	E.2	B.1	0.75"
	Suspended	All sizes	--	B.5	0.25"
Boilers (steam or HW)	Floor	All sizes	--	A.2	0.25"
Cooling Towers with Centrifugal Fans	Floor	All sizes	--	A.2	0.25"
Cooling Tower with Propeller Fans	Floor	All sizes	--	A.2	0.25"
Air Cooled Condensing Units	Floor	Up to 20 HP	--	A.1	0.25"
	Floor	25 Hp and above	--	A.2	0.50"
Air Cooled Chillers	Floor	Up to 20 HP	--	A.1	0.25"
	Floor	25 HP and above	--	A.2	0.50"
Air Compressors	Floor	All sizes	E.1	B.1	1.0"
Piping – Horizontal	Suspended	All sizes	-	B.4	0.25"
Piping – Vertical	Floor	All sizes	--	D.1	0.25"
<p>Notes:</p> <ol style="list-style-type: none"> 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer. 2. Provide C.1 type (thrust limits) isolators for all fans, air handling units rated for more than 5" total static pressure. 3. Isolators indicated for horizontal piping is only for three (3) hangers on discharge/outlet and three (3) hangers on suction/inlet pipes for pumps, air compressors, vacuum pumps, and equipment mounted on type "B" isolators. Remaining piping does not require isolation. 4. Fans within air handling units, equipped with internal vibration isolators, shall not require isolation for fans as indicated in table above. 					

3.08 VIBRATION ISOLATOR AND SEISMIC – RESTRAINT SCHEDULE FOR EQUIPMENT LOCATED ABOVE GRADE

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Centrifugal Fans	Floor	Up to 40 HP	E.1	B.1	2.0"
	Floor	50HP and above	E.2	B.1	2.0"
Inline Fans	Floor	Up to 40 HP	E.1	B.1	1.0"
	Suspended	All sizes	--	B.6	1.0"
Utility Sets	Floor/Roof	All sizes	--	B.1	0.75"
	Suspended	All sizes	E.1	B.4	0.75"
Air Handling Units	Floor	All sizes	--	B.1	1.0"
	Suspended	All sizes	--	B.6	1.0"
	Roof Top	All sizes	--	Roof curb rails	1.0"

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Centrifugal Chillers	Floor	All sizes	--	B.2	0.75"
Absorption Chillers	Floor	All sizes	--	B.2	0.75"
Reciprocating Chiller	Floor	All sizes	--	B.2	0.75"
Centrifugal Pumps	Floor	All sizes	E.2	B.1	1"
	Suspended	All sizes	--	B.5	0.25"
Boilers (steam or HW)	Floor	All sizes	--	A.2	0.25"
Cooling Towers with Centrifugal Fans	Roof	All sizes	E.1	B.2	1.0"
Cooling Towers with Propeller Fans	Roof	All sizes	E.1	B.2	1.0"
Air Cooled Condensing Units	Roof	Up to 20 HP	--	A.1	0.25"
	Roof	25 HP and above	--	B.2	0.75"
Air Cooled Condensers	Roof	All sizes	--	A.1	0.25"
Air Cooled Chillers	Roof	Up to 20 HP	--	A.1	0.25"
	Roof	25 HP and above	--	B.2	1.0"
Air Compressors	Floor	All sizes	E.2	E.2	1.0"
Piping – Horizontal	Suspended	All sizes	--	B.4	0.25"
Piping – Vertical	Floor	All sizes	--	D.1	0.25"
<p>Notes:</p> <ol style="list-style-type: none"> 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer. 2. Provide C.1 type (thrust limits) isolators for all fans, air handling units rated for more than 5" total static pressure. 3. Isolators indicated for horizontal piping is only for three (3) hangers on discharge/outlet and three (3) hangers on suction/inlet pipes for pumps, air compressors, vacuum pumps, and equipment mounted on type "B" isolators. Remaining piping does not require isolation. 4. Fans within air handling units, equipped with internal vibration isolators, shall not require isolation for fans as indicated in table above. 					

END OF SECTION

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.
 - 8. Ceiling Grid Labels

1.03 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.

1.04 COORDINATION

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

PART 2 - PRODUCTS

2.01 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch 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.
 - 3. Minimum Letter Size: 1/2 inch 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 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, 1/16 inch 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.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum Letter Size: 1/2 inch 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 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 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.

2.02 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/2 inch 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 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.

2.03 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 partially cover 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 high.

2.04 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch 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.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/2 inch 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 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 high.

2.05 STENCILS

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

2.06 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch 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 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.

2.07 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches.
 - 2. Fasteners: Reinforced grommet and wire or string.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

2.08 CEILING GRID LABELS

- A. Self-Adhesive Vinyl Labels for valves, fire dampers, fire/smoke dampers, controls and equipment: Minimum 1/2" Preprinted, flexible label to match Owner's standards. Color as directed.

PART 3 - EXECUTION

3.01 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.

3.02 EQUIPMENT LABEL INSTALLATION

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

3.03 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "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, 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 along each run. Reduce intervals to 25 feet in areas of congested piping and equipment, within mechanical rooms, boiler rooms, chiller rooms, etc.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

- D. In general follow Pipe Label Color Schedule as shown below, unless the Owner has different schedule standards in which case the Owner's schedule shall be followed:
1. Chilled-Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 2. Condenser-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 3. Heating Water Piping:
 - a. Background Color: Orange.
 - b. Letter Color: White.
 4. Refrigerant Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 5. Low-Pressure Steam Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: White.
 6. High-Pressure Steam Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: White.
 7. Steam Condensate Piping:
 - a. Background Color: Yellow.
 - b. Letter Color: White.

3.04 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
1. Blue: For cold-air supply ducts.
 2. Yellow: For hot-air supply ducts.
 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- 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 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 in each space where ducts are exposed or concealed by removable ceiling system. Reduce intervals to 25 feet in areas of congested piping and equipment, within mechanical rooms, boiler rooms, chiller rooms, etc.

3.05 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. Chilled Water: 1-1/2 inches, round.
 - b. Condenser Water: 1-1/2 inches, round.
 - c. Refrigerant: 1-1/2 inches, round.
 - d. Hot Water: 1-1/2 inches, round.
 - e. Gas: 1-1/2 inches, round.
 - f. Low-Pressure Steam: 1-1/2 inches, round.
 - g. High-Pressure Steam: 1-1/2 inches, round.
 - h. Steam Condensate: 1-1/2 inches, round.
2. Valve-Tag Color:
 - a. Chilled Water: Natural.
 - b. Condenser Water: Natural.
 - c. Refrigerant: Natural.
 - d. Hot Water: Natural.
 - e. Gas: Natural.
 - f. Low-Pressure Steam: Natural.
 - g. High-Pressure Steam: Natural.
 - h. Steam Condensate: Natural.
3. Letter Color:
 - a. Chilled Water: Black.
 - b. Condenser Water: Black.
 - c. Refrigerant: Black.
 - d. Hot Water: Black.
 - e. Gas: Black.
 - f. Low-Pressure Steam: Black.
 - g. High-Pressure Steam: Black.
 - h. Steam Condensate: Black.

3.06 WARNING-TAG INSTALLATION

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

3.07 CEILING GRID LABELS

- A. Install ceiling grid labels for all equipment located above ceilings such as HVAC valves, fire and fire/smoke dampers, VAV boxes, air valves, controls and miscellaneous equipment. Color of labels shall match owner's standards.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - b. Dual-duct systems.
 - c. Variable-air-volume systems.
 - d. Multizone systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.
 - c. Primary-secondary hydronic systems.
 - 3. Duct leak testing.

1.03 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.04 SUBMITTALS

- A. Qualification Data: Within 15 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.

1.05 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect, 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 and Commissioning Authority.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.06 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.

1.07 Coordination

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

- A. 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 Division 23 Section "Metal Ducts/Nonmetal 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 terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

- A. Prepare a TAB plan that includes 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. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.

7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 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" or 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 62.1-2004, 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 Division 23 Section "Air Duct Accessories."
 3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC 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.

3.04 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. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.05 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 or Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 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.

3.06 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check liquid level in expansion tank.
 - 3. Check makeup water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.07 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from Architect or Commissioning Authority and comply with requirements in Division 23 Section "Hydronic Pumps."
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
 - 1. Determine the balancing station with the highest percentage over indicated flow.
 - 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 - 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

3.08 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.09 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.10 PROCEDURES FOR STEAM SYSTEMS

- A. Measure and record upstream and downstream pressure of each piece of equipment.
- B. Measure and record upstream and downstream steam pressure of pressure-reducing valves.
- C. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- D. Check settings and operation of each safety valve. Record settings.
- E. Verify the operation of each steam trap.

3.11 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.

3.12 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Measure, adjust, and record the following data for each water coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering and leaving air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.
- B. Measure, adjust, and record the following data for each electric heating coil:
 - 1. Nameplate data.
 - 2. Airflow.
 - 3. Entering- and leaving-air temperature at full load.
 - 4. Voltage and amperage input of each phase at full load and at each incremental stage.
 - 5. Calculated kilowatt at full load.
 - 6. Fuse or circuit-breaker rating for overload protection.
- C. Measure, adjust, and record the following data for each steam coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Airflow.
 - 3. Air pressure drop.
 - 4. Inlet steam pressure.
- D. Measure, adjust, and record the following data for each refrigerant coil:
 - 1. Dry-bulb temperature of entering and leaving air.
 - 2. Wet-bulb temperature of entering and leaving air.
 - 3. Airflow.
 - 4. Air pressure drop.
 - 5. Refrigerant suction pressure and temperature.

3.14 PROCEDURES FOR DUCT SYSTEM LEAK TESTING

- A. Before testing ducts for leaks, observe the ductwork to verify completeness of installation and caps provided at end of sections to seal. Duct systems can be leak tested in sections if phasing or construction schedule prevents it to test entire system.
- B. All supply air ducts and sections from air handling units to inlet of boxes shall be leak tested. All return air ducts from return air grilles to return/relief air fan shall be leak tested. Ten percent (10%) of supply air ducts downstream of boxes, but not less than five systems, shall be leak tested. Two exhaust air duct systems shall be leak tested.
- C. Tests shall be conducted at 150% of static pressures, but not more than 6" wg, as identified in static pressure class.
- D. Provide blower, measuring instruments and other accessories as required to conduct leak tests. Each section or system shall be maintained at test pressure for minimum 30 minutes.
- E. Duct system leakage shall not exceed 5% of design air flow. If system is tested in sections, than total leakage of all sections shall not exceed 5% of design air flow.

- F. Record tests results and deficiencies for each section of system and submit to Architect or Commissioning Authority for review.
- G. Coordinate duct leak testing with contractor.

3.15 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 - 3. Check the refrigerant charge.
 - 4. Check the condition of filters.
 - 5. Check the condition of coils.
 - 6. Check the operation of the drain pan and condensate-drain trap.
 - 7. Check bearings and other lubricated parts for proper lubrication.
 - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 - 1. New filters are installed.
 - 2. Coils are clean and fins combed.
 - 3. Drain pans are clean.
 - 4. Fans are clean.
 - 5. Bearings and other parts are properly lubricated.
 - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
 - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
 - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
 - 4. Balance each air outlet.

3.16 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 5 percent.
 - 2. Air Outlets and Inlets: Plus or minus 5 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.17 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 biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.18 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Fan curves.
 - 3. Manufacturers' test data.
 - 4. Field test reports prepared by system and equipment installers.
 - 5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Data for terminal units, including manufacturer's name, type, size, and fittings.

14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outdoor-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
 1. Quantities of outdoor, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- 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.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - j. Number, make, and size of belts.
 - k. Number, type, and size of filters.
 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):
 - a. Total air flow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Filter static-pressure differential in inches wg.
 - f. Preheat-coil static-pressure differential in inches wg.
 - g. Cooling-coil static-pressure differential in inches wg.
 - h. Heating-coil static-pressure differential in inches wg.
 - i. Outdoor airflow in cfm.
 - j. Return airflow in cfm.
 - k. Outdoor-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- F. Apparatus-Coil Test Reports:
 1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in fins per inch o.c.
 - f. Make and model number.
 - g. Face area in sq. ft.
 - h. Tube size in NPS.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.
 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Average face velocity in fpm.
 - c. Air pressure drop in inches wg.
 - d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
 - e. Return-air, wet- and dry-bulb temperatures in deg F.
 - f. Entering-air, wet- and dry-bulb temperatures in deg F.
 - g. Leaving-air, wet- and dry-bulb temperatures in deg F.
 - h. Water flow rate in gpm.
 - i. Water pressure differential in feet of head or psig.
 - j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in psig.

- n. Refrigerant suction temperature in deg F.
 - o. Inlet steam pressure in psig.
- G. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- H. 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.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated air flow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual air flow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.

- I. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Apparatus used for test.
 - d. Area served.
 - e. Make.
 - f. Number from system diagram.
 - g. Type and model number.
 - h. Size.
 - i. Effective area in sq. ft.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary air flow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final air flow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
- J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
 - 1. Unit Data:
 - a. System and air-handling-unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Air flow rate in cfm.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. Water pressure drop in feet of head or psig.
 - e. Entering-air temperature in deg F.
 - f. Leaving-air temperature in deg F.
- K. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.

- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.
- 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
- L. Instrument Calibration Reports:
 - 1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.19 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, but not less than six.
 - b. Measure water flow of at least 5 percent of terminals, but not less than two.
 - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

- d. Verify that balancing devices are marked with final balance position.
 - e. 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 or Commissioning Authority.
 - 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect or Commissioning Authority.
 - 3. Architect or 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.

3.20 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00
HVAC INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Insulation Materials:
 - a. Calcium silicate.
 - b. Cellular glass.
 - c. Flexible elastomeric.
 - d. Mineral fiber.
 - 2. Fire-rated insulation systems.
 - 3. Insulating cements.
 - 4. Adhesives.
 - 5. Mastics.
 - 6. Lagging adhesives.
 - 7. Sealants.
 - 8. Factory-applied jackets.
 - 9. Field-applied fabric-reinforcing mesh.
 - 10. Field-applied cloths.
 - 11. Field-applied jackets.
 - 12. Tapes.
 - 13. Securements.
 - 14. Corner angles.
- B. Related Sections:
 - 1. Division 21 Section "Fire-Suppression Systems Insulation."
 - 2. Division 22 Section "Plumbing Insulation."
 - 3. Division 23 Section "Metal Ducts" for duct liners.
 - 4. Division 33 Section "Underground Hydronic Energy Distribution" for loose-fill pipe insulation in underground piping outside the building.
 - 5. Division 33 Section "Underground Steam and Condensate Distribution Piping" for loose-fill pipe insulation in underground piping outside the building.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, 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 attachment and covering of heat tracing inside insulation.
 - 3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per 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 and inspecting agency.
 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 INSULATION MATERIALS

- A. Comply with requirements in Part 3 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. Calcium Silicate: Inorganic, non-combustible, asbestos free high temperature with high structural strength.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Industrial Insulation Group.
 - b. Owens Corning Fiberglass Corp.
 - c. Pabco.
 - d. Schuller International Inc.
 - 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 performing insulation to cover valves, elbows, tees, and flanges.
 - 5. Density: 14.5 lbs./cu. ft.
 - 6. Thermal Conductivity: Not exceeding 0.45 BTU – in/hour sq. ft. °F at 300°F mean temperature.
- G. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. NOMACO Insulation.
 - 2. Thermal Conductivity: Not exceeding 0.25 BTU-in/hour °F at 75°F mean temperature.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning Fiberglas Corp.
 - 2. Density: 1.9 lbs/cu. ft.
 - 3. Thermal Conductivity: Not exceeding 0.25 BTU-in/hour sq. ft. °F at 75°F mean temperature.

- I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Owens Corning Fiberglas Corp.
 - 2. Density: 3.0 lbs/cu. ft.
 - 3. Thermal Conductivity: Not exceeding 0.30 BTU-in/hour sq. ft. °F at 100°F mean temperature.
- J. 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 ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning Fiberglas Corp.
 - 2. Density: 3.0 lbs/cu. ft.
 - 3. Thermal Conductivity: Not exceeding 0.23 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- K. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville.
 - b. Owens Corning Fiberglas Corp.
 - c. Rock Wool Manufacturing Company.
 - 2. Density: 3.0 lbs/cu. ft.
 - 3. Thermal Conductivity: Not exceeding 0.30 BTU-in/hour sq. ft. °F at 100°F mean temperature.
- L. Mineral-Fiber, Preformed Pipe Insulation:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville.
 - b. Knauf Insulation.
 - c. Manson Insulation Inc.
 - d. Owens Corning Fiberglas Corp.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 3. Thermal Conductivity: Not exceeding 0.23 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.
 - b. Johns Manville.
 - c. Knauf Insulation.
 - d. Manson Insulation Inc.
 - e. Owens Corning Fiberglas Corp.
 2. Density: 2.5 lbs/cu. ft.
 3. Thermal Conductivity: Not exceeding 0.27 BTU-in/hour sq. ft. °F at 75°F mean temperature.

2.02 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.03 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.
 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. Foster Products Corporation, H. B. Fuller Company.
 - c. Marathon Industries, Inc.
 - d. Mon-Eco Industries, Inc.
 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
 1. Acceptable Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LCC.
 - c. Foster Products Corporation, H. B. Fuller Company.
 - d. RBX Corporation.
 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
 - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. Foster Products Corporation, H. B. Fuller Company.
 - c. ITW TACC, Division of Illinois Tool Works.
 - d. Marathon Industries, Inc.
 - e. Mon-Eco Industries, Inc.
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. PVC Jacket Adhesive: Compatible with PVC jacket.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dow Chemical Company (The).
 - b. Johns-Manville.
 - c. P.I.C. Plastics, Inc.
 - d. Speedline Corporation
 - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.04 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-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. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Childers Products, Division of ITW.
 - 2. Foster Products Corporation, H. B. Fuller Company.
 - 3. ITW TACC, Division of Illinois Tool Works.
 - 4. Marathon Industries, Inc.
 - 5. Mon-Eco Industries, Inc.
- C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
 - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.05 perm at 43-mil dry film thickness.
 - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 4. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. Color: White.

2.05 SEALANTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Childers Products, Division of ITW.
 2. Foster Products Corporation, H. B. Fuller Company.
 3. Marathon Industries, Inc.
 4. Mon-Eco Industries, Inc.
 5. Pittsburgh Corning Corporation.
- B. Joint Sealants for Cellular Glass:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Permanently flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 100 to plus 300 deg F.
 4. Color: White or gray.
 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. FSK and Metal Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: Aluminum.
 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
 1. Materials shall be compatible with insulation materials, jackets, and substrates.
 2. Fire- and water-resistant, flexible, elastomeric sealant.
 3. Service Temperature Range: Minus 40 to plus 250 deg F.
 4. Color: White.
 5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.06 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 when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.07 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. (68 g/sq. m) with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

2.08 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.09 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. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville.
 - b. P.I.C. Plastics, Inc.
 - c. Proto PVC Corporation.
 - d. Speedline Corporation.
 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.
 5. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Childers Products, Division of ITW.
 - b. PABCO Metals Corporation.
 - c. RPR Products, Inc.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.

- c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 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.
- 3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240.
 - a. Factory cut and rolled to size.
 - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed 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.
- E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.
- F. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

2.10 TAPES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Avery Dennison Corporation, Specialty Tapes Division.

2. Compac Corp.
3. Ideal Tape Co., Inc., an American Biltrite Company.
4. Venture Tape.
- B. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
 1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- C. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
 1. Width: 3 inches.
 2. Thickness: 6.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
 1. Width: 2 inches.
 2. Thickness: 3.7 mils.
 3. Adhesion: 100 ounces force/inch in width.
 4. Elongation: 5 percent.
 5. Tensile Strength: 34 lbf/inch in width.

2.11 SECUREMENTS

- A. Bands:
 1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
 2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
 3. 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-diameter shank, length to suit depth of insulation indicated.
 2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
 - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 1. Verify that systems and equipment 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.

3.02 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.
- 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.

3.03 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and 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 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. Manholes.
 5. Handholes.
 6. Cleanouts.

3.04 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 1. Seal penetrations with flashing sealant.
 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 4. Seal jacket to roof flashing with flashing sealant.

- B. Insulation Installation at 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.
 - 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. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
 - 2. Pipe: Install insulation continuously through floor penetrations.
 - 3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.05 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.

- f. Impale insulation over anchor pins and attach speed washers.
 - g. 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.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
 1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch-diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 2. Fabricate boxes from galvanized steel or aluminum, at least 0.040 inch thick.
 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.06 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, vessels, and equipment. 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.

3.07 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- 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.

3.08 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes:
 1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
 2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
 2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Impale insulation over pins and attach speed washers.
 - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

- a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- F. 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 and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
 - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
 - d. Do not overcompress insulation during installation.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.09 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
 1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch 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 overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 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 Division 07 Section "Penetration Firestopping."

3.11 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

2. Inspect field-insulated equipment, 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 type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
1. Indoor, concealed supply and outdoor air.
 2. Indoor, exposed supply and outdoor air.
 3. Indoor, concealed return and relief air located in nonconditioned space.
 4. Indoor, exposed return and relief air located in nonconditioned space, chiller room, boiler room, mechanical room.
 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 7. Indoor, concealed oven and warewash exhaust.
 8. Indoor, exposed oven and warewash exhaust.
 9. Outdoor, concealed supply, return and relief air.
 10. Outdoor, exposed supply, return and relief air.
- B. Items Not Insulated:
1. Fibrous-glass ducts.
 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 3. Factory-insulated flexible ducts.
 4. Factory-insulated plenums and casings.
 5. Flexible connectors.
 6. Vibration-control devices.
 7. Factory-insulated access panels and doors.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, rectangular, round and flat-oval, supply-air, outdoor-air, return air and relief-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick.
 2. Mineral-Fiber Board: 1-1/2 inches thick.
- B. Concealed, supply-air plenum, outdoor-air plenum, plenums for laminar flow diffusers and plenums for HEP filter equipped diffusers, insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-½ inches thick.
 2. Mineral-Fiber Board: 1-½ inches thick.

- C. Exposed rectangular, round and flat-oval, supply-air, outdoor-air, return-air and relief-air duct insulation shall be the following:
 - 1. Mineral-Fiber Board: 1-½ inches thick.
- D. Exposed, supply-air, outdoor-air and relief-air plenum insulation shall be the following:
 - 1. Mineral-Fiber Board: 1-1/2 inches thick.

3.15 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.
- B. Concealed, rectangular, round and flat-oval, supply-air, return-air and relief-air duct insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick.
 - 2. Mineral-Fiber Board: 2 inches thick.
- C. Concealed, supply-air and return-air plenum insulation shall be one of the following:
 - 1. Mineral-Fiber Blanket: 2 inches thick.
 - 2. Mineral-Fiber Board: 2 inches thick.
- D. Exposed, rectangular, round and flat-oval, supply-air, return-air and relief air duct and plenum insulation shall be the following:
 - 1. Mineral-Fiber Board: 2 inches thick.

3.16 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Heat-exchanger (water-to-water for heating service and steam to hot water) insulation shall be one of the following:
 - 1. Calcium Silicate: 3 inches thick.
 - 2. Cellular Glass: 3 inches thick.
 - 3. Mineral-Fiber Board: 2 inches thick.
 - 4. Mineral-Fiber Pipe and Tank: 2 inches thick.

3.17 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.

3.18 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.

- B. Chilled Water, Glycol and Brine:
 - 1. NPS 4 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
 - 2. NPS 5 to NPS 8: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.
 - 3. NPS 10 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.
- C. Heating-Hot-Water Supply and Return, Snow Melting Supply and Return:
 - 1. NPS 2 and Smaller: Insulation shall be one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.
 - 2. NPS 2-1/2 to NPS 6: Insulation shall be one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inches thick.
 - 3. NPS 8 and Larger: Insulation shall be the following:
 - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
- D. Steam, Steam Condensate, Boiler Feed Water, Condensate Pump Discharge, Condensate Pump Receiver Vent to 7 ft., Flash Tank Vent to 7 ft., Steam Relief Vent:
 - 1. NPS 2 and Smaller: Insulation shall be one of the following:
 - a. Calcium Silicate: 2 inches thick.
 - b. Cellular Glass: 1-1/2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
 - 2. NPS 2-1/2 to NPS 6: Insulation shall be one of the following:
 - a. Calcium Silicate: 3 inches thick.
 - b. Cellular Glass: 2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 1-1/2 inches thick.
 - 3. NPS 8 and Larger: Insulation shall be one of the following:
 - a. Calcium Silicate: 4 inches thick.
 - b. Cellular Glass: 3 inches thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 2 inches thick.
- E. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- F. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 3/4 inch thick.
- G. Hot Service Drains:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches thick.

- b. Cellular Glass: 1-1/2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.
 - H. Hot Service Vents:
 - 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Calcium Silicate: 1-1/2 inches thick.
 - b. Cellular Glass: 1-1/2 inches thick.
 - c. Mineral-Fiber, Preformed Pipe, Type I or II: 1 inch thick.

3.19 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Refrigerant Suction and Hot-Gas Piping:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.
- B. Refrigerant Suction and Hot-Gas Flexible Tubing:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Flexible Elastomeric: 2 inches thick.

3.20 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Ducts and Plenums, Concealed:
 - 1. None.
- D. Ducts and Plenums, Exposed:
 - 1. None.
- E. Equipment, Concealed:
 - 1. None.
- F. Equipment, Exposed:
 - 1. None.
- G. Piping, Concealed:
 - 1. None.
- H. Piping, Exposed:
 - 1. None.

END OF SECTION

SECTION 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 - GENERAL

1.01 Related Documents

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

1.02 Summary

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Related Sections include the following:
 - 1. Division 23 Section "Meters and Gages for HVAC Piping" for measuring equipment that relates to this Section.
 - 2. Division 23 Section "Sequence of Operations for HVAC Controls" for requirements that relate to this Section.

1.03 Definitions

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.
- D. MS/TP: Master slave/token passing.
- E. PC: Personal computer.
- F. PID: Proportional plus integral plus derivative.
- G. RTD: Resistance temperature detector.

1.04 System Performance

- A. Comply with the following performance requirements:
 - 1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
 - 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 - 3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
 - 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 - 5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
 - 6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
 - 7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 - 8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.

- c. Water Pressure: Plus or minus 2 percent of full scale.
- d. Space Temperature: Plus or minus 1 deg F.
- e. Ducted Air Temperature: Plus or minus 1 deg F.
- f. Outside Air Temperature: Plus or minus 2 deg F.
- g. Dew Point Temperature: Plus or minus 3 deg F.
- h. Temperature Differential: Plus or minus 0.25 deg F.
- i. Relative Humidity: Plus or minus 5 percent.
- j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
- k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
- l. Airflow (Terminal): Plus or minus 10 percent of full scale.
- m. Air Pressure (Space): Plus or minus 0.01-inch wg.
- n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
- o. Carbon Monoxide: Plus or minus 5 percent of reading.
- p. Carbon Dioxide: Plus or minus 50 ppm.
- q. Electrical: Plus or minus 5 percent of reading.

1.05 Sequence of Operation

1.06 Submittals

- A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Details of control panel faces, including controls, instruments, and labeling.
 - 5. Written description of sequence of operation.
 - 6. Schedule of dampers including size, leakage, and flow characteristics.
 - 7. Schedule of valves including flow characteristics.
 - 8. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams and floor plans for field sensors and control hardware.

- c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
 - 9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
 - 10. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
 - C. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
 - D. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.
 - E. Software and Firmware Operational Documentation: Include the following:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.
 - 5. Software license required by and installed for DDC workstations and control systems.
 - F. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions.
 - G. Qualification Data: For Installer and manufacturer.
 - H. Field quality-control test reports.
 - I. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
 - 2. Interconnection wiring diagrams with identified and numbered system components and devices.
 - 3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 - 4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 - 5. Calibration records and list of set points.
- 1.07 Quality Assurance**
- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
 - 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 ASHRAE 135 for DDC system components.

1.08 Delivery, Storage, and Handling

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.09 Coordination

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment with Division 28 Section "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- C. Coordinate equipment with Division 28 Section "Access Control" to achieve compatibility with equipment that interfaces with that system.
- D. Coordinate equipment with Division 27 Section "Clock Systems" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Division 28 Section "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Division 26 Section "Network Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate equipment with Division 28 Section "Fire Detection and Alarm" to achieve compatibility with equipment that interfaces with that system.
- H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- I. Coordinate equipment with Division 26 Section "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- J. Coordinate equipment with Division 26 Section "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- K. Coordinate equipment with Division 26 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.
- L. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

1.10 Extra Materials

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Maintenance Materials: One thermostat adjusting key(s).
 - 2. Maintenance Materials: One pneumatic thermostat test kit.

PART 2 - PRODUCTS

2.01 Manufacturers

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 Control System

- A. Acceptable Manufacturers:
 - 1. Johnson Controls, Inc.; Controls Group.

2.03 Control System Components

- A. Acceptable Manufacturers:
 - 1. Alerton Inc.
 - 2. American Auto-Matrix.
 - 3. BEC Controls Corporation.
 - 4. Belimo Aircontrols.
 - 5. Cleveland Control.
 - 6. Delta Controls Inc.
 - 7. Ebtron, Inc.
 - 8. Functional Devices Inc.
 - 9. Grasslin Controls Corp.
 - 10. Hayward Industrial Products, Inc.
 - 11. Hoffman Enclosures, Inc.
 - 12. Kele Inc.
 - 13. Leslie Controls, Inc.
 - 14. MAMAC Systems, Inc.
 - 15. Magnatrol Valve Corp.
 - 16. Parker Hannifin Corp.
 - 17. Paragon Electric Co.
 - 18. Setra Corporation.
 - 19. Solidyne Corp.
 - 20. Spence Engineering Company, Inc.
 - 21. TCS/Basys Controls.
 - 22. tekmar Control Systems, Inc.
 - 23. Teletrol Systems Incorporated.
 - 24. Time Mark Corporation.
 - 25. Tour & Andersson Control, Inc.
 - 26. Triangle MicroSystems, Inc.
 - 27. Vaisala, Inc.
 - 28. Veris Industries.
 - 29. Voltec, Inc.
- B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- C. Control system shall include the following:
 - 1. Building lighting control system specified in Division 26 Section "Network Lighting Controls."

2.04 DDC Equipment

- A. Operator Workstation: PC-based microcomputer(s) with minimum configuration as follows:
1. Motherboard: With 8 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 2. Processor: Intel Pentium 4, 1.7 GHz.
 3. Random-Access Memory: 512 MB.
 4. Graphics: Video adapter, minimum 1280 x 1024 pixels, 64-MB video memory, with TV out.
 5. Monitor: 21 inches, LCD color.
 6. Keyboard: QWERTY, 105 keys in ergonomic shape.
 7. Floppy-Disk Drive: 1.44 MB.
 8. Hard-Disk Drive: 80 GB.
 9. CD-ROM Read/Write Drive: 48x24x48.
 10. Mouse: Three button, optical.
 11. Uninterruptible Power Supply: Two (2) kVa.
 12. Operating System: Microsoft Windows XP Professional with high-speed Internet access.
 - a. ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 13. Printer: Color, ink-jet type as follows:
 - a. Print Head: 4800 x 1200 dpi optimized color resolution.
 - b. Paper Handling: Minimum of 100 sheets.
 - c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
 14. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 10 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.
 - i. Trend logs retrievable in spreadsheets and database programs.
 - j. Alarm and event processing.
 - k. Object and property status and control.
 - l. Automatic restart of field equipment on restoration of power.
 - m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.
 - 3) Disabled objects.

- 4) Alarm lockout objects.
 - 5) Logs.
 - n. Custom report development.
 - o. Utility and weather reports.
 - p. Workstation application editors for controllers and schedules.
 - q. Maintenance management.
- 15. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.
 - f. Contains predefined time variables.
- B. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:
 - 1. System: With one integrated USB 2.0 port, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 - 2. Processor: Intel Pentium 4, 800 MHz.
 - 3. Random-Access Memory: 128 MB.
 - 4. Graphics: Video adapter, minimum 1024 x 768 pixels, 64-MB video memory.
 - 5. Monitor: 17 inches, LCD color.
 - 6. Keyboard: QWERTY 105 keys in ergonomic shape.
 - 7. Floppy-Disk Drive: 1.44 MB.
 - 8. Hard-Disk Drive: 10 GB.
 - 9. CD-ROM Read/Write Drive: 48x24x48.
 - 10. Pointing Device: Touch pad or other internal device.
- C. Control Units: Modular, comprising processor board with programmable, nonvolatile, random-access memory; local operator access and display panel; integral interface equipment; and backup power source.
 - 1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
 - 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 - d. Software applications, scheduling, and alarm processing.
 - e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

3. Standard Application Programs:
 - a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
 - b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
 - c. Chiller Control Programs: Control function of condenser-water reset, chilled-water reset, and equipment sequencing.
 - d. Programming Application Features: Include trend point; alarm processing and messaging; weekly, monthly, and annual scheduling; energy calculations; run-time totalization; and security access.
 - e. Remote communications.
 - f. Maintenance management.
 - g. Units of Measure: Inch-pound and SI (metric).
4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
5. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.
 1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
 2. Stand-alone mode control functions operate regardless of network status. Functions include the following:
 - a. Global communications.
 - b. Discrete/digital, analog, and pulse I/O.
 - c. Monitoring, controlling, or addressing data points.
 3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.
 4. ASHRAE 135 Compliance: Control units shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
- E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
 1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.

6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.
- F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
 1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.
- G. Power Line Filtering: Internal or external transient voltage and surge suppression for workstations or controllers with the following:
 1. Minimum dielectric strength of 1000 V.
 2. Maximum response time of 10 nanoseconds.
 3. Minimum transverse-mode noise attenuation of 65 dB.
 4. Minimum common-mode noise attenuation of 150 dB at 40 to 100 Hz.

2.05 Unitary Controllers

- A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.
 1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
 2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform automatic system diagnostics; monitor system and report failures.
 3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to diagnostic terminal unit.
 4. Enclosure: Dustproof rated for operation at 32 to 120 deg F.

2.06 Alarm Panels

- A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch-thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish. Provide common keying for all panels.
- B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.
 1. Alarm Condition: Indicating light flashes and horn sounds.
 2. Acknowledge Switch: Horn is silent and indicating light is steady.
 3. Second Alarm: Horn sounds and indicating light is steady.
 4. Alarm Condition Cleared: System is reset and indicating light is extinguished.
 5. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.07 Analog Controllers

- A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.
- B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F, and single- or double-pole contacts.
- C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.
 - 1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.
- D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.
- E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.
 - 1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig.
 - 2. Proportional band shall extend from 2 to 20 percent for 5 psig.
 - 3. Authority shall be 20 to 200 percent.
 - 4. Air-supply pressure of 18 psig, input signal of 3 to 15 psig, and output signal of zero to supply pressure.
 - 5. Gages: 1-1/2 inches in diameter, 2.5 percent wide-scale accuracy, and range to match transmitter input or output pressure.

2.08 Time Clocks

- A. Solid-state, programmable time control with 8 separate programs each with up to 100 on-off operations; 1-second resolution; lithium battery backup; keyboard interface and manual override; individual on-off-auto switches for each program; 365-day calendar with 20 programmable holidays; choice of fail-safe operation for each program; system fault alarm; and communications package allowing networking of time controls and programming from PC.

2.09 Electronic Sensors

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
 - 1. Accuracy: Plus or minus 0.5 deg F at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - 4. Averaging Elements in Ducts: Minimum 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 10 sq. ft.
 - 5. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Exposed.

- c. Thermometer: Concealed, Red-reading glass.
 - d. Orientation: Horizontal.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
 - 1. Accuracy: Plus or minus 0.2 percent at calibration point.
 - 2. Wire: Twisted, shielded-pair cable.
 - 3. Insertion Elements in Ducts: Single point, 8 inches long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
 - 4. Averaging Elements in Ducts: Minimum 72 inches long, flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required.
 - 5. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.
 - 6. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Exposed.
 - c. Thermometer: Concealed, Red-reading glass.
 - d. Orientation: Horizontal.
 - 7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 - 8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- D. Humidity Sensors: Bulk polymer sensor element.
 - 1. Accuracy: 5 percent full range with linear output.
 - 2. Room Sensor Range: 20 to 80 percent relative humidity.
 - 3. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Orientation: Horizontal.
 - 4. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 - 5. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of minus 10 to plus 100 deg F.
 - 6. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
 - 1. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: 0- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.

2. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 3. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 4. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- F. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
 2. Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
 3. Adjusting Key: As required for calibration and cover screws.

2.10 Pneumatic Sensors

- A. Pneumatic Transmitters: Vibration and corrosion resistant.
1. Space-Temperature Sensors: Linear-output type, 50 to 100 deg F range, with blank locking covers matching room thermostats.
 2. Room Return-Air Temperature Sensors: Linear-output type with bimetal sensing element and corrosion-proof construction, 50 to 100 deg F range, designed to be mounted in light troffers.
 3. Duct-Mounted or Immersion-Type Temperature Sensors: Range as required for 3- to 15-psig output signal.
 4. Temperature Transmitters: Rigid-stem type with bimetal sensing elements unless averaging is required, 3- to 15-psig output signal.
 - a. Averaging-Element Sensors: Single- or multiple-unit capillary elements.
 - b. Tamperproof Sensors: Corrosion-resistant construction, suitable for mounting on vibrating surface with exposed capillary protected with temperature-compensated armor or protective tubing.
 - c. Pipe-Mounted Temperature-Sensing Elements: Rod-and-tube type; with separable wells filled with heat-conductive compound.
 - d. Outdoors: Provide bulb shield with mounting bracket.
 5. Space and Duct Humidity Transmitters: One pipe, directly proportional, with minimum sensing span of 20 to 80 percent relative humidity for 3- to 15-psig output signal, corrosion resistant and temperature compensated, and with factory-calibrated adjustment.
 - a. Space Mounting: With covers to match thermostats.
 6. Differential-Pressure Transmitters: One pipe, direct acting for gas, liquid, or steam service; pressure sensor and transmitter of linear-output type; with range of 0 to 50 psig, and 3- to 15-psig output signal.
 7. Differential-Air-Pressure Transmitters: One pipe, direct acting, double bell; unidirectional with suitable range for expected input; and temperature compensated.
 - a. Accuracy: 5 percent of full range and 2 percent of full scale at midrange.
 - b. Output Signal: 3 to 15 psig.
- B. Digital-to-Pneumatic Transducers: Convert plus or minus 12-V dc pulse-width-modulation outputs, or continuous proportional current or voltage to 0 to 20 psig.

- C. Pneumatic Valve/Damper Position Indicator: Potentiometer mounted in enclosure with adjustable crank-arm assembly connected to damper to transmit 0 to 100 percent valve/damper travel.

2.11 Status Sensors

- A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg.
- B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig, piped across pump.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Water-Flow Switches: Bellows-actuated mercury or snap-acting type with pilot-duty rating, stainless-steel or bronze paddle, with appropriate range and differential adjustment, in NEMA 250, Type 1 enclosure.

2.12 Gas Detection Equipment

- A. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F; with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- B. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output, for wall mounting.
- C. Oxygen Sensor and Transmitter: Single detectors using solid-state zircon cell sensing; suitable over a temperature range of minus 32 to plus 1100 deg F and calibrated for 0 to 5 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
- D. Occupancy Sensor: Passive infrared, with time delay, daylight sensor lockout, sensitivity control, and 180-degree field of view with vertical sensing adjustment; for flush mounting.

2.13 Thermostats

- A. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.
 - 1. Label switches "FAN ON-OFF", "FAN HIGH-LOW-OFF", "FAN HIGH-MED-LOW-OFF".
 - 2. Mount on single electric switch box.
- B. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.

6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- C. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- D. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 2. Selector Switch: Integral, manual on-off-auto.
- E. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 1. Bulbs in water lines with separate wells of same material as bulb.
 2. Bulbs in air ducts with flanges and shields.
 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.
- F. Fire-Protection Thermostats: Listed and labeled by an NRTL acceptable to authorities having jurisdiction; with fixed or adjustable settings to operate at not less than 75 deg F above normal maximum operating temperature, and the following:
 1. Reset: Manual.
 2. Reset: Automatic, with control circuit arranged to require manual reset at central control panel; with pilot light and reset switch on panel labeled to indicate operation.
- G. Pneumatic Room Thermostats: Two pipe(s), fully proportional with adjustable throttling range and tamperproof locking settings, direct or reverse acting as required. Factory calibrated at 2.5 psig/deg F.
 1. Factory Calibration: 2.5 psig/deg F.
 2. Range: 45 to 85 deg F.

3. Sensitivity Adjustment Range: 1 to 4 psig/deg F.
 4. Dual-Temperature Thermostats: Automatic changeover from normal setting to lower setting for unoccupied cycles, with manual-reset lever to permit return to normal temperatures during unoccupied cycles, with automatic reset to normal during next cycle of operation.
 5. Limits: Field adjustable, to limit setting cooling set point below 75 deg F, and heating set point above 75 deg F.
 6. Room Thermostat Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Exposed.
 - b. Set-Point Indication: Exposed.
 - c. Thermometer: Concealed, Red-reading glass.
 - d. Orientation: Horizontal.
 7. Room thermostat accessories include the following:
 - a. Insulating Bases: For thermostats located on exterior walls.
 - b. Thermostat Guards: Locking; heavy-duty, transparent plastic; mounted on separate base.
 - c. Adjusting Key: As required for calibration and cover screws.
 - d. Aspirating Boxes: For flush-mounted aspirating thermostats.
 - e. Set-Point Adjustment: 1/2-inch-diameter, adjustment knob.
 - H. Immersion Thermostat: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range and adjustable set point.
 - I. Airstream Thermostats: Two-pipe, fully proportional, single-temperature type; with adjustable set point in middle of range, adjustable throttling range, plug-in test fitting or permanent pressure gage, remote bulb, bimetal rod and tube, or averaging element.
 - J. Electric, Low-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or below set point.
 1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
 - K. Electric, High-Limit Duct Thermostat: Snap-acting, single-pole, single-throw, manual-or automatic-reset switch that trips if temperature sensed across any 12 inches of bulb length is equal to or above set point.
 1. Bulb Length: Minimum 20 feet.
 2. Quantity: One thermostat for every 20 sq. ft. of coil surface.
 - L. Heating/Cooling Valve-Top Thermostats: Proportional acting for proportional flow, with molded-rubber diaphragm, remote-bulb liquid-filled element, direct and reverse acting at minimum shutoff pressure of 25 psig, and cast housing with position indicator and adjusting knob.
- 2.14 Humidistats**
- A. Pneumatic Room Humidistats: Wall-mounting, proportioning type with adjustable throttling range, 25 to 65 percent operating range, and cover matching room thermostat cover.
 - B. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.
 - C. Pneumatic Duct-Mounting Humidistats: Proportioning type with adjustable throttling range, 20 to 90 percent operating range, in galvanized-steel duct box.

2.15 Actuators

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
 - 2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 4. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 2. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 - 3. Coupling: V-bolt and V-shaped, toothed cradle.
 - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 - 6. Power Requirements (Two-Position Spring Return): 24-V ac.
 - 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 - 8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 - 9. Temperature Rating: Minus 22 to plus 122 deg F.
 - 10. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F.
 - 11. Run Time: 12 seconds open, 5 seconds closed.
- C. Pneumatic Valve Operators: Rolling-diaphragm, spring-loaded, piston type with spring range as required and start-point adjustment and positioning relay. Operator shall maintain full shutoff at maximum pump differential pressure.

- D. Pneumatic Damper Operators: Rolling-diaphragm, piston type with adjustable stops and spring return, sized to operate with sufficient reserve power to provide smooth modulating action or two-position action. Where actuators operate in sequence, provide pilot positioners.
 - 1. Pilot Positioners: With the following characteristics:
 - a. Start Point: Adjustable from 2 to 12 psig.
 - b. Operating Span: Adjustable from 5 to 13 psig.
 - c. Linearity: Plus or minus 10 percent of output signal span.
 - d. Hysteresis: 3 percent of span.
 - e. Response: 0.25-psig input change.
 - f. Maximum Pilot Signal Pressure: 20 psig.
 - g. Maximum Control Air-Supply Pressure: 60 psig.
 - 2. Actuator Housing: Molded or die-cast zinc or aluminum. Terminal unit actuators may be high-impact plastic with ambient temperature rating of 50 to 140 deg F unless located in return-air plenums.

2.16 Control Valves

- A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- B. Hydronic system valves shall have the following characteristics:
 - 1. Control valves shall be pressure independent. The flow through the valve shall not vary more than +/- 5% (due to system pressure fluctuations) across the valve in the selected operating range. The control valve shall accurately control the flow from 1 to 100% full rated flow.
 - 2. The valve bodies shall be of cast iron, steel or bronze rated for 150 PSI working pressure. All internal parts shall be stainless steel, steel, Teflon, brass or bronze.
 - 3. Valves shall be DeltaP Valves manufactured by Flow Control Industries, Belimo or approved equal.
 - a. Valves providing two-position service, except boiler isolation valve and boiler water minimum flow bypass valve, shall be quick opening. Two-way valves shall have replaceable disc or ball.
 - b. Close-off (Differential) Pressure Rating. Valve actuator and trim shall provide the following minimum close-off pressure ratings.
 - 1) Two-way: 150% of total system (pump) head.
 - 2) Three-way: 300% of pressure differential between ports A and B at design flow or 100% of total system (pump) head.
 - c. Ports. Valves providing modulating service shall have equal percentage ports.
 - d. Sizing.
 - 1) Two-position service: line size.
 - 2) Two-way modulating service: select pressure drop equal to (3 psi).
 - 3) Three-way modulating service: (3 psi).
 - e. Fail Position. Water valves shall fail normally open or closed as follows unless otherwise specified.
 - 1) Water zone valves: normally open.
 - 2) Heating coils in air handlers: normally open.
 - 3) Chilled water control valves: normally closed.

- C. Steam system globe valves shall have the following characteristics:
 - 1. NPS 2 and Smaller: Class 125 bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - 3. Internal Construction: Replaceable plugs and stainless-steel seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.
 - 4. Sizing: For pressure drop based on the following services:
 - a. Two Position: 20 percent of inlet pressure.
 - b. Modulating 15-psig Steam: 5 psig.
 - c. Modulating 16- to 50-psig Steam: 10 psig.
 - d. Modulating More Than 50-psig Steam: 10 psig.
 - 5. Flow Characteristics: Modified linear characteristics.
 - 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of operating (inlet) pressure.
- D. Butterfly Valves: 200-psig, 150-psig maximum pressure differential, ASTM A 126 cast-iron or ASTM A 536 ductile-iron body and bonnet, extended neck, stainless-steel stem, field-replaceable EPDM or Buna N sleeve and stem seals.
 - 1. Body Style: Lug.
 - 2. Disc Type: Nickel-plated ductile iron.
 - 3. Sizing: 1-psig maximum pressure drop at design flow rate.
- E. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 - 2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
 - 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
- F. Self-Contained Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
 - 1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
 - 2. Thermostatic Operator: Liquid-filled integral sensor with integral adjustable dial.

2.17 Dampers

- A. Dampers: AMCA-rated, parallel or opposed-blade design; 0.108-inch-minimum thick, galvanized-steel or 0.125-inch-minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch-thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 - 1. Secure blades to 1/2-inch-diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.18 Air Supply

- A. Control and Instrumentation Tubing: Copper tubing complying with ASTM B 88, Type L or ASTM B 280 Type ACR.
 1. Fittings: Cast-bronze solder fittings complying with ASME B16.18; or wrought-copper solder fittings complying with ASME B16.22, except forged-brass compression-type fittings at connections to equipment.
 2. Joining Method: Soldered or brazed.
- B. Control and Instrumentation Tubing: ASTM D 2737 Type FR plenum-rated polyethylene, flame-retardant, nonmetallic tubing rated for 30 psig and ambient temperature range of 10 to 150 deg F with flame-retardant harness for multiple tubing.
 1. Fittings: Compression or push-on polyethylene fittings.
- C. Tank: ASME storage tank with drain test cock, automatic moisture removal trap, tank relief valve, and rubber-cork vibration isolation mounting pads.
- D. Duplex Air Compressor: Capacity to supply compressed air to temperature-control system.
 1. Pressure control with adjustable electric contacts, set to start and stop both compressors at different pressures.
 2. Electrical alternation set with motor starters and disconnect to operate compressors alternately or on time schedule.
- E. Simplex Air Compressor: Tank-mounting compressor with capacity to supply compressed air to temperature-control system, with starter and disconnect.
 1. Pressure control with adjustable electric contacts, set to start and stop compressor.
- F. Compressor Type: Reciprocating or Scroll.
- G. Size compressor and tank to operate compressor not more than 20 minutes during a 60-minute period.
- H. Compressor Accessories: Low-resistance intake-air filter, and belt guards.
- I. System Accessories: Air filter rated for 97 percent efficiency at rated airflow, and combination filter/pressure-reducing station or separate filter and pressure-reducing station.
- J. Refrigerated Air Dryer: Two Self-contained, refrigerated air dryers complete with heat exchangers, moisture separator, internal wiring and piping, and with manual bypass valve. Each dryer sized to handle rated airflow capacity of one compressor.
 1. Heat Exchangers: Air-to-refrigerant coils with centrifugal-type moisture separator and automatic trap assembly.
 2. Refrigeration Unit: Hermetically sealed, operating to maintain dew point of 13 deg F at 20 psig, housed in steel cabinet with access door and panel.
 3. Accessories: Air-inlet temperature gage, air-inlet pressure gage, on-off switch, high-temperature light, power-on light, refrigerant gage on back, air-outlet temperature gage, air-outlet pressure gage, and with contacts for remote indication of power status and high-temperature alarm.
- K. Desiccant Dryer: Obtains dew point in pneumatic air piping between compressor and tank at least 15 deg F below inlet-air dew point at design conditions.

- L. Pressure Gages: Black letters on white background, 2-1/2 inches in diameter, flush or surface mounting, with front calibration screw to match sensor, and having a graduated scale in psig.
- M. Instrument Pressure Gages: Black letters on white background, 1-1/2 inches in diameter, stem mounted, with suitable dial range.
- N. Diaphragm Control and Instrument Valves: 1/4-inch forged-brass body with reinforced polytetrafluoroethylene diaphragm, stainless-steel spring, and color-coded phenolic handle.
- O. Gage Cocks: Tee or level handle, bronze, rated for 125 psig.
- P. Relays: For summing, reversing, and amplifying highest or lowest pressure selection; with adjustable I/O ratio.
- Q. Switches: With indicating plates and accessible adjustment; calibrated and marked.
- R. Pressure Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat reduced-pressure curve.
- S. Particle Filters: Zinc or aluminum castings with 97 percent filtration efficiency at rated airflow, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.
- T. Combination Filter/Regulators: Zinc or aluminum castings with elastomeric diaphragm, balanced construction to automatically prevent pressure buildup, and producing flat reduced-pressure curve; with threaded pipe connections, quick-disconnect service devices, and aluminum or plastic bowl with metal guard and manual drain cock.
- U. Airborne Oil Filter: Filtration efficiency of 99.9 percent for airborne lubricating oil particles of 0.025 micron or larger.
- V. Pressure Relief Valves: ASME rated and labeled.
 - 1. High Pressure: Size for installed capacity.
 - 2. Low Pressure: Size for installed capacity of pressure regulators and set at 20 percent above low pressure.
- W. Pressure-Reducing Stations: Two parallel pressure regulators.

2.19 Control Cable

- A. Electronic and fiber-optic cables for control wiring are specified in Division 27 Section "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.01 Examination

- A. Verify that conditioned power supply is available to control units and operator workstation.
- B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.02 Installation

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Mount compressor and tank unit on vibration devices. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment." Isolate air supply with wire-braid-reinforced rubber hose. Secure and anchor according to manufacturer's written instructions and seismic-control requirements.
 - 1. Pipe manual and automatic drains to nearest floor drain.

2. Supply instrument air from compressor units through filter, pressure-reducing valve, and pressure relief valve, with pressure gages and shutoff and bypass valves.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- E. Install guards on thermostats in the following locations:
 1. Entrances.
 2. Public areas.
 3. Where indicated.
- F. Install automatic dampers according to Division 23 Section "Air Duct Accessories."
- G. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- H. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- I. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."
- J. Install steam and condensate instrument wells, valves, and other accessories according to Division 23 Section "Steam and Condensate Heating Piping."
- K. Install refrigerant instrument wells, valves, and other accessories according to Division 23 Section "Refrigerant Piping."
- L. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.
- M. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.03 Pneumatic Piping Installation

- A. Install piping in mechanical equipment rooms inside mechanical equipment enclosures, in pipe chases, or suspended ceilings with easy access.
 1. Install copper tubing with maximum unsupported length of 36 inches, for tubing exposed to view.
 2. Install polyethylene tubing in metallic raceways or electrical metallic tubing. Electrical metallic tubing materials and installation requirements are specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install terminal single-line connections, less than 18 inches in length, with copper or polyethylene tubing run inside flexible steel protection.
- C. In concealed locations such as pipe chases and suspended ceilings with easy access, install copper or polyethylene tubing in electrical metallic tubing. Electrical metallic tubing materials and installation requirements are specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- D. In concrete slabs, furred walls, or ceilings with no access, install copper or polyethylene tubing in electrical metallic tubing or vinyl-jacketed polyethylene tubing.
 1. Protect embedded-copper and vinyl-jacketed polyethylene tubing with electrical metallic tubing extending 6 inches above finished slab and 6 inches into slab. Pressure test tubing before and after pour for leak and pinch.
 2. Install polyethylene tubing in electrical metallic tubing extending 6 inches above floor line; pull tubing into electrical metallic tubing after pour.
- E. Install tubing with sufficient slack and flexible connections to allow for vibration of piping and equipment.

- F. Purge tubing with dry, oil-free compressed air before connecting control instruments.
 - 1. Bridge cabinets and doors with flexible connections fastened along hinge side; protect against abrasion. Tie and support tubing.
- G. Number-code or color-code control air piping for future identification and service of control system, except local individual room control tubing.
- H. Pressure Gages or Test Plugs: Install on branch lines at each receiver controller and on signal lines at each transmitter, except individual room controllers.

3.04 Electrical Wiring and Connection Installation

- A. Install raceways, boxes, and cabinets according to Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Install building wire and cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Install signal and communication cable according to Division 27 Section "Communications Horizontal Cabling."
 - 1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
 - 2. Install exposed cable in raceway.
 - 3. Install concealed cable in raceway.
 - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - 7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
- E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- F. All power wiring (120 volt and higher) for equipment motor, for smoke dampers, for combination fire/smoke dampers, wiring shown on electrical drawings, and fire alarm wiring shall be furnished and installed under Division 26. All remaining control wiring required to achieve service of control as specified and communication wiring for smoke and combination fire/smoke damper shall be furnished and installed under Division 23.

3.05 Field Quality Control

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

4. Pressure test control air piping at 30 psig or 1.5 times the operating pressure for 24 hours, with maximum 5-psig loss.
5. Pressure test high-pressure control air piping at 150 psig and low-pressure control air piping at 30 psig for 2 hours, with maximum 1-psig loss.
6. Test calibration of pneumatic and electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
7. Test each point through its full operating range to verify that safety and operating control set points are as required.
8. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
9. Test each system for compliance with sequence of operation.
10. Test software and hardware interlocks.

C. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.

- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.06 Adjusting

A. Calibrating and Adjusting:

1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.

4. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 5. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 6. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 7. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 10. Provide diagnostic and test instruments for calibration and adjustment of system.
 11. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- B. Adjust initial temperature and humidity set points.
- C. Occupancy Adjustments: When requested within 12 months of date of final acceptance by Owner, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to four visits to Project during other than normal occupancy hours for this purpose.

3.07 Demonstration

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Glycol cooling-water piping.
 - 4. Makeup-water piping.
 - 5. Condensate-drain piping.
 - 6. Air-vent piping.
 - 7. Safety-valve-inlet and -outlet piping.
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.03 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.
- B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.04 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature, unless noted otherwise:
 - 1. Hot-Water Heating Piping: 100 psig at 200 deg F.
 - 2. Chilled-Water Piping: 100 psig at 200 deg F.
 - 3. Glycol Cooling-Water Piping: 100 psig at 150 deg F.
 - 4. Makeup-Water Piping: 80 psig at 150 deg F.
 - 5. Condensate-Drain Piping: 150 deg F.
 - 6. Air-Vent Piping: 200 deg F.
 - 7. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.05 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. RTRP and RTRF with adhesive.
 - 2. Pressure-seal fittings.
 - 3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 4. Air control devices.

5. Chemical treatment.
6. Hydronic specialties.
- B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
- C. Welding certificates.
- D. Qualification Data: For Installer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
 2. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.
- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

1.07 EXTRA MATERIALS

- A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
- B. DWV Copper Tubing: ASTM B 306, Type DWV.
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Grooved-Joint Fittings and Couplings:
 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.

- b. S. P. Fittings; a division of Star Pipe Products.
 - c. Victaulic Company of America.
- 2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
- 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
- E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. T-DRILL Industries Inc.
- F. Wrought-Copper Unions: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, black steel with plain ends; Type S or E or Grade B, Schedule 40.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. S. P. Fittings; a division of Star Pipe Products.
 - d. Victaulic Company of America.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.
- E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.
 - 1. Use fiberglass adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- G. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.04 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Hart Industries International, Inc.
 - c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - d. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.
 - 2. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.
- D. Dielectric Flanges:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Pipeline Seal and Insulator, Inc.

2. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 3. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Calpico, Inc.
 - b. Lochinvar Corporation.
 2. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Perfection Corporation; a subsidiary of American Meter Company.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Victaulic Company of America.
 2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 VALVES

- A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."
- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."
- C. Balancing Valves:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - c. Flow Design Inc.
 - d. Griswold Controls.
 - e. Taco.
 2. Bronze, Calibrated – Orifice Type:
 - a. Body: Bronze, ball or plug type with calibrated orifice or venturi.
 - b. Ball: Brass or stainless steel.
 - c. Plug: Resin.
 - d. Seat: PTFE.
 - e. End Connections: Threaded or socket.
 - f. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - g. Handle Style: Lever, with memory stop to retain set position.

- h. CWP Rating: Minimum 125 psig.
 - i. Maximum Operating Temperature: 250 deg F.
 - 3. Cast-Iron or Steel, Calibrated-Orifice Type:
 - a. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
 - b. Ball: Brass or stainless steel.
 - c. Stem Seals: EPDM O-rings.
 - d. Disc: Glass and carbon-filled PTFE.
 - e. Seat: PTFE.
 - f. End Connections: Flanged or grooved.
 - g. Pressure Gage Connections: Integral seals for portable differential pressure meter.
 - h. Handle Style: Lever, with memory stop to retain set position.
 - i. CWP Rating: Minimum 125 psig.
 - j. Maximum Operating Temperature: 250 deg F.
 - D. Diaphragm-Operated, Pressure-Reducing Valves:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. Body: Bronze or brass.
 - 3. Disc: Glass and carbon-filled PTFE.
 - 4. Seat: Brass.
 - 5. Stem Seals: EPDM O-rings.
 - 6. Diaphragm: EPT.
 - 7. Low inlet-pressure check valve.
 - 8. Inlet Strainer: Removable without system shutdown.
 - 9. Valve Seat and Stem: Noncorrosive.
 - 10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.
 - E. Diaphragm-Operated Safety Valves:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Bell & Gossett Domestic Pump; a division of ITT Industries.
 - d. Conbraco Industries, Inc.
 - e. Spence Engineering Company, Inc.
 - f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: Removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Automatic Flow-Control Valves:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flow Design Inc.
 - b. Griswold Controls.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 200 deg F.

2.06 AIR CONTROL DEVICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amtrol, Inc.
 2. Armstrong Pumps, Inc.
 3. Bell & Gossett Domestic Pump; a division of ITT Industries.
 4. Taco.
- B. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/8.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 225 deg F.
- C. Automatic Air Vents:
1. Body: Bronze or cast iron.

2. Internal Parts: Nonferrous.
 3. Operator: Noncorrosive metal float.
 4. Inlet Connection: NPS 1/2.
 5. Discharge Connection: NPS 1/4.
 6. CWP Rating: 150 psig.
 7. Maximum Operating Temperature: 240 deg F.
- D. Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.
 3. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.
 4. Gage Glass: Full height with dual manual shutoff valves, 3/4-inch-diameter gage glass, and slotted-metal glass guard.
- E. Bladder-Type Expansion Tanks:
1. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 2. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
 3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

2.07 CHEMICAL TREATMENT

- A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves.
1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.
- B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.08 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- B. Basket Strainers:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.

2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
 3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 125 psig.
- C. Stainless-Steel Bellow, Flexible Connectors:
1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
 2. End Connections: Threaded or flanged to match equipment connected.
 3. Performance: Capable of 3/4-inch misalignment.
 4. CWP Rating: 150 psig.
 5. Maximum Operating Temperature: 250 deg F.
- D. Spherical, Rubber, Flexible Connectors:
1. Body: Fiber-reinforced rubber body.
 2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
 3. Performance: Capable of misalignment.
 4. CWP Rating: 150 psig.
 5. Maximum Operating Temperature: 250 deg F.
- E. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

- A. Hot-water heating piping/chilled-water piping/dual-temperature heating and cooling water piping, aboveground, NPS 2 and smaller:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- B. Hot-water heating piping/chilled-water piping/dual-temperature heating and cooling water piping, aboveground, NPS 2-1/2, shall be any of the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.
 2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
 3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.
- C. Hot-water heating piping/chilled-water piping/dual-temperature heating and cooling water piping installed belowground and within slabs shall be either of the following:
1. Type K, annealed-temper copper tubing, wrought-copper fittings, and soldered or brazed joints. Use the fewest possible joints.
 2. RTRP and RTRF with adhesive or flanged joints.
- D. Makeup-water piping installed aboveground shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered or brazed joints.

- E. Makeup-Water Piping Installed Belowground and within Slabs: Type L, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.
- F. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- G. Air-Vent Piping:
 - 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
 - 2. Outlet: Type L, annealed-temper copper tubing with soldered or flared joints.
- H. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.02 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.03 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such 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. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
- M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

- N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
- P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
- Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
- S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
- T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.04 HANGERS AND SUPPORTS

- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
- B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- C. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
 - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
 - 8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
 - 9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.

10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
 11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
 12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
 13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
 14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
 15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.
- E. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- F. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- G. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- J. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

- K. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- L. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

3.06 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.
- C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.
- E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.
- F. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.
- G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
 - 1. Install tank fittings that are shipped loose.
 - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
- H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.07 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.08 CHEMICAL TREATMENT

- A. Perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the water characteristics as required by the Owner.
- B. Fill system with fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water.
- C. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.
- D. Fill systems indicated to have antifreeze or glycol solutions with the concentrations indicated on drawings or as required by the system.

3.09 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
 - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
 - 1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 - 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 - 3. Isolate expansion tanks and determine that hydronic system is full of water.
 - 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
 - 5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 - 6. Prepare written report of testing.
- C. Perform the following before operating the system:
 - 1. Open manual valves fully.
 - 2. Inspect pumps for proper rotation.
 - 3. Set makeup pressure-reducing valves for required system pressure.
 - 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 - 5. Set temperature controls so all coils are calling for full flow.
 - 6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
 - 7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 23 31 13
METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Double-wall rectangular ducts and fittings.
 - 3. Single-wall round and flat-oval ducts and fittings.
 - 4. Double-wall round and flat-oval ducts and fittings.
 - 5. Sheet metal materials.
 - 6. Duct liner.
 - 7. Sealants and gaskets.
 - 8. Hangers and supports.
- B. Related Sections:
 - 1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Division 23 Section "Nonmetal Ducts" for fibrous-glass ducts, thermoset fiber-reinforced plastic ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
 - 3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
 - 4. Division 23 Section "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 62.1-2004.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
 - 3. Seismic-restraint devices.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.

3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 4. Elevation of top of ducts.
 5. Dimensions of main duct runs from building grid lines.
 6. Fittings.
 7. Reinforcement and spacing.
 8. Seam and joint construction.
 9. Penetrations through fire-rated and other partitions.
 10. Equipment installation based on equipment being used on Project.
 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
 12. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: CAD generated plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Penetrations of smoke barriers and fire-rated construction.
 6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.
 7. Refer to Section "Common Work Results for HVAC".
- D. Welding certificates.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D1.2, "Structural Welding Code - Aluminum," for aluminum supports.
 3. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."
- D. Duct liner shall be utilized where indicated on drawings.
- E. Duct liner shall not be utilized in healthcare facilities, unless noted otherwise.

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 1-4, "Transverse (Girth) 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 1-5, "Longitudinal Seams - Rectangular Ducts," 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 2, "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 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) 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 1-5, "Longitudinal Seams - Rectangular Ducts," 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. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 - 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 - 3. Coat insulation with antimicrobial coating.
 - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- F. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent or solid sheet steel where indicated.

- G. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Traverse (Girth) 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."
- H. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SINGLE-WALL ROUND 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.
- 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 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 DOUBLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
 - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," 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."
 - a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," 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."
 - a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "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."
- C. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent or solid sheet steel, where indicated.
- D. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
 1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
 3. Coat insulation with antimicrobial coating.
 4. Cover insulation with polyester film complying with UL 181, Class 1.

2.5 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.
 1. Galvanized Coating Designation: G90.
 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653.
 1. Galvanized Coating Designation: G60.
 2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil thick on opposite surface.
 3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.
- D. Carbon-Steel Sheets: Comply with ASTM A 1008, with oiled, matte finish for exposed ducts.
- E. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.
- F. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

- G. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- H. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.6 DUCT LINER

- A. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Aeroflex USA Inc.
 - b. Armacell LLC.
 - c. NOMACO Insulation.
 - 2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 090A or NFPA 90B.
 - a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "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.
 - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

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 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 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.

2.7 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.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
 1. Application Method: Brush on.
 2. Solids Content: Minimum 65 percent.
 3. Shore A Hardness: Minimum 20.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. VOC: Maximum 75 g/L (less water).
 7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 8. Service: Indoor or outdoor.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

- D. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Base: Synthetic rubber resin.
 - 3. Solvent: Toluene and heptane.
 - 4. Solids Content: Minimum 60 percent.
 - 5. Shore A Hardness: Minimum 60.
 - 6. Water resistant.
 - 7. Mold and mildew resistant.
 - 8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 9. VOC: Maximum 395 g/L.
 - 10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - 11. Service: Indoor or outdoor.
 - 12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
 - 1. Seal shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 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 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

- H. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
 - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
 - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval 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, 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.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "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 "Duct Cleanliness for New Construction Guidelines."

3.2 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 before external insulation is applied. Provide adequate sealing as required to meet duct leakage requirements.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.

- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum interval of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 PAINTING

- A. Paint interior of metal ducts, for 24 inches length, that are visible through return and exhaust 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 Division 09 painting Sections.

3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Maximum Allowable Leakage: Duct system leakages shall not exceed 5% of design air flows. When systems are leak tested in section, the total cumulative leakage of the system shall not exceed 5%.
 - 3. Test the following systems:
 - a. All supply air ducts and sections from air handling unit to terminal units.
 - b. All return air ducts and sections from grilles/registers to return/relief air fan.
 - c. 10% of supply air ductwork downstream of boxes, but not less than two systems.
 - d. Two exhaust air duct systems.
 - 4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 5. Test for leaks before applying external insulation.
 - 6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 7. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.7 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.8 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Underground Ducts: Concrete-encased, PVC-coated, galvanized sheet steel with thicker coating on duct exterior.

B. Supply Ducts:

1. Downstream of Air Handling Units and Up to Terminal Units:
 - a. Pressure Class: Positive 4-inch wg.
2. From Terminal Units to Outlets:
 - a. Pressure Class: Positive 2-inch wg.
3. Ducts Located within Mechanical Equipment Rooms:
 - a. Pressure Class: Positive 2-inch wg.

C. Return Ducts:

1. All Ducts:
 - a. Pressure Class: Negative 4-inch wg.

D. Exhaust Ducts:

1. General Exhaust System Ducts:
 - a. Pressure Class: Negative 2-inch wg.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.
2. PVC-Coated Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
3. Stainless-Steel Ducts:
 - a. Exposed to Airstream: Match duct material.
 - b. Not Exposed to Airstream: Match duct material.
4. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

F. Liner:

1. Outside Air and Relief Air Plenums: Fibrous glass, Type I or Flexible elastomeric 2 inches thick.

- G. Double-Wall Duct Interstitial Insulation:
 - 1. Supply Air Ducts: 1-1/2 inches thick.
- H. Elbow Configuration:
 - 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
 - 2) Mitered Type RE 4 without vanes.
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "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 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
 - 3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
 - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
 - 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
 - 4) Radius-to Diameter Ratio: 1.5.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.

I. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
 - 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 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Fire dampers.
 - 5. Ceiling dampers.
 - 6. Smoke dampers.
 - 7. Combination fire and smoke dampers.
 - 8. Flange connectors.
 - 9. Duct silencers.
 - 10. Turning vanes.
 - 11. Remote damper operators.
 - 12. Duct-mounted access doors.
 - 13. Flexible connectors.
 - 14. Flexible ducts.
 - 15. Duct security bars.
 - 16. Duct accessory hardware.
- B. Related Sections:
 - 1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
 - 2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

- e. Duct security bars.
- f. Wiring Diagrams: For power, signal, and control wiring.
- C. 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.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.04 QUALITY ASSURANCE

- 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 AMCA 500-D testing for damper rating.

1.05 EXTRA MATERIALS

- 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, but not less than two.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. 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.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304, and having a No. 2 finish for concealed ducts and D4 finish for exposed ducts.
- D. 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.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Ruskin Company.

- 7. SEMCO Incorporated.
- 8. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Frame: 0.052-inch-thick, galvanized sheet steel/0.063-inch-thick extruded aluminum/0.052-inch, with welded corners and mounting flange.
- E. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum/0.050-inch-thick aluminum sheet with sealed edges.
- F. Blade Action: Parallel.
- G. Blade Seals: Extruded vinyl, mechanically locked.
- H. Blade Axles:
 - 1. Material: Nonferrous metal or galvanized steel.
 - 2. Diameter: 0.20 inch.
- I. Tie Bars and Brackets: Aluminum.
- J. Return Spring: Adjustable tension.
- K. Bearings: Steel ball or synthetic pivot bushings.
- L. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.
 - 4. Chain pulls.
 - 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20-gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 - 6. Screen Mounting: Rear mounted.
 - 7. Screen Material: Aluminum.
 - 8. Screen Type: Insect.
 - 9. 90-degree stops.

2.03 BAROMETRIC RELIEF DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Ruskin Company.
 - 7. SEMCO Incorporated.
 - 8. Vent Products Company, Inc.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.

- D. Frame: 0.064-inch-thick, galvanized sheet steel/0.063-inch-thick extruded aluminum, with welded corners and mounting flange.
- E. Blades:
 - 1. Multiple, 0.025-inch-thick, roll-formed aluminum/0.050-inch-thick aluminum sheet.
 - 2. Maximum Width: 6 inches.
 - 3. Action: Parallel.
 - 4. Balance: Gravity.
 - 5. Eccentrically pivoted.
- F. Blade Seals: Vinyl.
- G. Blade Axles: Galvanized steel or Nonferrous metal.
- H. Tie Bars and Brackets:
 - 1. Material: Aluminum.
 - 2. Rattle free with 90-degree stop.
- I. Return Spring: Adjustable tension.
- J. Bearings: Synthetic.
- K. Accessories:
 - 1. Flange on intake.
 - 2. Adjustment device to permit setting for varying differential static pressures.

2.04 MANUAL VOLUME DAMPERS

- A. Standard, Manual Volume Dampers:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products 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. METALAIRE, Inc.
 - e. Nailor Industries Inc.
 - f. Ruskin Company.
 - g. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness, or 0.10 inch aluminum sheet channels.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick, or roll-formed aluminum 0.10 inch thick.
 - 6. Blade Axles: Galvanized steel or nonferrous metal.

7. Bearings:
 - a. Molded synthetic or Stainless-steel sleeve.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel/Aluminum.

2.05 FIRE DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products 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. McGill AirFlow LLC.
 6. METALAIRE, Inc.
 7. Nailor Industries Inc.
 8. Ruskin Company.
 9. Vent Products Company, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. 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-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
 1. Minimum Thickness: 0.052 inch thick 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.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.06 CEILING DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Air Balance Inc.; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. McGill AirFlow LLC.
 4. METALAIRE, Inc.
 5. Nailor Industries Inc.
 6. Ruskin Company.
 7. Vent Products Company, Inc.

B. 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."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

F. Fire Rating: 2 hours.

2.07 SMOKE DAMPERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products 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. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. 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-thick galvanized steel; with mitered and interlocking corners.

E. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

F. Leakage: Class I.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: Modulating or two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "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 Division 23 Section "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 and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 24V, single phase, 60 Hz.

K. Accessories:

1. Momentary test switch, damper mounted.

2.08 COMBINATION FIRE AND SMOKE DAMPERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products 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. Ruskin Company.
- B. Type: Static and dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. 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-thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- G. Smoke Detector: Integral, factory wired for single-point connection.
- H. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Leakage: Class I.
- J. Rated pressure and velocity to exceed design airflow conditions.
- K. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- L. Damper Motors: Modulating or two-position action.
- M. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "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 Division 23 Section "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 and breakaway torque rating of 150 in. x lbf.
 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 24V, single phase, 60 Hz.

N. Accessories:

1. Momentary test switch, damper mounted.

2.09 FLANGE CONNECTORS

- A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- B. Material: Galvanized steel.
- C. Gage and Shape: Match connecting ductwork.

2.10 DUCT SILENCERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Industrial Noise Control, Inc.
 2. McGill AirFlow LLC.
 3. Ruskin Company.
 4. Vibro-Acoustics.
- B. General Requirements:
 1. Factory fabricated.
 2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
 3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- C. Shape:
 1. Rectangular straight with splitters or baffles.
 2. Round straight with center bodies or pods.
 3. Rectangular elbow with splitters or baffles.
 4. Round elbow with center bodies or pods.
 5. Rectangular transitional with splitters or baffles.
- D. Rectangular Silencer Outer Casing: ASTM A 653, G90, galvanized sheet steel, 0.034 inch thick.
- E. Round Silencer Outer Casing: ASTM A 653, G90, galvanized sheet steel.
 1. Sheet Metal Thickness for Units up to 24 Inches in Diameter: 0.034 inch thick.
 2. Sheet Metal Thickness for Units 26 through 40 Inches in Diameter: 0.040 inch thick.
 3. Sheet Metal Thickness for Units 42 through 52 Inches in Diameter: 0.052 inch thick.
 4. Sheet Metal Thickness for Units 54 through 60 Inches in Diameter: 0.064 inch thick.
- F. Inner Casing and Baffles: ASTM A 653, G90 galvanized sheet metal, 0.034 inch thick, and with 1/8-inch-diameter perforations.
- G. Special Construction:
 1. Suitable for outdoor use.
 2. High transmission loss to achieve STC 45.
- H. Connection Sizes: Match connecting ductwork unless otherwise indicated.

- I. Principal Sound-Absorbing Mechanism:
 - 1. Controlled impedance membranes and broadly tuned resonators without absorptive media.
 - 2. Dissipative type with fill material.
 - a. Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression.
 - b. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
 - 3. Lining: Mylar.
 - J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.
 - 1. Lock form and seal or continuously weld joints.
 - 2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 - 3. Reinforcement: Cross or trapeze angles for rigid suspension.
 - K. Accessories:
 - 1. Factory-installed end caps to prevent contamination during shipping.
 - L. Source Quality Control: Test according to ASTM E 477.
 - 1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with an airflow of at least 2000-fpm face velocity.
 - 2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
 - M. Capacities and Characteristics as indicated on drawings.
- 2.11 TURNING VANES**
- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. METALAIR, Inc.
 - 4. SEMCO Incorporated.
 - 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 - B. 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.
 - C. 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.
 - D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
 - E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.12 DUCT-MOUNTED ACCESS DOORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products 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. Flexmaster U.S.A., Inc.
 - 5. Greenheck Fan Corporation.
 - 6. McGill AirFlow LLC.
 - 7. Nailor Industries Inc.
 - 8. Ventfabrics, Inc.
 - 9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
 - 1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 - 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.13 DUCT ACCESS PANEL ASSEMBLIES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flame Gard, Inc.
 - 3. 3M.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon or 0.0428-inch stainless steel.
- D. Fasteners: Carbon or Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.14 FLEXIBLE CONNECTORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. Ventfabrics, Inc.
 - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd.
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 oz./sq. yd.
 - 2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
 - 3. Service Temperature: Minus 50 to plus 250 deg F.
- G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 oz./sq. yd.
 - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).
- H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
 - 2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
 - 3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).
- I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
 - 1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 - 2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.15 FLEXIBLE DUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.
 3. Thermaflex.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.
 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 175 deg F.
- D. Noninsulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil.
 1. Pressure Rating: 8-inch wg positive or negative.
 2. Maximum Air Velocity: 5000 fpm.
 3. Temperature Range: Minus 100 to plus 435 deg F.
- E. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- F. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 20 to plus 175 deg F.
 4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1-2004.
- G. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
 1. Pressure Rating: 8-inch wg positive or negative.
 2. Maximum Air Velocity: 5000 fpm.
 3. Temperature Range: Minus 20 to plus 250 deg F.
 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

H. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.
2. Non-Clamp Connectors: Liquid adhesive plus tape.

2.16 DUCT SECURITY BARS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carnes.
 2. KEES, Inc.
 3. Lloyd Industries, Inc.
 4. Metal Form Manufacturing, Inc.
 5. Price Industries.
- B. Description: Field- or factory-fabricated and field-installed duct security bars.
- C. Configuration:
1. Frame: 10 gage by 2 inches.
 2. Sleeve: 3/16-inch, continuously welded steel frames with 1-by-1-by-3/16-inch angle frame factory welded to 1 end, furnished loose for field welding on other end. To be poured in place or set with concrete block or welded or bolted to wall, one side only. Duct connections on both sides.
 3. Horizontal Bars: 1/2 inch.
 4. Vertical Bars: 1/2 inch.
 5. Bar Spacing: 6 inches.
 6. Mounting: Metal deck or roofing, Bolted or welded with masonry anchors, Bar extends 6 inches into wall.

2.17 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

3.01 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 security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- I. Connect ducts to duct silencers rigidly.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils.
 - 2. Upstream and downstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans and seals.
 - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 7. At each change in direction and at maximum 50-foot spacing.
 - 8. Upstream and downstream from turning vanes.
 - 9. Upstream or downstream from duct silencers.
 - 10. Control devices requiring inspection.
 - 11. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.

- O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect diffusers or light troffer boots to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands and adhesive plus sheet metal screws. Do not use flexible ducts through walls, partitions.
- S. Install duct test holes where required for testing and balancing purposes.
- T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that 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

SECTION 23 33 20
AIRFLOW MEASURING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes airflow measuring devices located in the inlet of fans.

1.03 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on actual site elevations.

1.04 SUBMITTALS

- A. Product Data: Include rated capacities and accessories for each type of product indicated and include the following:
 - 1. Certified curves for the specific fan installation.
- B. Coordination Drawings: Show device layout and relationships with fan inlets.
- C. Maintenance Data: For airflow measuring devices to include in maintenance manuals specified in Division 1.

1.05 QUALITY ASSURANCE

- A. AMCA Compliance: Products shall be calibrated in the AMCA Accredited Laboratory for the application.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver devices to the air handling unit manufacturer for installation in the factory.

1.07 COORDINATION

- A. Coordinate size and location of attachment with fan inlet.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Temflo; Temtrol Division.
 - 2. Piezometer Ring; Twin City Fan and Blower.

2.02 AIRFLOW MEASURING DEVICES

- A. Airflow measuring device shall consist of an array of differential pressure flow sensors mounted at opposing 90° positions around the inlet of the fan.
- B. Flow sensors shall be manifolded together with pneumatic tubing to form a piezometric ring.
- C. Each fan assembly and airflow measuring device shall have been tested for airflow vs. differential pressure and calibrated in an AMCA Accredited Laboratory throughout the fans range of operation.
- D. Airflow measuring device shall not obstruct the fan inlet, be directly mounted across the fan inlet or have any effect on fan air performance or sound power levels.
- E. Airflow measuring device shall be provided with extended differential pressure tubes for connection to field supplied DDC control system with pneumatic inputs.
- F. The airflow measuring device shall have accuracy of $\pm 2\%$ over full span and temperature compensated from 25°F to 150°F.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install airflow measuring devices at the inlet of fans.

3.02 CONNECTIONS

- A. Connect airflow measuring devices to control system. Refer to Division 23 Section "Instrumentation and Control for HVAC" for sequence of controls.

3.03 FIELD QUALITY CONTROL

- A. Test and adjust devices for proper operation. Verify operation the certified performance curves. Replace damaged and malfunctioning devices and equipment.
- B. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

3.04 CLEANING

- A. On completion of installation, clean probes according to manufacturer's written instructions. Remove foreign material and construction debris.

END OF SECTION

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Shutoff, single-duct air terminal units.

1.03 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
 - 4. Isolation room air flow systems.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
 - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Size and location of initial access modules for acoustic tile.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Instructions for resetting minimum and maximum air volumes.
 - 2. Instructions for adjusting software set points.

1.04 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: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.05 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

PART 2 - PRODUCTS

2.01 TERMINAL UNIT MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Price Industries.
 - 2. Titus.
 - 3. Tuttle & Bailey.

2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- B. Casing: 0.034-inch steel, single wall.
 - 1. Casing Lining: Adhesive attached, 1/2-inch-thick, polyurethane foam fiber-free insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
 - 3. Air Outlet: S-slip and drive connections.
 - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
 - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- C. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
 - 1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.
 - 2. Damper Position: Normally open.
- D. Attenuator Section: 0.034-inch steel sheet, 36" long. Attenuator section shall be provided only for units specifically indicated on drawings.
 - 1. Lining: Adhesive attached, 1-inch-thick, polyurethane foam fiber-free insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - 2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
- E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- F. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.
 - 1. Access door interlocked disconnect switch.

2. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
 3. Nickel chrome 80/20 heating elements.
 4. Airflow switch for proof of airflow.
 5. Fan interlock contacts.
 6. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
 7. Mercury contactors.
 8. Pneumatic-electric switches and relays.
 9. Magnetic contactor for each step of control (for three-phase coils).
- G. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Division 23 Section "Instrumentation and Control for HVAC" and shall have the following features:
1. Damper Actuator: 24 V, powered closed, spring return open.
 2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
 - a. Occupied and unoccupied operating mode.
 - b. Remote reset of airflow or temperature set points.
 - c. Adjusting and monitoring with portable terminal.
 - d. Communication with temperature-control system specified in Division 23 Section "Instrumentation and Control for HVAC."
- H. Control Sequence:
1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
 2. System-powered, wall-mounted thermostat.

2.03 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. Steel Cables: Galvanized steel complying with ASTM A 603.
- D. 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.
- E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.04 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.

3.02 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "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.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. 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.

3.03 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts." and Division 23 Section "Nonmetal Ducts."
- D. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.04 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.05 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. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.06 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 23 37 13
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Rectangular and square ceiling diffusers.
 - 2. Perforated diffusers.
 - 3. Louver face diffusers.
 - 4. Fixed face registers and grilles.
- B. Related Sections:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- C. Source quality-control reports.

PART 2 - PRODUCTS

2.01 CEILING DIFFUSERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Anemostat Products; a Mestek company.
 - 2. Carnes.
 - 3. Krueger.
 - 4. METALAIRE, Inc.
 - 5. Price Industries.

6. Titus.
7. Tuttle & Bailey.
- B. Rectangular and Square Ceiling Diffusers:
 1. Devices shall be specifically designed for variable-air-volume flows.
 2. Material: Steel or Aluminum.
 3. Finish: Baked enamel, white unless noted otherwise.
 4. Face Size: 24 by 24 inches or 12 by 12 inches.
 5. Face Style: Minimum three cone.
 6. Mounting: To match ceiling type.
 7. Pattern: Adjustable.
 8. Accessories:
 - a. Equalizing grid.
 - b. Sectorizing baffles.
- C. Louver Face Diffuser:
 1. Devices shall be specifically designed for variable-air-volume flows.
 2. Material: Steel or Aluminum.
 3. Finish: Baked enamel, white unless noted otherwise.
 4. Face Size: As indicated on drawings.
 5. Mounting: To match ceiling type.
 6. Pattern: Adjustable core style.
 7. Accessories:
 - a. Adjustable pattern vanes.
 - b. Equalizing grid.
 - c. Sectorizing baffles.
 - d. Operating rod extension.

2.02 REGISTERS AND GRILLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Anemostat Products; a Mestek company.
 2. Carnes.
 3. Krueger.
 4. METALAIRE, Inc.
 5. Price Industries.
 6. Titus.
 7. Tuttle & Bailey.
- B. Adjustable Bar Register and Grille:
 1. Material: Steel or Aluminum.
 2. Finish: Baked enamel, white unless noted otherwise.
 3. Face Blade Arrangement: Horizontal adjustable.
 4. Core Construction: Integral.

5. Rear-Blade Arrangement: Vertical adjustable.
 6. Frame: 1 inch wide.
 7. Mounting: Countersunk screw.
 8. Damper Type: Adjustable opposed blade for register only.
 9. Accessories:
 - a. Front-blade gang operator.
- C. Security Register and Grille:
1. Security Level: Medium and suicide deterrent.
 2. Material: Steel.
 3. Material Thickness: 0.19 inch unless noted otherwise.
 4. Finish: Baked enamel, white.
 5. Face Arrangement:
 - a. Design: Fixed bar.
 - b. Frame: Yes.
 - c. 1-1/2-inch bars and mandrel tubes and rods with zero-degree deflection in 1-1/4-by-1-1/4-by-3/16-inch angle border.
 6. Damper Type: Adjustable opposed blade for register only.
 7. Wall Sleeve: 3/16 inch welded to face.
 8. Mounting: 1-1/4-by-1-1/4-by-3/16-inch cast-in-place frame and tamperproof machine screws.
- D. Fixed Face Register:
1. Material: Steel or Aluminum.
 2. Finish: Baked enamel, white unless noted otherwise.
 3. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid.
 4. Core Construction: Integral.
 5. Frame: 1 inch wide.
 6. Mounting: Countersunk screw.
 7. Damper Type: Adjustable opposed blade for register only.
 8. Accessory: Filter.

2.03 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.

- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Coordination drawings.
 - 6. Project record drawings.
 - 7. TMS Asset Forms.
 - 8. Trenching, excavating and backfilling.
 - 9. Electrical demolition.
 - 10. Common electrical installation requirements.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For sleeve seals.

1.05 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.
- C. Equipment Selection: Equipment of larger physical dimensions, higher capacities or ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical/electrical services are appropriately modified. Any additional costs as a result of these modifications shall be borne by the Contractor.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Delivery raceways in clean condition. Store to prevent entrance of dirt, debris and moisture.
- B. Protect stored raceways, wires, and connectors from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.07 INTERPRETATION OF THE DRAWINGS

- A. The drawings indicate diagrammatically the conduit runs and the apparatus served in a general way. No attempt has been made to show exact location of every box, fitting or conduit offset. Such items are to be provided and all wiring connections and home runs are to be made as required. Where conduit runs are shown terminating in arrows, such conduit runs shall be extended to panels/boards or other equipment. Where equipment is specified to be wired, make connections as shown on approved equipment wiring diagrams. Consult equipment approved shop drawings for location of outlets and for miscellaneous controls. Where wire sizes are shown on drawings, the wire size for each circuit shall be for the entire circuit.
- B. Where conduit is shown without wiring symbols, install one (1) hot (phase) wire, one (1) neutral wire, and one (1) ground wire.
- C. Provide full size neutral for each circuit.
- D. No more than three circuits shall be installed in a conduit.

1.08 TEMPORARY POWER

- A. The contractor shall make all provisions for and furnish and install all necessary conduit, wire, and distribution equipment for a complete temporary wiring system for use during construction of the building. Temporary wiring shall include a system of temporary lights and power distribution. Refer to Division 01.

1.09 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- E. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.
- F. Coordinate rough-in connections to pre-manufactured headwall systems including power for lighting, receptacles; connections for nurse call, voice/data outlets and TV interface.

1.10 SCHEDULING AND PHASING

- A. All Electrical work shall be scheduled to meet project completion date. Electrical work shall be phased for projects requiring phasing of work. Install additional conduit, junction-boxes, pull-boxes, wiring devices as required to support phasing. Refer to phasing schedule on drawings.

PART 2 - PRODUCTS

2.01 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.02 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.03 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.04 COORDINATION DRAWINGS

- A. The contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:
 - 1. Electrical equipment locations and clearances required.
 - 2. Routing of main feeders and conduits (3" dia. and larger), cable trays and bus ducts.
 - 3. Locations of items in ceiling such as light fixtures.
- B. The contractor shall submit the CAD generated drawings to HVAC contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by HVAC contractor.
- C. The contractor shall participate in coordination meetings when requested by HVAC contractor.
- D. See General Conditions for additional coordination drawing requirements.

2.05 PROJECT RECORD DRAWINGS

- A. See General Conditions for project record drawings requirements.

2.06 TMS ASSET FORMS

- A. The Contractor shall populate and update Owner's TMS Asset forms for all areas renovated. This shall include listing information for all new equipment installed, existing equipment that is reused and deleting equipment removed during construction.

PART 3 - EXECUTION

3.01 TRENCHING, EXCAVATING AND BACKFILLING

- A. Excavate to required dimensions and depth. The trench excavation shall be in open cut from surface and shall be minimum width necessary to permit the placing of the pipe as required. Excess excavation shall be backfilled with crusher run rock. Such rocks shall be placed at the Contractor's expense. Lines shall be used to lay out trenches.
- B. All excavations shall be properly protected by the necessary bracing and timbers, to prevent any cave-ins or injury to adjacent improvements. The sides of the excavations shall be securely held by bracing or sheathing, which bracing or sheathing shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. Where adjacent improvements might be injured by the removal of such bracing, the braces shall be left in place to prevent such injury. The thickness of the sheathing and the dimensions of the cross braces, shoes and miscellaneous supports to be used by the Contractor shall be of type required to properly protect the sides of the trench and to prevent injurious cave-ins or erosions.
- C. The Contractor shall do all pumping and bailing necessary to keep all excavations free of water and shall provide for the uninterrupted flow of the surface water adjacent to the line of the work during the progress of the work. The Contractor shall inspect the ground where excavation is required to ascertain the structure of the soil. Additional consideration will not be allowed for encountering rock, stone, old foundations or other unfavorable excavating conditions.
- D. In cases where existing sewer or other piping are encountered, they shall not be displaced or disturbed. All sewer lines damaged or disturbed in the construction shall be replaced or required at the Contractor's expense, unless, in the opinion of the Architect, such damage was caused through no fault of the Contractor.
- E. Contractor shall provide all temporary steel plates, barricades, and such other signs and signals by day as shall be necessary to warn the public of and protect the workers from the danger caused by excavations and other obstructions, day and night.
- F. The backfilling of trenches shall be carried out as rapidly as the testing and acceptance of the finished sections of the installation will permit. The trench shall be backfilled in layers of not to exceed eight inches (8") with good selected clean earth, thoroughly tamped with mechanical tamper to a 95% optimum compaction. Density shall be tested by an approved laboratory, using a standard method. Tests shall be made of each 2 ft. depth on the basis of one test per 1000 sq. ft. of fill area. Last 12" of backfill shall be made with good clean top soil. Contractor shall obtain and pay for tests. Submit five (5) copies of tests for approval. Note: Broken stones, cinders, wood and rubbish are not acceptable for backfilling. Backfill all street cuts in a manner meeting the approval of the Architect.
- G. In spaces between walls and line of excavation, fill with thin layers of selected clean earth; thoroughly tamp in eight inches (8") thick layers and bring up to a finished level of established grades. All wood and foreign material shall be removed from excavation prior to backfilling.
- H. After backfilling, all surplus excavated materials shall be removed from the property.
- I. The work shall be executed so that any existing permanent structure along and adjacent to the new work are properly protected. Any damage occurring to these structures shall be repaired by the Contractor at his own expense.

- J. The Contractor shall make field inspection of the location along which the underground conduit is to be routed, and note all obstructions and improvements at the surface which may affect the method of operation in the construction of these conduits. Such underground pipes or conduits which may exist, or which may be encountered, shall be protected by the Contractor during this construction. Any expense or inconvenience caused by their existence and the necessary protection for utilities adjacent thereto shall be considered as covered and included in the contract, without additional cost to the Owner.

3.02 ELECTRICAL DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove electrical systems, fixtures, devices, and components indicated to be removed. In general, remove all fixtures, raceways, cables, junction boxes, and equipment not utilized in new construction. For circuits disconnects, remove raceways and cables all way to the source. Label breakers/switches from where circuits have been removed as "SPARE".
- C. Protect existing electrical equipment and installation indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- D. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- E. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish. Raceways shall not be abandoned within walls.
- F. Remove demolished material from Project site.
- G. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- H. Remove equipment to be salvaged, disconnect from power, and deliver to Owner as directed.

3.03 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. In general install raceways and boxes minimum 8" above hung ceiling. All raceways, boxes and equipment shall be independently supported from structure. Do not support from ductwork or piping.
- G. Where new devices are added to existing circuits, take readings prior to adding new devices, and submit to Architect for review. Do not proceed with new work until approved by Architect.
- H. All low voltage devices (including but not limited to voice/data communication; nurse call; master antenna television; patient monitoring; telemetry, etc.) that are installed in patient care areas or patient rooms or procedure rooms shall have their conduit extended out to above accessible ceiling space in adjacent corridor. Terminate conduit with a bushing.

3.04 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.05 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.06 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 26 05 05
ELECTRICAL TESTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:
 - 1. Suitability of test equipment.
 - 2. Calibration of test instruments.
 - 3. Coordination requirements for testing and inspecting.
 - 4. Reporting requirements for testing and inspecting.
- B. Emergency systems shall be tested as specified herein.

1.03 QUALITY ASSURANCE

- A. The Electrical Contractor shall completely test and inspect all systems in accordance with the specifications and drawings. The Electrical Contractor shall certify that all systems are in complete working order prior to turning over the Owner.
- B. Except as modified by governing codes and by the contract documents, comply with the latest applicable provisions and latest recommendations of the following:
 - 1. NFPA.
 - 2. NEMA.
 - 3. NEC.
 - 4. IEEE.
 - 5. IPCEA.
 - 6. ANSI.
 - 7. UL.
 - 8. NECA.
 - 9. Local Fire Department.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 GENERAL TESTING

- A. It shall be the responsibility of this Contractor to furnish all testing instruments/equipment, materials and labor necessary to perform the following tests.
 - 1. After wires or cables are in place, but before being connected to devices and equipment, the system shall be tested for shorts, opens, intentional and unintentional grounds by means of wires in conduit that are shorted or unintentionally grounded shall be replaced.
 - 2. Voltage drops for panel and large feeders shall not exceed 3% hence the total voltage drop for a feeder and any branch circuit shall not exceed 5% of the service voltage. The test shall be made under design load or it's equal.
 - 3. Any wiring device, or electrical apparatus in this contract, if grounded or shorted on an integral "line" part, shall be removed and the problem rectified.

4. When required, complete test and inspection records shall be made and incorporated into a report for each piece of equipment tested. All readings taken shall be recorded. Four (4) copies shall be submitted to the Architect for approval.
5. Notify the Architect, with minimum seven (7) days notice, about testing schedule.

3.02 Wiring Test

- A. The wiring and cable tests shall be made before any circuits, main switches, motors, transformers or feeders are energized.
- B. Tests shall be made for continuity, identification and absence of shorts and grounds for each conductor. Both ends of a given conductor shall be identified alike. Before circuit terminal connections are made, continuity and identification of wiring shall be checked by means of a DC test device using a bell, light, meter, or buzzer.
- C. Insulation Resistance (IR) test shall be made using meggers at the following values:
 1. 480Y/277 Volt wiring at 1000 Volts DC.
 2. 208Y/120 Volt Wiring at 500 Volts DC.
- D. Insulation resistance between phase conductors and neutral, phase conductors and ground shall not be less than the minimum requirements of 2000 meg-ohms.
 1. Wire terminations shall not be made to equipment (motors, MCCs, but ducts, etc.), until that piece of equipment has been tested and verified as specified in this section.
 2. Test motor feeders with motors disconnected, but with circuit breakers, switches or starters in the circuit opened so as to include only that portion of the feeder, required to be tested.
 3. Test lighting feeders with the circuit breakers and panelboards connected but with lighting branch circuit breakers or switches open so as to include only the branch circuit to be tested.
 4. Contractor shall correct or replace any circuit which is defective or grounded and shall correct all other problems encountered by these tests. All defects whether due to faulty workmanship or material furnished by the Contractor shall be corrected under this section at the Contractor's expense.

3.03 LIGHTING TEST

- A. Check all lighting fixtures for proper operation. All Contractor supplied fixtures shall be 100% operable at no additional cost to the Owner. Repair cost to Owner-supplied fixtures shall not be the responsibility of the Contractor unless otherwise stated.
- B. Verify operation of Lighting Control Systems. Program time clocks per client's requirements, including holiday setbacks.

3.04 MOTOR TEST

- A. Perform motor tests in coordination with fire suppression, plumbing and HVAC contractors for motors furnished with their equipment.
- B. All 460-volt motors shall be individually "spot tested" for insulation resistance using 1000V DC. All 208/120V motors shall be "spot tested" with 500V DC in a similar manner. The minimum resistance to ground shall be 2000 meg-ohm (corrected to 20 degrees C). The Contractor shall record the ambient temperature of the motor and submit this value along with insulation resistance value. For motors from 7-½ to 20 HP, Contractor shall submit Dielectric Absorption Ratios. For motor above 20 HP, the Polarization Indexes of the motor shall also be submitted.
- C. Make the following checks on all motors prior to start up.
 1. Check motor nameplates for HP, speed, phase and voltages. Verify proper voltage available for terminal wiring.

2. Check shaft for freedom of rotation.
3. Verify that the motor is properly lubricated prior to energizing.
- D. Contractor shall furnish a proper sized heater for each overload relay.
- E. Make the following tests on all motors during or immediately after start-up:
 1. Check for proper shaft rotation.
 2. Check motor for smooth operation (vibration).
 3. Take a current reading using a clamp-on ammeter. (Record no-load readings and loaded readings).

3.05 PANELBOARD, BUS DUCT AND M.C.C. TESTS

- A. Test all equipment to be operated on the 480/277V system at 1000V DC and all equipment to be operated on the 208/120V system at 500V DC prior to connecting feeders. A minimum insulation resistance of 2000 meg-ohms shall be obtained between all phases and between phase and neutral, and phase and ground.

3.06 TRANSFORMER (RATED FOR 600V OR LESS) TEST

- A. Insulation tests on transformers shall be as follows:
 1. 480 Volt Side.
 - a. Test with 1000V DC, high side winding to low side winding and high side winding to ground. 2000 meg-ohm shall be minimum acceptable insulation resistance.
 2. 208/120 Volt Side.
 - a. Test with 500V DC, low side to ground. 200 meg-ohm shall be the minimum acceptable insulation resistance.

3.07 SPOT TEST

- A. "Spot Test" mentioned in this section shall be interpreted as the specific test method of obtaining insulation resistance by applying indicated test voltage for 60 seconds to the equipment or wiring being tested.

3.08 CONTROL WIRING/OUTLET TEST

- A. Control wiring shall perform the function as noted in operation methods and/or included schematics and single line diagrams.
- B. All 120-volt outlets shall be tested with a Daniel Woodhead Cat. No. 1750 and 1760 tester. Minimum acceptable tension is 10 oz. for NEMA 5-15R, and 5-20R, 6-15R, 6-20R, 7-15R, 7-20R, 14-20R, 15-15R and 15-20R receptacles.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
 - 1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.
 - 2. Division 26 Section "Undercarpet Electrical Power Cables" for flat cables for undercarpet installations.
 - 3. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.03 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Qualification Data: For testing agency.
- C. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- 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 NFPA 70.
- D. All conductors and cables shall be UL labeled.

1.06 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

- B. Coordinate layout and installation of conductors and cables with other trades.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Delivery conductors and cables according to NEMA WC 26.
- B. Protect stored conductors and cables from moisture and dirt. Do not store outside, exposed to elements. Elevate above grade. Do not exceed structural capacity of floor, when stored inside.

PART 2 - PRODUCTS

2.01 CONDUCTORS AND CABLES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. American Insulated Wire Corp.; a Leviton Company.
 - 3. General Cable Corporation.
 - 4. Senator Wire & Cable Company.
 - 5. Southwire Company.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.
- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC or mineral-insulated, metal-sheathed cable, Type MI with ground wire.

2.02 CONNECTORS AND SPLICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. AMP Incorporated/Tyco International.
 - 3. Hubbell Power Systems, Inc.
 - 4. O-Z/Gedney; EGS Electrical Group LLC.
 - 5. 3M; Electrical Products Division.
 - 6. Panduit Corporation.
 - 7. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.04 SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.

2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.01 CONDUCTOR MATERIAL AND SIZE APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Conductors smaller than No. 12 AWG shall not be utilized anywhere, unless specifically noted on drawings.
- D. The minimum conductor size for branch circuits shall be #12 AWG copper. To compensate for voltage drop, where branch circuit lengths are between 100 and 150 feet, use #10 AWG copper. For branch circuit lengths exceeding 150 feet, use #8 AWG copper.
- E. Wire size ampacity shall equal or exceed its overload protective device. Where wire sizes shown on the drawings are greater than the apparent ampacity requirements, the size shown shall prevail to compensate for voltage drop. In no instance shall conductors be installed that are less than required by NEC.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway or Type XHHW, single conductors in raceway. Mineral-insulated, metal-sheathed cable, Type MI where specifically indicated on drawings.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- D. Feeders at all other locations: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits at all other locations: Type THHN-THWN, single conductors in raceway.
- H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- I. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- J. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- K. Fire Alarm Circuits: Refer to Section 280513 "Conductors and Cables for Electronic Safety and Security".

3.03 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and factory color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.04 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.06 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Perform tests and inspections and prepare test reports.
- C. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and branch circuit conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of final acceptance.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

- D. Test Reports: Prepare a written report to record the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.
- C. Related Sections include the following:
 - 1. Division 26 Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for requirements for grounding conductors.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
 - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
 - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
 - b. Include recommended testing intervals.

1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- 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 UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. No. 4 AWG minimum, soft-drawn copper.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.02 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.03 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch diameter by 10 feet in diameter.

2.04 DEEP EARTH GROUND

- A. Furnish and install a minimum of two (2) deep earth grounding electrodes. Each electrode shall have a maximum resistance of 3 ohms. The preferred resistance is 1 ohm. The resistance of each electrode shall be measured using the 3-point fall of potential method.
- B. Each electrode shall be installed to a depth as required to obtain specified resistance. Drilling for electrode shall be done in conformance with all local and national codes. Locate all site utilities prior to drilling. Furnish and install ingrade junction box at top of each electrode.
- C. Submit test report of each electrode. Include with report pictures and plans indicating locations for test electrode. Submit information on test instruments used and dates of last calibrations.
- D. Repair and replace any items damaged or changed in any way due to the drilling.

PART 3 - EXECUTION

3.01 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.02 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Armored and metal-clad cable runs.
 - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 - 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- G. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- H. Metal and Wood Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.03 INSTALLATION

- A. Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.
- B. Electrical Room Grounding Bus: Space 1 inch (25 mm) from wall and support from wall 6 inches (150 mm) above finished floor except as otherwise indicated.
- C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- D. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- E. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

- F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- G. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- H. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- I. In addition to using the water service as a grounding electrode, effectively grounded building steel or rebar of reinforced concrete columns, driven ground rods outside or buried electrode shall be provided and inter connected.
- J. Provide a copper ground cable from the above main service ground bus to building steel, driven ground rods outside or buried electrodes.
- K. Provide a copper ground cable from the reference ground bus in the primary service room to each 480/120V transformer.
- L. The Main service neutral shall be bonded to the main service ground. Main ground bars shall be 4 foot width x 12" height x 1/4" thick.
- M. Bond with a grounding conductor, minimum #4 copper all interior metallic water, gas and other metallic lines.
- N. The complete metal conduit system shall be used for the equipment grounding system. Conduit systems and associated fittings and terminations shall be made mechanically tight to provide a continuous electrical path to ground and shall be safely grounded at all equipment by bonding all metallic conduit to the equipment enclosures with locknuts cutting thru paint of enclosures. Bond all conduits entering primary switchgear, unit substations and secondary switchboards with a ground wire connecting the grounding type bushings to the equipment ground bar. Conductors shall be sized per NEC.
- O. In addition to using the conduit system for grounding, a complete auxiliary green wire equipment grounding system shall be installed, continuous from main ground, through distribution and branch circuit panelboards and paralleling all feeders and branch circuit wiring. The minimum size shall be #12 copper except #14 on control circuits. This shall apply to all circuits rated 100 volts or more above ground potential.
- P. Bond all communications conduit systems to ground.
- Q. Connect ground terminal on wiring devices to auxiliary green wire equipment grounding system.

- R. Ground the neutral terminals of all transformers for separately derived systems. The Ground electrode shall be either of the following:
 - 1. Building system ground bus. The ground bus must be effectively bonded to the service ground.
 - 2. Nearest building steel or concrete column re-bar. The steel or re-bar must be effectively bonded to the service ground.
 - 3. The street side of the main water service.
 - 4. A set of interconnected ground rods or other NEC approved electrodes.
- S. Ground the neutral terminals of all Generators for separately derived systems. The Ground electrode shall be either of the following:
 - 1. A set of interconnected ground rods or other NEC approved electrodes.
 - 2. Building system ground bus. The ground bus must be effectively bonded to the service ground.
 - 3. Nearest building steel or concrete column re-bar. The steel or re-bar must be effectively bonded to the service ground.
 - 4. The street side of the main water service.
- T. Ground Generators at the following locations.
 - 1. Generator frame.
 - 2. Engine- generator skid.
 - 3. Generator output circuit breaker and switchgear.
 - 4. Automatic Transfer Switch.
 - 5. Fuel Tanks.
- U. Motor frames shall be bonded to the equipment grounding system by an independent green wire, sized as shown.
- V. System neutral connections shall be insulated from metal enclosures except at the neutral of the service entrance equipment and on the neutral of a separately derived system. Connections to the main switchgear enclosure shall be by means of bonding jumpers.
- W. The building neutral shall be identified throughout with white conductors. Where there are neutral conductors from a separately derived system (such as 120/208 volt, 3 phase, 4 wire where the main building service is 277/480 volt, 3 phase, 4 wire) the neutrals of the two systems shall be separately identifiable.
- X. Steel frame buildings and metal exterior coverings on buildings that are not effectively grounded shall be grounded thru a low resistance grounding system whether or not a lightning protection system is required.
- Y. Ground metal exterior coverings and metal roofs with minimum #4 copper conductor at a minimum of two points, intervals not exceeding 100 feet.
- Z. Ground steel frame buildings at each corner with maximum of every 60 ft. around the outside perimeter by cadwelding #2/0 (#4/0 for buildings over 75 ft. tall) copper conductor to steel columns and extending below ground to driven ground rods; top of 0.625 inch x 10 ft. ground rod shall be minimum of 12 inches below finished grade and 3 ft. out from building foundation. Bond the water service, street side of water meter, to the adjacent perimeter steel column with #4/0 insulated copper conductor. Sleeve all concrete foundations and masonry walls with PVC sleeve.
- AA. Metal covers on pull boxes and junction boxes shall be effectively grounded.

- BB. Connections to driven ground rods or other such electrodes shall be a minimum of three feet from the foundation wall or beyond the roof drip line, whichever is greater. Do not install ground rods in backfill.
- CC. The electrodes (driven ground rods) of the electrical grounding system shall not be used for the electrodes for the lightning protection system, and vice versa. However, these two systems shall be bonded together at one point.
- DD. Wiring devices shall be connected with grounding jumper from ground pole on device to grounding screw in the outlet box.
- EE. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
 - 1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 - 2. Bury ground ring not less than 24 inches from building foundation.
- FF. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70, using a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.
 - 1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building grounding grid or to grounding electrode external to concrete.

3.04 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, and connection methods so metals in direct contact will be galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Complete with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

- F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.05 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 - 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 - 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 - 5. Substations and Pad-Mounted Equipment: 5 ohms.
 - 6. Manhole Grounds: 10 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
 - 1. Division 26 Section "Vibration and Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with criteria.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
 - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Nonmetallic slotted channel systems. Include Product Data for components.
 - 4. Equipment supports.
- C. Welding certificates.

1.06 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.07 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. Fabco Plastics Wholesale Limited.
 - d. Seasafe, Inc.
 - 2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
 - 3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
 - 4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 5. Toggle Bolts: All-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.05 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
 - 1. Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. RMC: Rigid metal conduit (rigid steel conduit).

1.04 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Custom enclosures and cabinets.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Structural members in the paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.
- D. Source quality-control test reports.

1.05 QUALITY ASSURANCE

- A. 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.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 METAL CONDUIT AND TUBING

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.

2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.; Anaconda Metal Hose.
4. International Metal Hose Co.
5. Manhattan/CDT/Cole-Flex.
6. Maverick Tube Corporation.
7. O-Z Gedney; a unit of General Signal.
8. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket.
- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel or die-cast, set-screw or compression type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.02 NONMETALLIC CONDUIT AND TUBING

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. CANTEX Inc.
 4. CertainTeed Corp.; Pipe & Plastics Group.
 5. Condux International, Inc.
 6. Lamson & Sessions; Carlon Electrical Products.
 7. Manhattan/CDT/Cole-Flex.
 8. RACO; a Hubbell Company.
 9. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.03 METAL WIREWAYS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Keystone/Rees Inc.
 - 4. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 3R, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type. Flanged-and-gasketed type where shown on drawings.
- E. Finish: Manufacturer's standard enamel finish.

2.04 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Enduro Systems, Inc.; Composite Products Division.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Walker Systems, Inc.; Wiremold Company (The).
 - g. Wiremold Company (The); Electrical Sales Division.

2.05 BOXES, ENCLOSURES, AND CABINETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.

7. RACO; a Hubbell Company.
8. Thomas & Betts Corporation.
9. Walker Systems, Inc.; Wiremold Company (The).
- B. Pull and junction boxes shall be minimum 4" x 4".
- C. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- D. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- F. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, with gasketed cover.
- I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- J. Cabinets:
 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

2.06 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.07 SLEEVE SEALS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Carbon steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.01 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 1. Exposed Conduit: Rigid steel conduit or IMC or RNC, Type EPC-40-PVC.
 2. Concealed Conduit, Aboveground: Rigid steel conduit or IMC or RNC, Type EPC-40-PVC.
 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 4. Within Underground Duct Banks: IMC or RNC, Type EPC-40-PVC.
 5. Underground Conduit: RNC, Type EPC-40-PVC, when encased in minimum 3" thick concrete.
 6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 7. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Electrical rooms.
 - e. Stairwells.
 - f. Within block or masonry walls.
 3. Concealed Above Hung Ceilings and Within Interior Sheet Rock Walls and Partitions: EMT.
 4. Underground Conduit: Rigid steel conduit or IMC, below concrete or within poured concrete.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations. Length not to exceed 6 ft.
 6. Damp or Wet Locations: Rigid steel conduit.
 7. Connection to Kitchen Equipment: LFMC/LFNC from disconnecting switch. Length not to exceed 6 ft.
 8. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
 9. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
 10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Concealed: FMC ½" inch – only in specific locations, in existing areas, within existing walls to remain. Utilize only between box in wall to junction box above ceiling. Junction box shall be located within 12" above hung ceiling. FMC, within walls, not acceptable in other locations.

- D. Minimum Raceway Size: 3/4-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- G. Install raceways underground or below floor only for locations indicated on drawings.

3.02 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping. Do not install horizontal raceway directly and parallel under cold water or chilled water pipes. In general, install raceways as high as possible, closer to underside of structure. Install horizontal raceways minimum 8 inches above ceilings.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter entering the raceways.
- F. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
 - 1. Run parallel or banked raceways together on common supports.
 - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
 - 1. Use insulating bushings to protect conductors.
- K. Utilize compression fittings only with suitable tools.
- L. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

- O. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with one (1) locknut, use two (2) locknuts: one (1) inside and one (1) outside the box.
- P. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- R. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
 - 1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 - 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- S. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- T. Expansion-Joint Fittings: Install UL approved expansion fittings in each run of aboveground conduit that is located at building expansion joint. Length of fittings shall not exceed 6 inches.
- U. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit from junction boxes to recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Flexible conduit from light fixture to lighting fixture not allowed.
- V. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.
- W. Set metal floor boxes level and flush with finished floor surface.
- X. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- Y. All raceways terminating a junction boxes, located above ceiling shall be provided with color coded vinyl tape indicating the service. Color coding tape shall be applied next to the junction box. Tape color shall match junction box cover color.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section "Common Work Results for Electrical".
 - 2. Install backfill as specified in Section "Common Work Result for Electrical".
 - 3. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.05 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.06 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.07 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.08 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes. Remove burrs, dirt, and construction debris.

END OF SECTION

SECTION 26 05 48

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Spring isolators.
 - 3. Restrained spring isolators.
 - 4. Channel support systems.
 - 5. Restraint cables.
 - 6. Hanger rod stiffeners.
 - 7. Anchorage bushings and washers.
- B. Related Sections include the following:
 - 1. Division 26 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.03 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.04 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
 - a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
 - 2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
 - 3. Field-fabricated supports.
 - 4. Seismic-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.

- b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
- C. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.
- D. Welding certificates.
- E. Field quality-control test reports.

1.05 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- D. Comply with NFPA 70.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- B. Pads Type - A.1: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene or rubber.
- C. Spring Isolators - Type B.1: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 - 4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- D. Restrained Spring Isolators - Type B.2: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch-thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- E. Elastomeric Hangers - Type B.4: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

2.02 SEISMIC-RESTRAINT DEVICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Amber/Booth Company, Inc.
 2. Cooper B-Line, Inc.; a division of Cooper Industries.
 3. Hilti Inc.
 4. Mason Industries.
 5. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be acceptable to authorities having jurisdiction.
1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

- G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.
- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.03 VIBRATION ISOLATION EQUIPMENT BASES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Amber/Booth Company, Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
 - 4. Vibration Eliminator Co., Inc.
 - 5. Vibration Isolation.
 - 6. Vibration Mountings & Controls, Inc.
- B. Steel Base - Type E.1: Factory-fabricated, welded, structural-steel bases and rails.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mounting and to provide for anchor bolts and equipment support.
- C. Inertia Base - Type E.2: Factory-fabricated, welded, structural-steel bases and tails ready for placement of cast-in-place concrete.
 - 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 - 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36. Bases shall have shape to accommodate supported equipment.
 - 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 - 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.04 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
 - 1. Powder coating on springs and housings.
 - 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 - 3. Baked enamel or powder coat for metal components on isolators for interior use.
 - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
 - 1. Install restrained isolators on electrical equipment.
 - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- D. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

3.05 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.06 VIBRATION ISOLATOR AND SEISMIC-RESTRAINT SCHEDULE FOR SLAB ON GRADE LOCATED EQUIPMENT

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Generator sets (with internally isolated engine and generator)	Floor	All sizes	-	A.1	0.25"
Remote Radiators	Floor	All sizes	-	A.1	0.25"
Transformers	Floor	All sizes	-	A.1	0.25"
	Suspended	All sizes	-	B.4	0.25"
Notes: 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer.					

3.07 VIBRATION ISOLATOR AND SEISMIC - RESTRAINT SCHEDULE FOR EQUIPMENT LOCATED ABOVE GRADE

Equipment	Mounting	Size	Base Type	Isol. Type	Static Deflection
Generator sets (with internally isolated engine and generator)	Floor	Up to 300 KW 350 KW and higher	E.1	B.1	1.0"
			E.2	B.2	1.0"
Remote Radiators	Roof	All sizes	-	B.1	1.0"
Transformers	Floor	All sizes	-	A.1	0.25"
	Suspended	All sizes	-	B.4	0.25"
Notes: 1. The table indicates minimum static deflection for the isolator. The Contractor shall provide isolators with proper deflection, for equipment furnished, as recommended by the isolator manufacturer.					

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Indoor occupancy sensors.
 - 3. Lighting contactors.
 - 4. Emergency shunt relays.
- B. Related Sections include the following:
 - 1. Division 26 Sections "Central Dimming Controls" for architectural dimming system equipment.
 - 2. Division 26 Section "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
 - 3. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.
 - 4. Division 26 Section "Theatrical Lighting" for theatrical lighting controls.

1.03 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
 - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.06 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.01 TIME SWITCHES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.

2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 3. Intermatic, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls; a Genlyte Company.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Paragon Electric Co.; Invensys Climate Controls.
 8. Square D; Schneider Electric.
 9. TORK.
 10. Watt Stopper (The).
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
1. Contact Configuration: SPST or DPDT as indicated on drawings.
 2. Contact Rating: 20-A ballast load, 120/240-V ac or as indicated on drawings.
 3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays or as indicated on drawings.
 4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 5. Astronomic Time: All channels.
 6. Battery Backup: For schedules and time clock.
- C. Electromechanical-Dial Time Switches: Type complying with UL 917.
1. Contact Configuration: SPST or DPDT as indicated on drawings.
 2. Contact Rating: 20-A ballast load, 120/240-V ac or as indicated on drawings.
 3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
 4. Astronomic time dial.
 5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
 6. Skip-a-day mode.
 7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.02 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Area Lighting Research, Inc.; Tyco Electronics.
 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 3. Intermatic, Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Paragon Electric Co.; Invensys Climate Controls.
 6. Square D; Schneider Electric.
 7. TORK.
 8. Watt Stopper (The).

- B. Description: Solid state, with SPST or DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
 - 1. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
 - 2. Time Delay: 15-second minimum, to prevent false operation.
 - 3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
 - 4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.03 INDOOR PHOTOELECTRIC SWITCHES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. Area Lighting Research, Inc.; Tyco Electronics.
 - 3. Eaton Electrical Inc; Cutler-Hammer Products.
 - 4. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 5. Intermatic, Inc.
 - 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 7. MicroLite Lighting Control Systems.
 - 8. Paragon Electric Co.; Invensys Climate Controls.
 - 9. Square D; Schneider Electric.
 - 10. TORK.
 - 11. Watt Stopper (The).
- B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
 - 1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - 3. Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
 - 4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
 - 5. Indicator: Two LEDs to indicate the beginning of on-off cycles.
- C. Skylight Photoelectric Sensors: Solid-state, light-level sensor; housed in a threaded, plastic fitting for mounting under skylight, facing up at skylight; with separate relay unit mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
 - 1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.

2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.04 INDOOR OCCUPANCY SENSORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Lighting.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Sensor Switch, Inc.
 5. TORK.
 6. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
 1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 - 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
 - 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.05 OUTDOOR MOTION SENSORS (PIR)

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bryant Electric; a Hubbell Company.
 - 2. Hubbell Lighting.
 - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 4. Paragon Electric Co.; Invensys Climate Controls.
 - 5. TORK.
 - 6. Watt Stopper (The).
- B. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as raintight according to UL 773A.
 - 1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 2. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
 - b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 - 3. Bypass Switch: Override the on function in case of sensor failure.
 - 4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keep lighting off during daylight hours.

- C. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
- D. Detection Coverage: Up to 35 feet, with a field of view of 90 degrees.
- E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
- F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 - 1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 - 2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.06 LIGHTING CONTACTORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 4. GE Industrial Systems; Total Lighting Control.
 - 5. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 6. Hubbell Lighting.
 - 7. Lithonia Lighting; Acuity Lighting Group, Inc.
 - 8. MicroLite Lighting Control Systems.
 - 9. Square D; Schneider Electric.
 - 10. TORK.
 - 11. Watt Stopper (The).
- B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
 - 1. Monitoring: On-off status.
 - 2. Control: On-off operation.

2.07 EMERGENCY SHUNT RELAY

- A. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
 - 1. Coil Rating: 120 or 277 V.

2.08 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.01 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.02 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.03 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.04 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.05 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.06 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of final acceptance by Owner, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.07 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Receptacles with integral surge suppression units.
 - 4. Wall-box motion sensors.
 - 5. Isolated-ground receptacles.
 - 6. Hospital-grade receptacles.
 - 7. Snap switches and wall-box dimmers.
 - 8. Solid-state fan speed controls.
 - 9. Wall-switch and exterior occupancy sensors.
 - 10. Communications outlets.
 - 11. Pendant cord-connector devices.
 - 12. Cord and plug sets.
 - 13. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
- B. Related Sections include the following:
 - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.

- 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 NFPA 70.

1.06 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

1.07 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Service/Power Poles: One for every 10 installed, but no fewer than one.
 - 2. Floor Service Outlet Assemblies: One for every 10 installed, but no fewer than one.
 - 3. TVSS Receptacles: One for every 10 of each type installed, but no fewer than one.
 - 4. Hospital-Grade Receptacles: One for every 20 installed, but no fewer than two.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers' Names: Subject to compliance with requirements, provide products by one of the following:
 - 1. Wiring Devices (Receptacles, Switches):
 - a. Cooper Wiring Devices.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Mfg. Company Inc.
 - d. Pass & Seymour/Legrand; Wiring Devices Div.
 - 2. Wiring Devices for Hazardous (Classified) Locations:
 - a. Crouse-Hinds/Cooper Industries, Inc.; Arrow hart Wiring Devices.
 - b. EGS/Appleton Electric Company.
 - c. Killark Electric Manufacturing Co./Hubbell Incorporated.
 - 3. Occupancy Sensors:
 - a. Cooper Industries, Inc.
 - b. Hubbell Incorporated.
 - c. Leviton Mfg. Company, Inc.
 - d. Pass & Seymour/Legrand.
 - e. The Watt Stopper.
 - 4. Poke-Through, Floor Service Outlets and Telephone/Power Poles:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand; Wiring Devices Div.
 - c. Square D/Groupe Schneider NA.
 - d. Thomas & Betts Corporation.
 - e. Wiremold Company (The).

5. Multioutlet Assemblies:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Wiremold Company (The).

2.02 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
- B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.
- C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 1. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.03 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
- C. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.

2.04 TVSS RECEPTACLES

- A. General Description: Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 1449, with integral TVSS in line to ground, line to neutral, and neutral to ground.
 1. TVSS Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 volts and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.
 2. Active TVSS Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."
- B. Duplex TVSS Convenience Receptacles:
 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.
- C. Isolated-Ground, Duplex Convenience Receptacles:
 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- D. Hospital-Grade, Duplex Convenience Receptacles: Comply with UL 498 Supplement SD.
 1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R.

E. Isolated-Ground, Hospital-Grade, Duplex Convenience Receptacles:

1. Description: Straight blade, 125 V, 20 A; NEMA WD 6 configuration 5-20R. Comply with UL 498 Supplement SD. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.05 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

- A. Comply with NEMA FB 11 and UL 1010.

2.06 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:
1. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.07 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.08 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.09 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A.
- C. Switches shall be heavy-duty, quiet type.
- D. Pilot Light Switches, 20 A:
1. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- E. Key-Operated Switches, 120/277 V, 20 A:
1. Description: Single pole, with factory-supplied key in lieu of switch handle.
- F. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
- G. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.10 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.11 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Continuously adjustable rotary knob, 5 A.
 - 2. Three-speed adjustable rotary knob, 1.5 A.

2.12 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.
- B. Wall-Switch Sensors:
 - 1. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.
- C. Long-Range Wall-Switch Sensors:
 - 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft.
- D. Long-Range Wall-Switch Sensors:
 - 1. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft.
- E. Wide-Range Wall-Switch Sensors:
 - 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft.
- F. Exterior Occupancy Sensors:
 - 1. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.13 COMMUNICATIONS OUTLETS

- A. Telephone Outlet:
 - 1. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.
- B. Combination TV and Telephone Outlet:
 - 1. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.14 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: Smooth, high-impact thermoplastic or 0.035-inch-thick, satin-finished stainless steel or 0.04-inch-thick steel with chrome-plated finish.
 - 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
 - 5. Material for Devices on Emergency Power: Smooth, high-impact thermoplastic, red in color.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.15 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.16 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 - 1. Service Outlet Assembly: Pedestal type with services indicated or Flush type with two simplex receptacles and space for two RJ-45 jacks.
 - 2. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
 - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 4. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
 - 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.

2.17 MULTIOUTLET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Wire: No. 12 AWG.
- D. Number of Circuits: As indicated on drawings.

2.18 SERVICE POLES

- A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
 - 1. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.

2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
3. Finishes: Manufacturer's standard painted finish and trim combination.
4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.
5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
6. Voice and Data Communication Outlets: Four RJ-45 Category 5e jacks.

2.19 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 1. Wiring Devices Connected to Normal Power System: Ivory or White or As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
 2. Wiring Devices Connected to Emergency Power System: Red.
 3. TVSS Devices: Blue.
 4. Isolated-Ground Receptacles: As specified above, with orange triangle on face].

PART 3 - EXECUTION

3.01 APPLICATION

- A. Wiring devices, on emergency power circuits, shall be red in color.
- B. Tamper resistant receptacles shall be utilized in all Pediatrics areas, children's play areas, public waiting rooms and public toilet rooms.
- C. Stainless steel wall plates shall be utilized for switches and receptacles, on normal power, located in critical areas (Surgery, PACU, Delivery, Nursery, ICU, Cath Lab, etc.) within Healthcare facilities.
- D. All wall plates, serving normal power devices, within a room or area shall be same type – either thermoplastic or stainless steel. Mix matching of wall plates shall not be acceptable.
- E. All wiring devices, located with Healthcare facilities, shall be hospital grade.

3.02 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 8. Tighten unused terminal screws on the device.
 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
 10. Install devices and assemblies level, plumb and square with building lines.
- E. Receptacle Orientation:
 1. Install ground pin of vertically mounted receptacles at top, and on horizontally mounted receptacles to the right.
 2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
 3. Install ground pin of vertically mounted receptacles, located more than 60" above floor, at bottom.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
 1. Install dimmers within terms of their listing.
 2. Verify that dimmers used for fan speed control are listed for that application.
 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- J. Install GFCI receptacles as shown on drawings and within 60 inches of water source.

3.03 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles and Switch Wall Plates: Identify panelboard and circuit number from which served. Use engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight blade hospital-grade convenience outlets for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less for use in enclosed switches, panelboards, switchboards, enclosed controllers and motor-control centers.
 - 2. Plug fuses rated 125-V ac and less for use in plug-fuse-type enclosed switches and panelboards.
 - 3. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.
 - 4. Spare-fuse cabinets.

1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 3. Current-limitation curves for fuses with current-limiting characteristics.
 - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 5. Coordination charts and tables and related data.
 - 6. Fuse sizes for elevator feeders and elevator disconnect switches.
- B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 4. Coordination charts and tables and related data.

1.04 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.05 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.07 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two each size and type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Littelfuse, Inc.

2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.03 PLUG FUSES

- A. Characteristics: UL 248-11, nonrenewable plug fuses; 125-V ac.

2.04 PLUG-FUSE ADAPTERS

- A. Characteristics: Adapters for using Type S, rejection-base plug fuses in Edison-base fuseholders or sockets; ampere ratings matching fuse ratings; irremovable once installed.

2.05 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class L, fast acting.
 - 2. Feeders Rated for More than 600 Amps: Class L, fast acting.
 - 3. Feeders Rated Less than 600 Amps: Class J, time
 - 4. Motor Branch Circuits: Class RK1, time delay.
 - 5. Other Branch Circuits: Class RK5, non-time delay.
 - 6. Control Circuits: Class CC, fast acting.
- B. Plug Fuses:
 - 1. Motor Branch Circuits: Edison-base type, single-element time delay.
 - 2. Other Branch Circuits: Edison-base type, dual-element time delay.

3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Install spare-fuse cabinet(s).

3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. Section Includes:
 - 1. Fusible disconnect switches.
 - 2. Nonfusible disconnect switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.03 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.04 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of NRTL listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Field quality-control reports.
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Architect no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Architect's written permission.
 - 4. Comply with NFPA 70E.

1.07 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.08 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer.
 - 2. General Electric Company.

3. Siemens Energy & Automation, Inc.
4. Square D; Group of Schneider Electric.

2.02 FUSIBLE DISCONNECT SWITCHES

- A. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 6. Lugs: Compression type, suitable for number, size, and conductor material.
 7. Service-Rated Switches: Labeled for use as service equipment.

2.03 NONFUSIBLE DISCONNECT SWITCHES

- A. Type GD, General Duty, Single Throw, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
 1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
 4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 5. Lugs: Compression type, suitable for number, size, and conductor material.

2.04 RECEPTACLE SWITCHES

- A. Type HD, Heavy-Duty, Single-Throw Fusible Switch: 600-V ac, 60 A and smaller; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate specified fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- B. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: 600-V ac, 60 A and smaller; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- D. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.05 SHUNT TRIP SWITCHES

- A. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.
- B. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Control Circuit: 120-V ac; obtained from a control power source of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.
- D. Accessories:
 - 1. Oiltight key switch for key-to-test function.
 - 2. Oiltight red ON pilot light.
 - 3. Isolated neutral lug; 100 percent rating.
 - 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 - 5. Form C alarm contacts that change state when switch is tripped.

2.06 MOLDED-CASE CIRCUIT BREAKERS

- A. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- B. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- C. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- D. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- E. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

- F. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- H. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- I. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - 8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.07 MOLDED-CASE SWITCHES

- A. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- B. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
 - 7. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

2.08 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NECA 1.
- F. Circuit breakers and switches installed in existing switchgear and switchboard shall have interrupting capacity to match interrupting capacity of switchgear, switchboard, panelboard in which they are installed.

3.03 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- D. Tests and Inspections:
 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section "Overcurrent Protective Device Coordination Study".

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Exit signs.
 - 4. Lighting fixture supports.
 - 5. Retrofit kits for fluorescent lighting fixtures.
- B. Related Sections include the following:
 - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Division 26 Section "Central Dimming Controls" for architectural dimming systems.
 - 3. Division 26 Section "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.
 - 4. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
 - 5. Division 26 Section "Theatrical Lighting" for theatrical lighting fixtures and their controls.

1.03 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. HID: High-intensity discharge.
- E. LER: Luminaire efficacy rating.
- F. Luminaire: Complete lighting fixture, including ballast housing if provided.
- G. RCR: Room cavity ratio.

1.04 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
 - 1. Physical description of lighting fixture including dimensions.
 - 2. Emergency lighting units including battery and charger.
 - 3. Ballast.
 - 4. Energy-efficiency data.
 - 5. Life, output, and energy-efficiency data for lamps.

6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
 - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
 - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 1. Lighting fixtures.
 2. Suspended ceiling components.
 3. Structural members to which suspension systems for lighting fixtures will be attached.
- D. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
 1. Lamps: Specified units installed.
 2. Accessories: Cords and plugs.
- E. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- 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 NFPA 70.
- D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- E. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.
 1. Obtain Architect's approval of fixtures for mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.06 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.07 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of final acceptance by Owner. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Electronic Ballasts: Five years from date of final acceptance by Owner.
 - 2. Warranty Period for Electromagnetic Ballasts: Three years from date of final acceptance by Owner.
- C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: Two year(s) from date of final acceptance by Owner.

1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
 - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 2. Troffers:
 - a. Columbia Lighting; Division of Hubbell Lighting.
 - b. LSI Midwest Lighting.

- c. Metalux.
 - d. H. E. Williams Inc.
 - 3. Strip Fluorescent Fixtures:
 - a. Columbia Lighting; Division of Hubbell Lighting.
 - b. Lithonia Lighting.
 - c. LSI Midwest Lighting.
 - d. H. E. Williams Inc.
 - 4. Under Cabinet Fixtures:
 - a. ALKCO; Division of JJI Lighting Group Co.
 - b. Columbia Lighting.
 - c. Lithonia Lighting.
 - d. LSI Midwest Lighting.
 - e. Nulite Limited.
 - f. H. E. Williams Inc.
 - 5. Exit Signs and Emergency Lighting:
 - a. Dual-Lite; Division of Hubbell Lighting.
 - b. Emergi-lite; Division of Thomas and Betts.
 - c. Failsafe; Division of Cooper Lighting.
 - d. Hubbell Lighting, Inc.
 - e. Lithonia Lighting.
 - f. Prscolite; Division of Hubbell Lighting.
 - g. Surelite; division of Cooper Lighting.
 - 6. Downlighting (Recessed, Surface, HID):
 - a. Edison Price Lighting.
 - b. Halo; Division of Cooper Lighting.
 - c. Hubbell Lighting, Inc.
 - d. Infinity Lighting.
 - e. The Kirlin Company.
 - f. Kurt Versen Co.
 - g. Lithonia Lighting.
 - h. Lightolier; Division of Genlyte Thomas Co.
 - i. Prescolite; division of Hubbell Lighting.
 - j. Rambusch Lighting.
- C. In order to create a controlled, competitive bidding climate, the Lighting Fixture Schedule, as indicated on the drawings, was developed around the manufacturer listed in the schedule. Equal products from the manufacturers listed will be acceptable. In limited circumstances, for various reasons, certain fixtures were deemed to be proprietary. In these cases, the language, "No substitutions", is intended to provide the electrical distributors bidding the job with the ability to assemble the most competitive lump sum price for the lighting fixture/lamp package. The electrical distributor, therefore, has the authority to require unit pricing from the manufacturer's representatives for those products so specified.
- D. Light Fixture Schedule as indicated on drawings.

- E. Lamps: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. General Electric Company.
 - 2. Philips Electronics.
 - 3. Siemens Corporation.
 - 4. Osram Sylvania.
 - 5. Westinghouse Corporation.
- F. Ballasts: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. Advance; Division of Philips Electronics.
 - 2. General Electric Company.
 - 3. Lutron Products.
 - 4. Osram Sylvania.
 - 5. Universal.

2.02 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- D. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.
- E. Metal Parts: Free of burrs and sharp corners and edges.
- F. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- H. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
 - 4. Laminated Silver Metallized Film: 90 percent.
- I. Plastic Diffusers, Covers, and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- J. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.03 BALLASTS FOR LINEAR FLUORESCENT LAMPS

- A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
 - 1. Sound Rating: A.
 - 2. Total Harmonic Distortion Rating: Less than 10 percent.
 - 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 4. Operating Frequency: 20 kHz or higher.
 - 5. Lamp Current Crest Factor: 1.7 or less.
 - 6. BF: 0.85 or higher.
 - 7. Power Factor: 0.95 or higher.
 - 8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Electronic Programmed-Start Ballasts for T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
 - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: A.
 - 4. Total Harmonic Distortion Rating: Less than 20 percent.
 - 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 6. Operating Frequency: 20 kHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher, unless otherwise indicated.
 - 9. Power Factor: 0.95 or higher.
- C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
 - 1. Ballast Manufacturer Certification: Indicated by label.
- D. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and bundled extension wiring to suit final installation conditions without modification or rewiring in the field.
- E. Ballasts for Low-Temperature Environments:
 - 1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
 - 2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.
- F. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
- G. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 10 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

- H. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
 - 1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 50 percent of rated lamp lumens.
 - 2. Ballast shall provide equal current to each lamp in each operating mode.
 - 3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.04 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
 - 1. Lamp end-of-life detection and shutdown circuit.
 - 2. Automatic lamp starting after lamp replacement.
 - 3. Sound Rating: A.
 - 4. Total Harmonic Distortion Rating: Less than 20 percent.
 - 5. Transient Voltage Protection: IEEE C62.41, Category A or better.
 - 6. Operating Frequency: 20 kHz or higher.
 - 7. Lamp Current Crest Factor: 1.7 or less.
 - 8. BF: 0.95 or higher, unless otherwise indicated.
 - 9. Power Factor: 0.95 or higher.
 - 10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
 - 11. Ballast Case Temperature: 75 deg C, maximum.
- B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
 - 1. Dimming Range: 100 to 10 percent of rated lamp lumens.
 - 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 - 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

2.05 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
 - 1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 - 2. Night-Light Connection: Operate one fluorescent lamp continuously.
 - 3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 4. Battery: Sealed, maintenance-free, nickel-cadmium type.

5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
- B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from lighting fixture. Comply with UL 924.
1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
 2. Night-Light Connection: Operate one fluorescent lamp in a remote fixture continuously.
 3. Battery: Sealed, maintenance-free, nickel-cadmium type.
 4. Charger: Fully automatic, solid-state, constant-current type.
 5. Housing: NEMA 250, Type 1 enclosure.
 6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.06 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
 3. Normal Ambient Operating Temperature: 104 deg F.
 4. Open-circuit operation that will not reduce average life.
 5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
1. Lamp end-of-life detection and shutdown circuit.
 2. Sound Rating: A.
 3. Total Harmonic Distortion Rating: Less than 15 percent.
 4. Transient Voltage Protection: IEEE C62.41, Category A or better.
 5. Lamp Current Crest Factor: 1.5 or less.
 6. Power Factor: .90 or higher.

7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.
8. Protection: Class P thermal cutout.
9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
 - a. High-Level Operation: 100 percent of rated lamp lumens.
 - b. Low-Level Operation: 35 percent of rated lamp lumens.
 - c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
11. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.
 - a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
 - b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
- C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.
- D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
 1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
 - a. Restrike Range: 105- to 130-V ac.
 - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
 2. Minimum Starting Temperature: Minus 40 deg F.
 3. Open-circuit operation shall not reduce average lamp life.

2.07 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
 2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

- d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
3. Master/Remote Sign Configurations:
- a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
 - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

2.08 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
- 1. Battery: Sealed, maintenance-free, lead-acid type.
 - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
 - 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 15 minutes when power is restored after an outage.
 - 8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 - 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

2.09 FLUORESCENT LAMPS

- A. Low-Mercury Lamps: Comply with EPA's toxicity characteristic leaching procedure test; shall yield less than 0.2 mg of mercury per liter when tested according to NEMA LL 1.
- B. T8 rapid-start low-mercury lamps, rated 32 W maximum, nominal length of 48 inches, 2800 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life 20,000 hours, unless otherwise indicated.

- C. T8 rapid-start low-mercury lamps, rated 25 W maximum, nominal length of 36 inches 2,000 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- D. T8 rapid-start low-mercury lamps, rated 17 W maximum, nominal length of 24 inches, 1300 initial lumens (minimum), CRI 75 (minimum), color temperature 3500 K, and average rated life of 20,000 hours, unless otherwise indicated.
- E. T5 rapid-start low-mercury lamps, rated 28 W maximum, nominal length of 45.2 inches, 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3000 K, and average rated life of 20,000 hours, unless otherwise indicated.
- F. T5HO rapid-start, high-output low-mercury lamps, rated 54 W maximum, nominal length of 45.2 inches, 5000 initial lumens (minimum), CRI 85 (minimum), color temperature 4100 K, and average rated life of 20,000 hours, unless otherwise indicated.
- G. Compact Fluorescent Lamps: 4-Pin, low mercury, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at 3 hours operation per start, and suitable for use with dimming ballasts, unless otherwise indicated.
 - 1. 13 W: T4, double or triple tube, rated 900 initial lumens (minimum).
 - 2. 18 W: T4, double or triple tube, rated 1200 initial lumens (minimum).
 - 3. 26 W: T4, double or triple tube, rated 1800 initial lumens (minimum).
 - 4. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).
 - 5. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).
 - 6. 55 W: T4, triple tube, rated 4300 initial lumens (minimum).
- H. Headwall System: Provide lamps for patient light fixtures provided by the headwall manufacturer. The lamps shall be T8, rapid start, 32W for 4 ft. lamps and 25W for 3 ft. lamps. Coordinate type and quantity with headwall system manufacturer.

2.10 HID LAMPS

- A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.
 - 1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.
- B. Metal-Halide Lamps: ANSI C78.1372, with a minimum CRI 65, and color temperature 4000 K.
- C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.
- D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.11 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.12 RETROFIT KITS FOR FLUORESCENT LIGHTING FIXTURES

- A. Comply with UL 1598 listing requirements.
 - 1. Reflector Kit: UL 1598, Type I. Suitable for two- to four-lamp, surface-mounted or recessed lighting fixtures by improving reflectivity of fixture surfaces.
 - 2. Ballast and Lamp Change Kit: UL 1598, Type II. Suitable for changing existing ballast, lamps, and sockets.

2.13 DIMMING CONTROL DEVICES

- A. Dimming Controls: Sliding-handle type with on/off control; compatible with ballast and having light output and energy input over the full dimming range.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Headwall System: Install lamps and ballasts for fixtures provided in the pre-manufactured headwall systems. Coordinate type of lamps and quantity with Headwall System manufacturer.
- C. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
 - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
 - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
 - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
 - 4. Install at least two independent support rods or wires from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- E. Adjust aimable lighting fixtures to provide required light intensities.
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.02 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 27 05 50
FIRESTOPPING FOR COMMUNICATIONS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Firestopping of through penetrations in fire rated assemblies.
- B. Smoke seals.
- C. Construction enclosing compartmentalized areas.

1.02 RELATED SECTIONS

- A. Division 3 – Section 03 30 00 – Cast-In-Place Concrete.
- B. Division 4 – Section 04 22 00 – Concrete Unit Masonry.
- C. Division 9 – Section 09 20 00 – Plaster and Gypsum Board.
- D. Division 7 – Section 07 84 13 – Penetration Firestopping.
- E. Division 26 – Section 26 00 00 – Electrical.
- F. Division 27 – Section 27 00 00 – Communications.

1.03 REFERENCES

- A. ASTM E 84, "Surface Burning Characteristics of Building Materials".
- B. ASTM E 119, "Fire Tests of Building Construction and Materials".
- C. ASTM E814, "Fire Tests of Penetration Firestop Systems".
- D. ANSI/UL263, "Fire Tests of Building Construction and Materials".
- E. ANSI/UL723, "Surface Burning Characteristics of Building Materials".
- F. ANSI/UL1479, "Fire Tests of Through Penetration Firestops".
- G. Underwriters Laboratories Inc. (UL) – Fire Resistance Directory.
- H. National Fire Protection Association (NFPA) – NFPA 101: Life Safety Code.
- I. National Fire Protection Association (NFPA) – NFPA 70: National Electrical Code.

1.04 PERFORMANCE REQUIREMENTS

- A. Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:
 - 1. Meet the hourly rating of the floor or wall penetrated.
 - 2. Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
 - 3. Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - a. Opening or closing of doors.
 - b. Twisting an inner liner.
 - c. Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
 - 4. Permit multiple devices to be ganged together to increase overall cable capacity.

5. Allow for retrofit to install around existing cables.
 6. Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.
- B. Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.
- C. Where non-mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, seeping pipes, ponding water or other forms of moisture characteristic during or after construction.
- D. Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
- E. Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 3 00.
- B. Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with references standards and listing numbers of systems in which each product is to be used.
- C. Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- D. Certificates: Products certificates signed by firestop manufacturer certifying material compliance with applicable code and specified performance characteristics.
- E. Installation Instructions: Submit manufacturer's printed installation instructions.

1.06 QUALITY ASSURANCE

- A. Products/Systems: Provide firestopping systems that comply with the following requirements:
1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 2. Firestopping products bear the classification marking of qualified testing and inspection agency.
- B. Installer Qualifications: Experience in performing work of this section who is FM4991 qualified and qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
1. Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multi-component products.

2. Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

B. Storage and Protection:

1. Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.08 PROJECT CONDITIONS

- A. Do not install firestopping products when ambient or substrate temperatures are outside of limitations recommended by manufacturer.
- B. Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
- C. Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- D. Do not use materials that contain flammable solvents.
- E. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- F. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- G. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.
- B. Substitutions: Not permitted.
- C. Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.02 MATERIALS

- A. General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.
- B. Firestop Sealants: STI SpecSeal® Brand single component latex formulations that upon cure do not re-emulsify during exposure to moisture, the following products are acceptable:
 1. Specified Technologies Inc. (STI) SpecSeal® Series SSS Sealant.
 2. Specified Technologies Inc. (STI) SpecSeal® Series LCI Sealant.
- C. Firestop Putty: STI SpecSeal® Brand intumescent, non-hardening, water resistant putties containing no solvents, inorganic fibers or silicone compounds, the following products are acceptable:
 1. Specified Technologies Inc. (STI) SpecSeal® Series SSP Putty.
- D. Firestop Pillows: STI SpecSeal® Brand re-enterable, non-curing, mineral fiber core encapsulated on six sides with intumescent coating contained in a flame retardant poly bag, the following products are acceptable:
 1. Specified Technologies Inc. (STI) SpecSeal® Series SSB Pillows.

- E. Fire Rated Cable Pathway: STI EZ-PATH™ Brand device modules comprised of steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.
- F. Firestop Plugs: Re-enterable, foam rubber plug impregnated with intumescent material for use in blank openings and cable sleeves, the following products are acceptable:
 - 1. Specified Technologies, Inc. (STI) SpecSeal Series FP Firestop Plug.
- G. Fire-Rated Cable Grommet: Molded two-piece grommet made from plenum grade polymer with a foam inner core for sealing individual cable penetrations up to 0.27 in. (7 mm) diameter, the following products are acceptable:
 - 1. Specified Technologies Inc. (STI) Ready Firestop Grommet

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
- B. Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
- C. Provide masking and temporary covering to protect adjacent surfaces.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classifications as specified in the published design.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.03 FIELD QUALITY CONTROL

- A. Inspections: Owner shall engage qualified independent inspection agency to inspect through-penetration firestop systems.
- B. Keep areas of work accessible until inspection by authorities having jurisdiction.
- C. Where deficiencies are found, repair firestopping products so they comply with requirements.

3.04 ADJUSTING AND CLEANING

- A. Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

3.05 SCHEDULES

	Concrete Floor	Concrete Wall	Gypsum Board Wall
Penetrant Type			
Blank Opening	C-AJ-0100, C-AJ-0101	C-AJ-0100, C-AJ-101	
Metal Conduits	C-AJ-1080, C-AJ-1240, C-AJ-1353	C-AJ-1080, W-J-1098, W-J-1100	W-L-1049, W-L-1222, W-L-1168
Plastic Conduits/Raceways	C-AJ-2140, C-AJ-2292	W-J-2018, W-J-2076	W-L-2093, W-L-2241
Cables	F-A-3021, F-A-3037	W-J-3098, W-J-3130, W-J-3158, W-J-3180	W-L-3218, W-L-3255, W-L-3306, W-L-3377
Cable Trays	C-AJ-4029	W-J-4021, W-J-4022, W-J-4033	W-L-4008, W-L-4029, W-L-4043

END OF SECTION

SECTION 27 06 00
ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including "Special Conditions", "General Conditions", "Supplement to the General Conditions", and Division 1 Specifications Sections, form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.
- B. Entire Divisions 26 and 27.

1.02 SUMMARY

- A. This Section includes:
 - 1. Project Meetings.
 - 2. Coordination with Owner.
 - 3. Submittals.
 - 4. Record / As-Built Drawings.

1.03 PROJECT MEETINGS

- A. This Contractor shall attend weekly job meetings during the entire course of the project as directed by the Architect.
- B. The purpose of the meetings shall be to coordinate the work of this contract with all other contractors on the project and to address any conflicts or problems that may arise during the course of construction.
- C. Scheduling, delivery and storage of materials and labor resources shall be coordinated weekly.

1.04 COORDINATION WITH OWNER

- A. This Contractor shall closely coordinate all work with the Architect. Owner and all other contractors.
- B. No system shutdown or cutover shall be completed prior to providing the Owner and Architect with 72 hour advance notice.
- C. It will not be permitted to complete any cabling, voice system or data LAN electronics system cutover or shutdown during Monday through Friday. All systems cutover and shutdowns shall be completed on a Friday after 5:00 PM and must be fully functional prior to the following Monday morning at 5:00 AM. If it becomes apparent (at least 10 hours before Monday at 5:00 AM) the cutover will not be successful, the Contractor will be required to reinstall and assembly all the old cabling systems, to their original state, and have all existing systems functional prior to Monday at 5:00 AM. The Contractor will then be required to provide 72 hours notice to the Owner and Architect before attempting the cutover again.

1.05 SUBMITTALS

- A. The Contractor shall submit the following documents to the Architect for approval prior to placing any orders for materials and equipment or completing any work on-site with the number of copies as directed by the Architect.
 - 1. A Submittal Log prepared and submitted by the Contractor showing each item and product, which will be submitted for the project.

2. Coordination drawings showing exact dimensions of all racks, cabinets, enclosures, other equipment and telecommunications closets shall be drawn on a scale of $1/4" = 1'-0"$. Floor plans shall be drawn on a scale of $1/8" = 1'-0"$. The coordination drawings shall show all cable and outlet identifiers for each network drop throughout the building. These drawings shall be reviewed with other contractors and the Architect to verify no installation conflicts exist. (The existing telecommunications drawings will be provided, in electronic format, to the successful Contractor to assist in preparation of the coordination drawings.)
 3. Manufacturer specification data sheets and / or shop drawings shall be submitted on every product, part and equipment used on this project.
- B. Two (2) copies of Operation and Maintenance Manuals shall be submitted within 30 days of project substantial completion. The O&M Manuals shall include but not limited to the following:
1. Mfg. Manuals of all equipment.
 2. Mfg. Installation instructions.
 3. Mfg. Operation Manuals.
 4. Mfg. Maintenance Manuals.
 5. An approved copy of all submitted shop drawings and manufacturer specifications sheets.
 6. All Mfg. Warranty documents for every product.
 7. All multimode and singlemode fiber optic power meter test results.
 8. OTDR Traces of all SM fiber optic cable.
 9. Level III Category 6A and Category 6 Test results of all network drops.
 10. Level III Category 5c Test results of all analog voice drops.
 11. The 25-year Performance Warranty certificate from the Mfg. of the network cabling system.
 12. Manuals shall be in multiple volumes in three ring binders not thicker than three inches.
 13. Manuals shall be tabbed for each major section and network closed test results.
 14. A CD-ROM containing the following:
 - a. Categories 6A, 6 and 5c; fiber optic power meter and fiber optic OTDR trace test results.
 - b. The test equipment utility software to read all tests.
 - c. A copy of the 25-year Performance Warranty and any Warranty registration documents required to register the project with the mfg.
 - d. The final set of As-Built (AutoCAD, VISIO or equal) Drawings.
 - e. Any other documentation that is readily available to allow the Owner to manage their network in the future.

1.06 RECORD / AS-BUILT DRAWINGS

- A. During the course of the project the Contractor shall maintain a full set of Telecommunications drawings on-site for the sole purpose of red lining any changes and or modifications in the work. This set of drawings shall be updated on a daily basis. The following shall be shown and or revised on the As-Built drawings:
1. Any outlet locations that have moved more than 12 inches.
 2. Exact locations of all equipment racks, cabinets and enclosures.
 3. Primary cable pathways.
 4. Location of grounding bus bars and grounding terminations.

5. Exact layout of every equipment rack elevation showing all cable management, patch panels, fiber optic enclosures, patch panel labeling and identification, network electronics, etc.
 6. Every outlet identifier matching the test result identifier.
 7. Exact telecommunications backboard layouts and elevations.
 8. Any revisions to outlet details.
- B. At project completions, the Contractor shall revise all items noted above on the electronic drawings and submit two (2) copies in paper and electronic version to the Architect for approval.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 27 07 00
QUALITY ASSURANCE REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including "Special Conditions", "General Conditions", "Supplement to the General Conditions", and Division 1 Specifications Sections, form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.
- B. Entire Divisions 26 and 27.

1.02 SUMMARY

- A. This Section includes:
 - 1. Quality Control.

1.03 QUALITY CONTROL

- A. The Telecommunications Contractor shall be experienced in installations of this type and shall have at least 5 years documented experience.
- B. The following shall be submitted WITH THE BID to allow the Owner and Architect to verify the Telecommunications Contractor is qualified to complete this project. Failure to submit the following items with the bid shall be cause for disqualification of the bidder:
 - 1. A current BICSI Registered Communications Distributions Designer (RCDD) Certificate. This RCDD shall be on staff and shall ultimately be responsible for the overall project.
 - 2. A current Certificate from the manufacturer of the Network Cabling / Hardware Infrastructure verifying the Telecommunications Contractor is certified to execute and issue the 25-year Performance Warranty required on this project.
 - 3. Certificates demonstrating manufacturer certification of the Contractor's installers who will be working on this project.
- C. The following shall be submitted as required to allow the Owner and Architect to evaluate the Telecommunications Contractor's performance in past projects:
 - 1. A documented list of references from five projects completed during the past 5 years that were similar in size and nature, listing the following:
 - a. Owner name, address and phone number.
 - b. Contact name.
 - c. Project name.
 - d. Brief description of project.
 - e. Contract value.
 - f. Contract completion date.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 27 08 00
TESTING, IDENTIFICATION AND ADMINISTRATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including "Special Conditions", "General Conditions", "Supplement to the General Conditions", and Division 1 Specifications Sections, form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.
- B. Entire Divisions 26 and 27.

1.02 SUMMARY

- A. This Section includes:
 - 1. Testing Categories 6A, 6 and 5e Cabling.
 - 2. Testing Fiber Optic Cabling.
 - a. Power Meter.
 - b. Optical Time Domain Reflectometer (OTDR).
 - 3. Labeling / Documentation.
 - 4. Test Results / As-Built Drawings.

1.03 REFERENCE STANDARDS

- A. All regulations and references shall be as specified in section 27 05 00.

1.04 SUBMITTALS

- A. All submittals shall be as specified in section 27 06 00.
- B. A copy of the RCDD certification from BICSI Institute as specified in Section 27 07 00 shall be submitted for approval.
- C. Samples of each type of test result for copper; Single-mode (SM) fiber optic power meter and SM fiber optic OTDR traces shall be submitted for approval.
- D. Samples of each type of proposed label (to include faceplate, patch panel and cable marking labels) shall be submitted for approval.

1.05 QUALITY ASSURANCE

- A. Install all products in accordance with the manufacturer's instructions.
- B. The manufacturer of the cabling system being installed shall have trained the Contractor's installers; said installers shall have at least 2 years experience in the installation of Infrastructure Cabling Systems. Technicians completing the testing and certification of the cabling shall be experienced in all functions of the test equipment.

PART 2 - PRODUCTS

2.01 TEST EQUIPMENT

- A. The specified test equipment shall be independently verified by ETL to meet ISO Level IV and TIA Level IIIe Accuracy requirements, and shall be capable to test the following parameters:
 - 1. Wiremap
 - a. The wiremap measurements shall check for proper end-to-end continuity and pairing. Problems to be detected are:
 - 1) Short Circuit
 - 2) Open Circuit
 - 3) Reversed Pairs

- 4) Transposed Pairs
- 5) Split Pairs
- 6) Shield Continuity Faults
- b. Length
 - 1) The length measurements shall determine the electrical length of the Basic Link cabling run under test. Length measurements shall require the accurate cable nominal velocity of the propagation (NVP) setting to yield specified accuracy. NVP values shall automatically load when the correct cable is selected from the test instruments built-in database. The test equipment shall be capable of the following:
 - a) Accuracy: $\pm (ns + 2\%)$
 - b) Accuracy: $\pm (2ns + 2\%)$
 - c) Resolution: 1 foot
- c. Propagation Delay
 - 1) The propagation delay functions shall measure the one-way propagation delay over each pair of the cabling run under test. The test equipment shall be capable of the following:
 - a) Accuracy: $\pm (2ns + 2\%)$
 - b) Resolution: 1 ns
 - c) Range: 750 ns
- d. Delay Skew
 - 1) Delay Skew shall be calculated as the difference in ns between the longest and shortest measured propagation delay among the four pairs of a single cabling run.
 - a) Accuracy: ± 10 ns
 - b) Resolution: 1 ns
 - c) Range: 0 to 100 ns
- e. Near End Crosstalk (NEXT)
 - 1) Measures near end coupling between pairs in the cabling run under test. Shall be measured at both ends of the cabling over 6 pair combinations.
- f. Insertion Loss (Attenuation)
 - 1) The test equipment shall test the attenuation of all four pairs.
- g. Return Loss
 - 1) The test equipment shall measure the return loss of all four pairs from each end of the cabling run under test.
- h. Equal Level Far End Cross Talk (ELFEXT)
 - 1) The test equipment shall measure far end coupling between pairs in the cabling run under test and for all pair combinations.
- i. Attenuation to Crosstalk Ratio (ACR)
 - 1) The test equipment shall compute this test by subtracting the measured attenuation from the near end crosstalk (NEXT) at each frequency point.
- j. Power Sum NEXT (PSNEXT)
 - 1) The test equipment shall compute this test for each pair by calculating a power sum total of the pair-to-pair NEXT from the three other pairs.

- k. Power Sum ELFEXT (PSELFEXT)
 - 1) The test equipment shall compute this test for each pair by calculating a power sum total of the pair-to-pair ELFEXT from the three other pairs.
- l. Power Sum ACR (PSACR)
 - 1) The test equipment shall compute this test by subtracting the measured attenuation from the computed power sum near end crosstalk (PSNEXT) at each frequency point.
- m. Resistance
 - 1) The test equipment shall measure the DC loop resistance for each pair in the tested cabling run.
- n. The specified test equipment shall test the Category 6A, 6 and 5e cabling to the following:
 - 1) Category 6A, 6 or 5e Permanent Link as applicable per cable type, per EIA/TIA 568-C.
 - 2) List the Site information (End User).
 - 3) List the manufacturer of the cabling system and type: (Category 6A, 6 or 5e CMP).
 - 4) List the manufacturer of the jacks and type (Category 6A, 6 or 5e).
 - 5) List the cable pairing: (T568B).
 - 6) List the measurements (EIA/TIA 568-C).
 - a) Wiremap.
 - b) NEXT.
 - c) Return Loss.
 - d) PS NEXT.
 - e) Delay.
 - f) Length.
 - g) Attenuation.
 - h) ELFEXT.
 - i) PS ELFEXT.
 - j) Delay Skew.
 - 7) Shall be tested in the Certification Mode.
 - 8) Summary ELFEXT Mode.
 - 9) Shall calculate fault location.
 - 10) Maximum Frequency for Category 6A: 500 MHz.
 - 11) Maximum Frequency for Category 6: 250 MHz.
 - 12) Maximum Frequency for Category 5e: 100 MHz.
 - 13) List all test results with numerical data AND plots.
 - 14) List whom the operators are completing the testing.
- o. The test equipment used for the copper cabling shall be as manufactured by Fluke Series Versiv or approved equal.

2.02 TEST EQUIPMENT (FIBER OPTIC)

- A. Power Meter and Light Source shall test to the following parameters:
 - 1. The specified test equipment shall be able to test Single-mode fiber optic cable at 1310 and 1550 nm in both directions, and generate one test result from this dual ended test.
 - 2. The test shall be completed with the Length / Loss Method where the operator can set the following:
 - a. Quantity of connectors.
 - b. Loss per connector (0.75 dB).
 - c. Quantity of splices.
 - d. Loss per splice (0.30).
 - e. Cable loss (1300nm 1.0 dB/Km).
 - 3. Length Limit (Horizontal 90M, Backbone 2 Km).
 - 4. Show the type of glass being tested.
 - 5. List the Site information (End User).
 - 6. List whom the operators are completing the testing.
 - 7. The test equipment used for the fiber optic single-mode cabling shall be as manufactured by Fluke, Series Versiv with Single-mode Fiber Modules to allow for dual ended testing at both wavelength windows, or approved equal.
- B. Optical Time Domain Reflectometer (OTDR):
 - 1. OTDR testing shall be completed on all Single mode fiber optic backbone cabling. Traces shall show the following:
 - a. Exact traces of the fiber cable being tested including every splice, connector and / or other type of signal loss.
 - b. Shall be completed with test equipment listing the latest parameters required by the TIA/EIA 568-C standards.
 - c. Shall list the exact length of each single mode fiber optic strand.
 - 2. All OTDR traces shall be completed with an OTDR as manufactured by Laser Precision part number TD2000 OTDR Mainframe, Tektronix part number TFP2 FiberMaster OTDR Mainframe or equal.

2.03 LABELING / DOCUMENTATION

- A. Faceplates, Patch Panels, Equipment Racks:
 - 1. Faceplates and patch panels shall be identified using durable machine-generated labels.
 - 2. The labels shall be 3/8" wide, white background and black letters.
 - a. Letters shall be at least 1/4" high for faceplates and patch panels. Letters shall be at least 3/8" high on 1/2" labels for equipment racks.
 - b. The labels shall be laminated with a clear plastic lamination over the top of the label and letters for protection.
 - c. Labels shall be as manufactured by Brother Industries, LTD part number TZ221 and TZ231 or approved equal.
 - d. The printer used for the labels shall be as manufactured by Brother Industries, LTD part number P-Touch PT-340 or approved equal.
- B. Cable Markers for Copper and Fiber Optic Cables:
 - 1. All cables shall be identified at BOTH ends (faceplate and patch panel) using durable machine generated labels.

2. The labels shall be 1" wide, 1/2" of white printable area and 3/4" of clear adhesive to wrap around the cable and cover the machine printed text.
3. Letters shall be at least 1/8" high.
4. Cable marker labels shall be as manufactured by Brady Worldwide, Inc. part number WML-311-292 or approved equal.
5. The printer used for the labels shall be as manufactured by Brady Worldwide, Inc. part number I.D. PRO PLUS or approved equal.

C. Color Coding:

1. The color codes for cross-connect fields are shown in the following table.
 - a. Orange Demarcation point (e.g., central office terminations).
 - b. Green Network connections (e.g., network and auxiliary equipment).
 - c. Purple Common equipment, PBX, LANS, BAS.
 - d. White Horizontal voice cabling.
 - e. Blue Horizontal data cabling.
 - f. Brown Interbuilding backbone.
 - g. Yellow Miscellaneous (e.g., auxiliary, alarms, security).
 - h. Red Fire Alarm

2.04 TEST RESULTS, AS-BUILT DRAWINGS

A. Network Cabling Test Results:

1. Three ring binders shall be of high quality and no more than 3" thick.
2. Multiple volumes shall be used as required.
3. Tabs used in the binders shall be of good quality and have laser printed labels on the tabs.
4. CD-ROMs used for the soft copy for test results shall be of the record / write type.

B. As-Built Drawings:

1. As-built drawings shall be printed on durable paper to ensure long lasting documents for the Owner's use.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate and sequence all work in accordance with the schedule established by the Owner, Architect and the lead Prime Contractor.

3.02 INSTALLATION

A. Testing Copper Cabling:

1. All test instruments shall have been calibrated by the manufacturer of the test equipment within the past year. This manufacturer calibration sheet shall be forwarded to the Architect or Owner upon request.
2. Daily equipment calibration shall be performed by the operator in the field prior to completing any test on any given day.
3. All cable identifiers entered into the test equipment shall match the identifiers on the faceplates, patch panels and As-Built drawings.
4. Copper cabling shall be tested as noted in Part 2 above. Every run of Category 6A, Category 6 and Category 5e cabling shall be tested, corrected and re-tested if required, ensuring 100% of all drops have passed all the testing requirements noted.

B. Testing Fiber Optic Cabling:

1. All test instruments shall have been calibrated by the manufacturer of the test equipment within the past year. This calibration sheet shall be forwarded to the Architect or Owner upon request.
2. Daily equipment calibration shall be performed by the operator in the field prior to completing any test on any given day.
3. All cable identifiers entered into the test equipment shall match the identifiers on the faceplates, patch panels and As-Built drawings.
4. Fiber optic cabling shall be tested as noted in Part 2 above. Every strand of cabling shall be tested, corrected and re-tested if required; ensuring 100% of all strands have passed all the testing requirements noted.
5. Optical fiber attenuation shall be measured in both directions at both 1310 nanometers (NM) and 1550 NM a light source and power meter. Test set-up and performance shall be conducted in accordance with ANSI/EIA/TIA-526-7 Standard, Method B. One 2-meter patch cord shall be used for the test reference and two 2-meter patch cords shall be used for the actual test. This test method uses a one-jumper reference, two-jumper test to estimate the actual link loss of the installed cables plus the loss of two connectors. This measurement is consistent with the loss which network equipment will see under normal installation and use. Test evaluation for the panel to panel (backbone) or panel to outlet (horizontal) shall be based on the values set forth in ANSI/TIA-568-C.

C. Labeling / Documentation:

1. Each faceplate shall be identified with the products specified in Part 2.
2. Each patch panel shall be identified with the patch panel value, i.e. A, B, C, etc.
3. Each equipment rack shall be identified with the Closet value, i.e. NW2, etc.
4. Each horizontal and backbone cable shall be identified with the cable marker labels specified in Part 2.
5. Labeling Nomenclature:
 - a. An existing identification method is in use by the Owner on campus. The following labeling nomenclature shall be followed for this project (see diagram on next two pages):
 - 1) WC = Wiring Closet
 - 2) NWPT = Building Identification, i.e.: Northwest Patient Tower
 - 3) NW2 = Wiring Closet Identification
 - 4) A = Patch panel
 - 5) 03 = Port Number
 - 6) Example = (WCNWPT – NW2 – B03)
 - 7) Faceplate labeling will be as follows:
 - a) NWPT2 = Building Identification and floor number
 - b) 2415 = Unique room number
 - c) 1 = Sequential jack number within unique room
 - d) D = Data

SLHS Data Cable Labeling standard

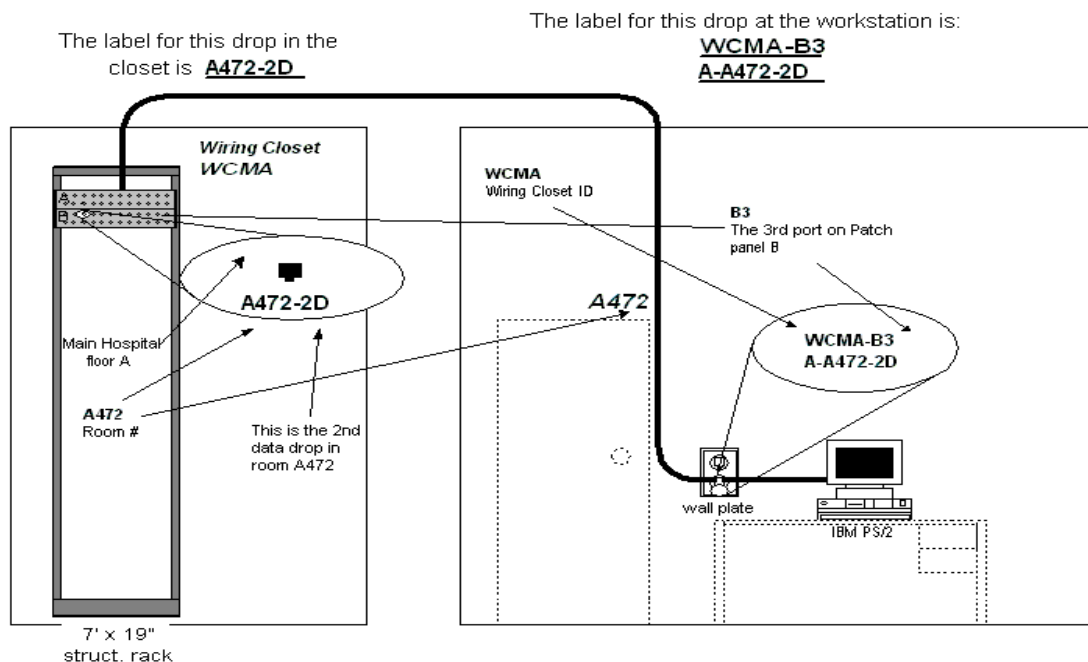
11-25-03

Workstation

The workstation label will be based on the location of the destination in the wiring closet. The label structure is detailed out in Appendix A(workstation).

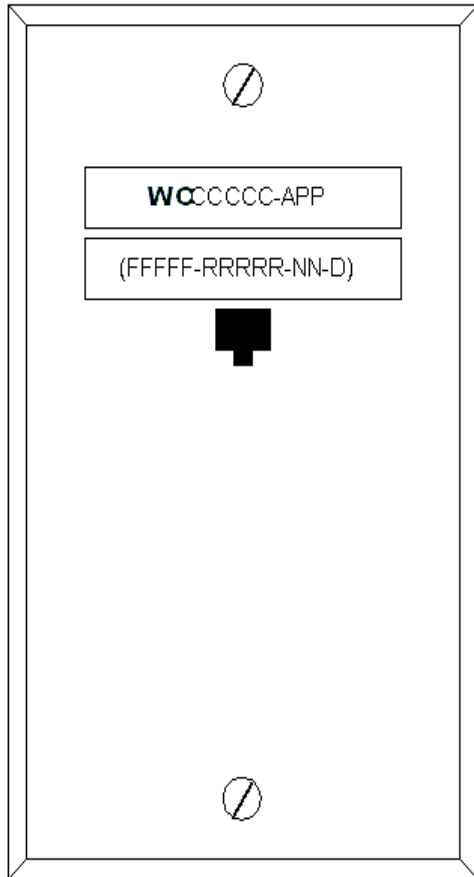
Wiring Closet

The wiring closet label will be based on the location of the destination room. If this is new construction the whole panel will be labeled with a unique letter centered on the left center and facility floor ID placed at the top center in bold. If this is an existing patch panel the facility floor ID will be placed above the port. The structure of the label is detailed out in Appendix A(Patch Pane in closet).



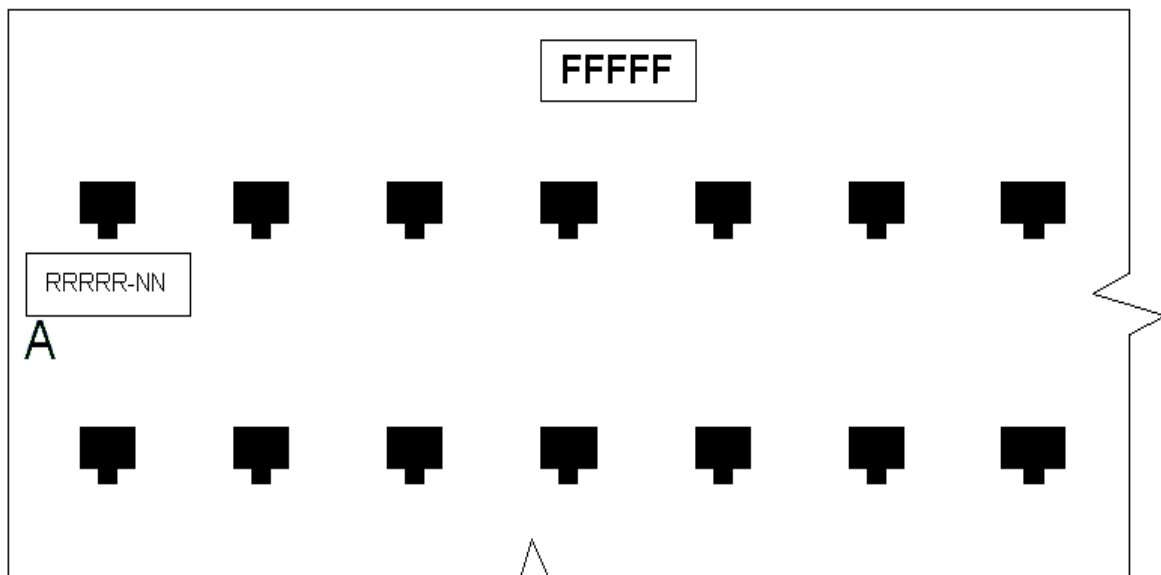
Wiring Closet Label Standard For Saint Lukes Health System (Appendix A)

Workstation



B = Building ID
C = Wiring Closet ID
A = Patch Panel Letter
P = Patch Panel Port Number
F = Facility Floor
R = Room Number
N = Unique sequential number(in room)
D = Data

Patch Panel in closet



21 00 00 - 0

TESTING, IDENTIFICATION
AND ADMINISTRATION

- 8) All backbone cabling shall be labeled as follows:
 - a) MC IC FO1-12 (From Closet MC to Closet IC, Fiber Optic cable, strand 1 thru 12.)
 - b) IC TC1 V1-50 (From Closet IC to Closet TC1, Voice Cable, Pairs 1 thru 50).

D. Test Results / As-Built Drawings:

1. Test results shall be printed, sorted and assembled into three ring binders.
2. Test results shall show all values as specified including plot style graphs for each cable. Test results with numerical values only will not be acceptable.
3. Test results shall be assembled in sequential order starting with closet MC, IC and TC-1, etc.
4. Closets shall be separated by durable tabs with machine-generated labels.
5. All backbone test results shall be separated from the horizontal test results with tabs.
6. Manuals shall be assembled in accordance with Section 27 06 00.
7. As-Built information shall be collected and updated manually on drawings stored in the field expressly for recording changes. These drawings shall be revised at least once a week during the course of the project to accurately depict all field revisions.
8. As-Built drawings shall then be updated in electronic format and printed showing all changes and revisions throughout the project.
9. All as-built records shall be in accordance with Section 27 06 00.
10. Archive CD-ROMs shall be created in accordance with Section 27 06 00.

END OF SECTION

SECTION 27 11 50
TELECOMMUNICATIONS PATHWAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including "Special Conditions", "General Conditions", "Supplement to the General Conditions", and Division 1 Specifications Sections, form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes:
 - 1. Pathways.
 - 2. Cable Hangers and Supports, Tie Wraps.
 - 3. Innerduct, Corrugated.
 - 4. Firestopping Systems, which are to be furnished and installed by the Firestop Contractor.

1.3 REFERENCE STANDARDS

- A. All regulations and references shall be as specified in Section 27 05 00.

1.4 SUBMITTALS

- A. All submittals shall be as specified in Section 270600.
- B. A copy of the BICSI RCDD certification as specified in Section 27 07 00 shall be submitted for approval.
- C. A copy of all Installer Certifications (whom will work on this project) from the manufacturer of the Infrastructure Cabling System shall be submitted for approval. The Certificate shall indicate the level of certification achieved by the installer.

1.5 QUALITY ASSURANCE

- A. Install all products in accordance with the manufacturer's instructions.
- B. Manufacturer: The equipment shall be manufactured by a firm engaged in the manufacture of pathway systems hardware for a period of at least 5 years.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Typically, the electrical contractor shall install all conduits, wire ways, cable tray and surface metal raceway for use by this Contractor. However, any pathways not provided under the electrical contract and required for a fully functional network cabling system, shall be supplied and installed by this Contractor.
- B. Sleeves shall be sized two times larger than what is presently required for future use.

2.2 CABLE HANGERS AND SUPPORTS, TIE WRAPS

- A. Cable hangers shall be specifically designed and manufactured for high performance network cabling systems. They shall have an extra wide base to provide cable support on a flat surface, eliminating kinking, bending and crimping of the network cable. All cable hangers shall come packaged with a steel beam clamp attached to the cable hanger with a 1/4" steel bolt for supporting to structural steel. Cable hangers shall be Erico Caddy J-hook part number CAT64, CAT32, CAT21, CAT12, or approved equals by B-Line. Size J-hooks to provide 30% spare capacity for future cable adds.
- B. Tie wraps used in Distributive Network Rooms (DNRs) shall be Velcro-type cable ties to prevent over tension and to allow for reuse in the event of future adds moves or changes. Velcro cable ties shall be as manufactured by Panduit or approved equal.

- C. Tie wraps used in all other areas shall be self-locking and natural nylon color cable ties, UL Listed for use in air handling spaces per NEC. Cable ties shall be Panduit, Series PLTxS-C in the length required or approved equal.
- D. Innerduct, Corrugated:

In most cases armored indoor fiber is specified, eliminating need for indoor innerduct. However, refer to drawings and where indicated provide innerduct per the following requirements.

 - 1. Plenum Rated:
 - a. Plenum innerducts shall be corrugated, communication orange in color, have a pull tape pre-installed, meet the IPS dimensions, comply with TIA-569, UL 910, NEC 770-53 plenum and have footage sequentially marked. Plenum innerducts shall be Carlon Telecom Systems part number 16108-xxx or approved equal by Endot Industries.
 - b. Innerduct shall be sized as noted on the drawings.
 - 2. Outside Plant:
 - a. General purpose innerducts shall be corrugated, communication orange in color, have a pull line pre-installed, meet the IPS dimensions, comply with TIA-569, UL 94V-0, NEC 770-53 general purpose and have footage sequentially marked. Outside plant innerducts shall be suitable for direct burial and plowing applications. Outside plant innerducts shall be Carlon Telecom Systems part number 14108xx-xxx or approved equal by Endot Industries.
 - b. Innerduct shall be sized as noted on the drawings.
- E. Firestopping Systems:
 - 1. Pre-manufactured sleeve assemblies with built-in firestopping are required at all cable penetrations through walls, and shall be by ST1, EZ Path series, furnished and installed by the Firestop Contractor.
 - 2. All fire stop material shall be by a single manufacturer, furnished and installed by the Firestop Contractor, and shall comply with the following:
 - a. ASTM E-814, Standard Method of Fire Tests of Through-Penetration Fire Stops.
 - b. UL 1479, Fire Tests of Through-Penetration Fire Stops.
 - c. U.L. Fire Resistance Directory: Through Penetration Fire Stop Devices (XGCR) and Through Penetration Fire Stop Systems (XHEZ).
 - d. ULC List of Equipment and Materials, Vol. II.
 - 3. Designs selected for installation shall provide a fire resistance rating at least equal to the hourly resistance rating of the floor, wall or partition into which the fire stop design will be installed.
 - 4. Fire stop systems and materials shall not require special tools for installation and shall not emit hazardous, combustible or irritating fumes during installation, curing or use.
 - 5. When more than one fire stop design is applicable, individual product characteristics should be evaluated for secondary benefits in performance, e.g. environmental/water sealing, or ease of installation or modification.
 - 6. Installation shall conform to requirements of qualified designs or manufacturer approved modification, as supported by engineering reports and accepted by the authority having jurisdiction.
 - 7. Manufactured assemblies and material formulations shall be prepared under a third party monitored Quality Control Program, e.g., U.L. Follow-up Service.

8. Fire stop products shall be as manufactured by Nelson Firestop Products, a Unit of General Signal or approved equal as follows:
 - a. Nelson FSP, Flameseal: A ready to use, permanently pliable intumescent putty.
 - b. Nelson CLK: A one part, silicone based, non-sagging, adhesive sealant.
 - c. Nelson CMP: A non-slump, cementitious sealant.
 - d. Nelson PLW: A ready to use, intumescent fibrous material enclosed in a strong polyethylene envelope.
 - e. Nelson RSW: Intumescent coated mineral wool strips which may be used in conjunction with CLK.
 - f. Nelson CTG: A highly intumescent, water based, fire protective coating suitable for use on electrical power, control and communications cables.
 - g. IPC International: KBS Sealbags System, re-usable heat expanding pillows or bags.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pathways:

1. Comply with ANSI/TIA-569-B and BICSI TDMM guidelines for separation from potential EMI sources, including electrical power lines and equipment, maintaining throughout communications pathways the following minimum separation distances from EMI sources exceeding 5 kVA:

Condition	Minimum Separation Distance
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	24 inches
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	12 inches
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway	6 inches
Electrical motors and transformers	47 inches

The following separation requirements shall also be followed throughout communications pathways.

Source of Disturbance	Minimum Separation (inches)
Fluorescent lamps	6
Neon lamps	6
Mercury vapour lamps	6
High-intensity discharge lamps	6
Arc welders	31.5
Frequency induction heating	39.5

B. Cable Hangers and Supports, Tie Wraps:

1. Cable supports (J-hooks) shall be installed where required to properly manage cables not supported by cable tray and or conduit.

2. Cable supports must be attached to the structural steel. It shall not be permissible to install J-hooks on any support installed by another trade for their use such as ceiling drop wires and or acoustical tile ceiling grid.
 3. Cable supports shall be spaced a maximum of 4'-0" apart.
 4. Velcro cable ties must be used to manage cabling in all cable management troughs in every DNR. Velcro cable ties shall be used for management of the backbone, station and patch cord cabling.
 5. All cable ties shall be installed "loosely" and shall not be cinched tight to prevent any damage and/or stress to cabling.
- C. Innerduct, Corrugated:
1. All innerducts installed inside any building shall be plenum rated.
 2. All innerducts installed in underground conduits shall be general purpose rated as defined by NEC 770-53.
 3. Innerduct shall be installed for all fiber optic cabling and as shown on the drawings.
 4. Innerducts shall be managed into the side cable management troughs of all equipment racks and onto backboards.
 5. Innerduct shall be sized as noted on the drawings.
- D. Firestop Systems:
1. Identify all locations requiring firestopping.
 2. Storage of products shall comply with manufacturer's requirements for each product.
 3. Comply with recommended procedures, precautions or remedies described in Material Safety Data Sheets as applicable.
 4. Schedule installation of firestopping by Firestop Contractor after completion of cable, innerduct and runways, but prior to covering or concealing of openings or elimination access thereto.
 5. Install penetration seal materials in accordance with the design requirements and manufacturers' instructions.
 6. Fire stop systems shall be installed in all openings and around all penetrating elements or devices as required by these Contract Documents, and as required by applicable design, building and construction codes, subject to the interpretation of the authority having jurisdiction.
 7. All firestopping compounds applied to cables (e.g., inside existing legacy sleeves which lack integrated built-in firestop material), shall be non-hardening and reusable. Hardening caulks are not acceptable due to damage caused to cable sheaths when compound is removed for future cable adds and maintenance.
 8. Follow design requirements pertaining to cable separation.
 9. Follow manufacturer's recommendations to obtain a smooth, professional finish.
 10. Complete and affix a firestop label on wall, both sides, next to firestopped penetration. Label shall include type of UL Assembly installed, name of Technician, name of Contractor Company, and date firestop installed.
 11. Remove equipment, materials and debris, leaving area in a clean undamaged condition.
 12. Schedule a final inspection with the Owner, Architect and the local Fire Marshal to verify all firestopping and sealing requirements are approved and complete.

END OF SECTION

SECTION 27 15 00
HORIZONTAL CABLING REQUIREMENTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including "Special Conditions", "General Conditions", "Supplement to the General Conditions", and Division 1 Specifications Sections, form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.
- B. Entire Divisions 26 and 27.

1.02 SUMMARY

- A. This Section includes:
 - 1. Categories 6A and 6 Plenum Cable.
 - 2. Faceplates and Jacks.
 - 3. Patch Cords at Work Areas.

1.03 REFERENCE STANDARDS

- A. All regulations and references shall be as specified in Section 27 05 00.

1.04 SUBMITTALS

- A. All submittals shall be as specified in Section 27 06 00.
- B. A copy of the BICSI RCDD certification as specified in Section 27 07 00 shall be submitted for approval.
- C. A copy of all Installer Certifications (who will work on this project) from the manufacturer of the Infrastructure Cabling System shall be submitted for approval. The Certificate shall indicate the level of certification achieved by the installer.

1.05 QUALITY ASSURANCE

- A. Install all products in accordance with the manufacturer's instructions.
- B. The manufacturer of the cabling system being installed shall have trained the Contractor's installers; said installers shall have at least 2 years experience in the installation of Infrastructure Cabling Systems.
- C. Manufacturer: The network cabling equipment shall be manufactured by a firm engaged in the manufacture of network cabling systems for a period of at least 10 years.

PART 2 - PRODUCTS

2.01 CATEGORY 6A PLENUM CABLE: NETWORK WIRELESS ACCESS POINT OUTLETS

- A. Category 6A Plenum Cables shall meet the following specifications:
 - 1. Horizontal cabling shall be 23 AWG, 4-pair UTP, UL/NEC CMP rated and be independently verified for compliance. Cable performance shall be independently verified by ETL and meet all performance requirements of ANSI/TIA-568-C.2 Category 6A.
 - 2. Cable jacketing shall be Blue and shall be lead-free. Independent verification for flammability compliance shall be to NEC article 800 and NFPA 70; CMP (NFPA 262, UL 910). Horizontal cable shall be CommScope CS44P Series, part # UN874035114/10.

2.02 CATEGORY 6 PLENUM CABLE: DATA, VOICE, BIO-MED, PATIENT MONITORING / PHILIPS, TV

- A. Category 6 Plenum Cables shall meet the following specifications:
1. Cable shall be 23 AWG, 4-pair UTP, NEC/NFPA CMP rated and be independently verified for compliance. Cable performance shall be independently verified by ETL and meet the performance requirements per ANSI/TIA-568-C.2 Category 6.
 2. Cable performance shall be characterized to 400 MHz. Cable jacketing shall be Blue (except for Philips outlets, where cable jacketing shall be Orange), and shall be lead-free. Independent verification for flammability compliance shall be to NEC article 800 and NFPA 70; CMP (NFPA 262, UL 910). Horizontal cable shall be CommScope CS37P Series, part # UN874043014/10.

2.03 FACEPLATES AND JACKS

- A. Faceplates and jacks shall be as follows:
1. Duplex Faceplate, and dual RJ45 empty insert, both White color – CommScope 1339118-3, 1116406-3.
 2. Dust Cover/Blank Insert, White, for faceplate – CommScope 1116407-3.
- B. Wireless Access Point (WAP) outlets shall be as follows:
1. Provide two (2) Category 6A cables and jacks at each WAP outlet. Provide 20-foot length service loop in figure-8 shape, managed neatly at outlet, to facilitate future moves of outlet.
 2. Category 6A jacks shall be CommScope part # USL10G-DC-BLUE.
 3. Outlets shall be provided/mounted in a steel single-gang deep back-box with stainless steel 2-port faceplate.
- C. Modular Category 6 Jacks shall be provided for Data/VoIP, Analog Voice, Bio-Medical, and TV outlets, and comply with the following:
1. Modular jacks shall be RoHS compliant, unkeyed, unshielded, 4-pair, RJ-45. Modular jacks shall be color-coded for both T568A and T568B wiring (all jacks to be terminated as T568B on this project). Each modular jack shall meet all TIA and ISO component performance requirements.
 2. Modular jacks shall be compatible with the CommScope NETCONNECT SL Series Modular Jack Termination Tool part number 1725150-1. Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination. Each jack shall incorporate an integral, hinged dust cover. Modular jacks shall be Blue in color for Data, CommScope part # USL600-DC-BLUE.
- D. Modular Category 6 Jacks shall be provided for Patient Monitoring / Philips, and comply with the following:
1. Modular jacks shall be RoHS compliant, unkeyed, unshielded, 4-pair, RJ-45. Modular jacks shall be color-coded for both T568A and T568B wiring (all jacks to be terminated as T568B on this project). Each modular jack shall meet all TIA and ISO component performance requirements.
 2. Modular jacks shall be compatible with the CommScope NETCONNECT SL Series Modular Jack Termination Tool part number 1725150-1. Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination. Modular jacks shall be Orange for Patient Monitoring / Philips, CommScope part # USL600-DC-ORANGE.

2.04 MODULAR JACK TERMINATION TOOLING

- A. Termination of UTP modular jacks at every TO shall be completed using a hand tool which employs a fully repeatable, self centering, non-impact mechanical termination process. This process shall simultaneously cut and terminate all 8 conductors to the modular jack. This hand tool shall be CommScope NETCONNECT part number 1725150-1.

2.05 WORK AREA PATCH CORDS

- A. Provide (1) 10-foot Blue Category 6A patch cord with T568B wiring, with every Wireless Network Access Point jack. Patch Cord to be CommScope part # UNC10G.
- B. Provide (1) 10-foot Category 6 patch cord with T568B wiring, with every Data, VoIP, Bio-Medical, and Patient Monitoring / Philips jack. Patch Cord to be Blue except for Philips which shall be Orange. CommScope part # UNC6.
- C. Provide (1) 10-foot White Category 6 patch cord with every work area Analog Voice Jack Patch Cord, to be CommScope part # UNC6.

PART 3 - EXECUTION

3.01 COORDINATION

- A. Coordinate and sequence all work in accordance with the schedule established by the Architect and the lead Prime Contractor.
- B. Equipment shall not be installed in dusty and unclean work areas. If equipment is installed and there is still risk of damage to the equipment, this Contractor shall protect and cover all materials and equipment to prevent any damage. All finishes and products shall be protected at all times.
- C. Contractor shall provide and install all patch cords at both the work area locations and patch panel locations (reference Section 271100 Distributive Network Rooms) for both data and voice. Typically provide 10 foot long patch cords at the work area.

3.02 INSTALLATION

- A. Horizontal cable installation shall be as follows:
 - 1. Cable shall be installed in accordance with manufacturer's recommendations and best industry practices.
 - 2. Cable raceways shall not be filled greater than the NEC maximum fill for the particular raceway type.
 - 3. Cables shall be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this document.
 - 4. Where cable splices are allowed, they shall be in accessible locations and housed in an enclosure intended and suitable for the purpose.
 - 5. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
 - 6. If a J-hook or trapeze system is used to support cable bundles all horizontal cables shall be supported at a maximum of four-foot intervals. At no point shall cable(s) rest on acoustic ceiling grids or panels.
 - 7. Horizontal distribution cables shall be bundled in groups of not greater than 40 cables. Cable bundle quantities in excess of 40 cables may cause deformation of the bottom cables within the bundle.
 - 8. Cable shall be installed above fire-sprinkler and systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.

9. At no point shall cable be installed within six (6) inches of light fixture ballasts or within twelve (47) inches of electrical motors. Reference also Section 271150 Telecommunications Pathways.
10. Cables shall not be attached to ceiling grid or lighting fixture wires.
11. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
12. The cable must not be stripped back any farther than is absolutely necessary. The contractor should follow the manufacturer's specification for the cable being installed. A .5" maximum of exposed (stripped) cable is recommended.
13. The pair twists in the stripped cable should be maintained as close as possible to the point of termination. The twists must be maintained to within .5" from the point of termination.
14. Cables shall be identified by a machine-generated label in accordance with the specification 27 08 00. The cable label shall be applied to the cable behind the faceplate on a section of cable that can be accessed by removing the cover plate.
15. Unshielded twisted pair cable shall be installed so that there are no bends less than four times the cables outside diameter (4 X cable O.D.) at any point in the run and at the termination field.
16. Pulling tension on 4-pair UTP cables shall not exceed 25-pounds for a single cable or cable bundle.
17. The routing shall be through the ceiling and in the walls wherever possible. All ceiling routing shall be routed in cabling tray through the main corridors as indicated on the floor plan drawings.
18. The floor plan drawings shall be the authoritative source for determining the final drop count for all bids.
19. Cable rollers shall be used when pulling cable. Cable pulleys must be used when pulling cable around bends and corners of wireways. Pulleys shall have a minimum diameter of six inches, so as not to exceed the allowable bend radius of the cable.
20. Contractor shall use basket grips wherever possible, and exercise care while pulling cable so as not to exceed the maximum allowable pulling strength of the cable.
21. Saint Luke's Health System requests that the bidder make every effort to conceal all new cables installed as part of the project. Where impractical or impossible to run cables in ceilings and walls, the bidder should include surface mount raceways or power poles.
22. Pull strings shall be left in each wire routeway.
23. The contractor is responsible to determine the lengths and routing of the copper cable to be installed by examining the floor plan and site drawings and becoming acquainted with the local conditions during the site walk through. Drop lengths should not exceed 90 meters in order to allow the total length of the run, including jumpers at both ends to fall within the 100 meter standard for Categories 6A, 6 and 5e installations.
24. Managing cable lengths is essential to overall system integrity. The cable shall be routed as shown on the drawings. The contractor shall make every effort to conceal all new cables installed as part of the project. Where impractical or impossible to run cables in conduit, ceilings and walls, the contractor shall include surface mount raceways or power poles.

- B. Categories 6A, 6 and 5e work station outlet installations shall comply with the following:
1. Jacks shall be terminated to T568B wiring pin-out pattern.
 2. Cables shall be coiled in the in-wall or surface-mount boxes if adequate space is present to house the cable coil without exceeding the manufacturer's bend radius.
 3. In hollow wall installations where box-eliminators are used, excess wire can be stored in the wall. 12" of UTP slack shall be stored in in-wall boxes, modular furniture raceway, or insulated walls.
 4. 3-feet of additional slack shall be neatly coiled and stored in the ceiling above each drop location.
 5. Cables shall be dressed and terminated in accordance with the recommendations made in the TIA/EIA-568-C documents, manufacturer's recommendations and/or best industry practices.
 6. Pair untwist at the termination shall not exceed one-half an inch.
 7. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.
 8. The cable jacket shall be maintained as close as possible to the termination point.

END OF SECTION

SECTION 27 52 23
NURSE CALL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the installation of a, modular, audio-visual nurse communication system. This system is installed in an open wire or conduit, box and cabling system provided by the contractor.
- B. This performance specification provides the minimum requirements for a supervised audio-visual Voice over IP-based (VoIP) Nurse Call System. The System shall include, but not be limited to all equipment, materials, labor, documentation, and services necessary to furnish and install a complete, operational Voice over IP-based Nurse Call System. The System shall comply in all respects with all pertinent codes, rules, regulations, and laws of the hospital authority and local jurisdiction. The System shall comply in all respects with the requirements of the specifications, manufacturer's recommendations and Underwriters Laboratories Inc. (UL) Listings.
- C. Each System shall be capable of supporting in excess of 1000 Patient Stations. The System shall support a single integrated platform for:
 - 1. Wireless communications system(s).
 - 2. Reporting Database.
 - 3. ADT Integration.
 - 4. Wireless Locating.
 - 5. Electronic Whiteboard.
 - 6. Supplemental PC applications.
 - 7. Patient/Staff Assignments.
 - a. It is further intended that upon completion of this work, the Owner be provided with complete information and drawings describing and depicting the entire System(s) as installed, including all information necessary for maintaining, troubleshooting, and/or expanding the System(s) at a future date, and complete documentation of System certification.

1.02 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specifications Sections.
- B. The Contractor will provide product data for each component, including detailed manufacturer's specifications.
- C. The Contractor will provide shop drawings detailing the system including, but not limited to, the following:
 - 1. A single-line block diagram showing cabling interconnection of all components for this specific system.
 - 2. CAD drawing of the floor/floors that the Nurse Communications Module will be installed.
- D. The Contractor will provide coordination drawings detailing system components that must fit, match, and line up with provisions made in equipment supplied under other Sections of the Specifications or under other contractors, including the following:
 - 1. Patient head-wall units.
 - 2. Patient consoles.
 - 3. Patient beds with built-in nurse call features.

- E. The Contractor will provide wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance.
- F. Report of field tests and observations, including an as-built package of final adjustments certified by Installer.
- G. The Contractor will provide maintenance data for system to include in the operation and maintenance manual specified in Division 1.

1.03 QUALITY ASSURANCE

- A. Listing and Labeling: Provide conduit and box system components as specified in accordance with Section 16100 and as indicated herein.
- B. Coordination of Work: The contractor will coordinate patient control units with items controlled that are not part of the nurse call system, including the following:
 - 1. TV: Channel selection and volume.
 - 2. Lights: Up light and down light at patient location.

1.04 INTERPRETATION

- A. No interpretations of the meaning of the bid documents will be made to any Bidder orally. Each request for such interpretation shall be made to the Engineer in writing.

1.05 MANUFACTURER

- A. Acceptable Nurse Call System Manufacturers include:
 - 1. Hill-Rom.
- B. All equipment and components shall be the Manufacturer's current model. The materials, appliances, equipment, and devices shall be tested and listed by a nationally recognized approval agency for use as part of a Nurse Call System. The Manufacturer's representative shall be responsible for the satisfactory installation of the complete System.
- C. The manufacturer's representative shall provide equipment and components, which comply with the requirements of these specifications. Equipment or components, which do not provide the performance and features required by these specifications, are not acceptable, regardless of manufacturer.
- D. The Manufacturer of the System equipment shall be regularly involved in the design, manufacturer, and distribution of all products specified in this document. These processes shall be monitored under a quality assurance program that meets ISO requirements. The Manufacturer shall have the financial stability to provide project financing/lease options to the Owner if desired.
- E. All System components shall be the cataloged products of a single Supplier. All products shall be listed by the Manufacturer for their intended purpose.
- F. All connected field electronics shall be both designed and manufactured by the same company, and shall be tested to ensure that a fully functioning System is designed and installed. The VoIP-based Nurse Call System shall utilize Ethernet topology, switches, and devices. These devices shall make up a UL 1069 Listed nurse call LAN/WAN.

1.06 ALTERNATES

- A. Strict conformance to this specification is required to ensure that the installed and programmed System will function as designed, and will accommodate the future requirements and operations of the building Owner. All specified operational features shall be met without exception.
- B. The authorized Representative of the Manufacturer of the equipment shall be responsible for the satisfactory installation of the complete System.

- C. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approval agency for use as part of an audio-visual Voice over IP-based Nurse Call System. An authorized Representative of the Manufacturer shall be responsible for the satisfactory installation of the complete System.
- D. All equipment and components shall be installed in strict compliance with the Manufacturer's recommendations.
- E. Alternates to the equipment specified will be considered only if all sections of the performance specification are met. Any deviations from System performance as outlined in this specification will be considered only when the following requirements have been met:
 - 1. A complete description of proposed alternate System performance methods with three (3) copies of working drawings thereof shall be submitted to the Owner for approval not less than seven (7) calendar days prior to the scheduled date for submission of bids. The Supplier shall submit a point-by-point statement of compliance for all sections in this specification. The statement of compliance shall consist of a list of all paragraphs within these sections. Where the proposed System complies fully with the paragraph, as written, placing the word "comply" opposite the paragraph number shall indicate such. Where the proposed System does not comply with the paragraph as written, and the Supplier feels the proposed System will accomplish the intent of the paragraph, a full description of the function, as well as a full narrative description of how its proposal will meet its intent, shall be provided. Any submission that does not include a point-by-point statement of compliance as described herein shall be disqualified. Where a full description is not provided, it shall be assumed that the proposed System does not comply.
 - 2. The acceptability of any alternate proposed System shall be the sole decision of the Owner or their authorized Representative.

1.07 SEQUENCING AND SCHEDULING

- A. The contractor will coordinate with space provided, including wiring paths and maintenance access, at locations listed below. Coordinate with trim features and finishes at these locations to present a unified design appearance. Include the following:
 - 1. Patient head-wall units.
 - 2. Patient beds with built-in nurse call features.

PART 2 - PRODUCTS

2.01 MANUFACTURER FURNISHED EQUIPMENT

- A. General:
 - 1. The System shall be network-based and incorporate decentralized, distributed intelligence architecture. The System shall allow both data and voice to be distributed over a common network infrastructure, which is consistent with the communication industry. The System shall provide a means of interoperability and 3rd party wired and wireless network devices within the facilities, including PCs, PDA's, phones, databases, pagers, etc. The system shall consist of (include):
 - a. Staff Consoles and Annunciator Panels with color touch screen LCD panels.
 - b. Power over Ethernet (PoE) Switches.
 - c. Room Control Boards (RCB).
 - d. Standard Room Stations.
 - e. Graphical Room Stations.
 - f. Single-Gang Push/Pull Type Peripheral Devices.
 - g. Auxiliary Input Stations with 1/4" input receptacle(s).
 - h. Icon-based LED Corridor Lights.
 - i. Bed Interface Device consisting of pillow speaker, bed and auxiliary input.

- j. VoIP Server.
- k. Configuration Software.
- B. System:
 - 1. It should be possible to configure the System using a modular, flexible GUI application that provides the system administrator the ability to manage, (add, delete, modify) and diagnose information within the nurse call network.
 - 2. System cable plan should be of standard Ethernet topology utilizing dedicated CAT5/5e/6 home runs to each location. Systems requiring separate cabling for power shall not be accepted.
 - 3. System shall have the ability to use .wav files to create custom tones for each call type.
 - 4. The system architecture shall not require external power supplies. Systems requiring power supplies to be installed separately from the control equipment shall not be accepted.
 - 5. Head end equipment/controller equipment shall be standard 19" rack mountable.
 - 6. All patient stations and staff consoles shall have antimicrobial additives in the plastics to prevent biodegradation due to bacterial residue.
 - 7. Nurse call system should conform to FDA Class II except medical device standards.
- C. Integrations:
 - 1. The System shall be capable of integrating with:
 - a. Ascom wireless telephones.
 - b. Any brand of pocket paging system
 - c. Nurse Call data and reporting software.
 - d. Staff locating systems, wireless call cords, CCTV switching controls, and door access controls.
 - e. Patient-to-staff assignments, wandering patient alarm systems, bed exit and/or fall prevention alarm systems, and patient equipment calls.
 - f. PC monitors, and large screen monitors such as Flat Panel LCD or Plasma display.
 - g. The System shall be capable of Hill-Rom and/or Stryker bed side-rail communication compatibility including visual and audible annunciation of a disconnected bed.

2.02 STAFF CONSOLES

- A. The staff console provides a central point to monitor and respond to nurse calls. It shall be able to visually and audibly annunciate nurse calls as well as provide full duplex voice capability to answer these calls. Staff consoles should include a handset for private communication but shall support speaker phone for monitoring events.
- B. The staff console has a small footprint that can be desk mounted or wall mounted.
- C. The staff console must be able to monitor single, multiple or all nursing units based on OWNER configuration.
- D. The Staff Console displays incoming calls from stations and connected healthcare equipment, and provides a means for the user to prioritize and respond to selected events. As an audio device, it provides audible signaling functions and facilitates two-way full-duplex staff/patient and staff/staff communications.
- E. Staff Consoles shall have the ability to adjust talk and listen volume levels via easy-to-use controls. These settings shall be adjustable on a room-by-room basis. Systems using group or zone-wide audio adjustments shall not be accepted.

- F. The Staff Console shall provide visual identification of the calling station(s) by room number, bed identification, priority, station type or call type. The Staff Console audible annunciation shall indicate priority level. Incoming calls shall be displayed on the color display in the colors assigned to their specific priority levels.
- G. The Staff Console shall be IP-based, utilizing Voice over IP technology.
- H. The Staff Console shall have a 10.4" color LCD touch screen.
- I. The touch screen shall utilize programmable soft keys as opposed to a mechanical dial/touchpad.
- J. Staff Console display shall provide an adjustable tilt mechanism for viewing clarity.
- K. Intercom audio between the Staff Console and any station in the System shall be full duplex. Systems utilizing one-way (half-duplex) audio shall not be accepted.
- L. The Staff Console shall connect to the nurse call network utilizing CAT5/5e/6 cable and powered Ethernet. No separate power supply or wiring shall be used.
- M. The call pending screen on the Staff Console shall allow up to six calls to be visible at a time and provide a simple scrolling function to view additional calls when more than six pending calls are present.
- N. The Staff Console shall allow the user to select what call to answer from the pending calls list.
- O. The Staff Console shall be able to call other Staff Consoles on the same network. Staff Console to Staff Console audio shall be full VoIP, full duplex.
- P. The Staff Console shall be a self-contained unit not taking up more than 160 inches of desk space.
- Q. The Staff Console shall provide patient data without the use of a separate PC.
- R. Staff Console shall receive power from the CAT5 cable supplying data. It shall not require a separate power supply or external transformer.
- S. All components used are RoHS (Reduction of Hazardous Substances) compliant.
- T. With Locating: Staff Console shall show location of active staff members and communicate with them in a single click.
- U. Staff Console primary screen shall indicate incoming calls and staff location information simultaneously.

2.03 AUDIO (PATIENT/STAFF) STATIONS

- A. Patient Stations are a primary point of two-way communication between patients and staff. Equipped with two call buttons and a cancel button, they offer users an easy-to-operate means of placing calls on the patient-staff communications system. With two built-in speakers and a separate microphone, these devices also provide staff with the means of opening a full-duplex channel of audio communications with patients. On-board LEDs provide operational feedback as well as status indication.
- B. Any Audio station may be configured to act as a patient station or a staff station. Staff/Duty stations have all the functionality of an Audio Station with the exception of a Code Lever.
- C. Standards Audio Stations:
 - 1. Standard Audio Stations shall mount in a 3-gang back box.
 - 2. Standard Audio Stations shall have a separate Code Blue Lever to actuate a code blue call in order to prevent false calls.
 - 3. Standard Audio Stations shall have two speakers to provide clear audio throughout the patient room.
 - 4. Standard Audio Stations shall have separate microphone to support full-duplex conversation. Systems not providing full-duplex audio capabilities shall not be accepted.

5. Standard Audio Stations shall not have call devices connected to allow flexible placement for optimal staff access.
 6. Standard Audio Stations shall have anti-microbial additives embedded in the plastic to prevent breakdown due to bacterial residue.
 7. Standard Audio Stations shall provide a cleaning mode to allow staff to clean station surfaces without accidental placement of calls. Activating cleaning mode shall temporarily disable the front panel buttons for a configurable period of time.
 8. Standard Audio Stations shall have a status LED to indicate call and communication status.
 9. Standard Audio Stations shall NOT have DIP switches that require manual setting by field personnel. Stations utilizing manual DIP switches shall not be considered.
 10. Standard Audio Stations shall be hot swappable and not require system shutdown or removal of power prior to replacement.
 11. Talk/Listen volume levels for each Patient Station shall be adjustable on a station-by-station basis. Systems that only allow adjustment of audio levels for a zone, wing or floor, shall not be accepted.
 12. All Standard Audio Stations shall be supervised.
- D. Graphical Audio Stations:
1. Graphical Audio Stations shall mount in a 3-gang back box.
 2. Where specified, system shall provide graphical touch screen Audio Stations in each patient room. These stations shall allow for staff to place a call to any other station on the system.
 3. Graphical Audio Station shall provide a list of available locations and allow staff to call any of these locations directly.
 4. Graphical Audio Station shall provide a clean room station button to allow the station to be wiped down without accidentally placing a call.
 5. Graphical Audio Stations shall meet UL 1069 impact test requirements. Graphical stations not meeting these requirements shall not be accepted.
 6. Graphical Audio Stations shall be able to select and initiate an audio conversation with any other graphical station by selecting from a list on the graphical display.
 7. Each Graphical Audio Station shall have a dedicated audio path to ensure audio call back from a caregiver. Systems requiring an audio bus topology that share voice paths over multiple rooms shall not be accepted.
 8. Graphical Audio Stations shall have the ability to display active calls by indicating the room number, bed number and type of call on the display. These calls may be answered from any station on the unit.
 9. Graphical Audio Stations shall have the ability to scroll up or down to view a list of information contained on the display.
 10. Graphical Audio Stations shall have a separate Code Blue Lever to actuate a code blue call in order to prevent false calls.
 11. Graphical Audio Stations shall have two speakers to provide clear audio throughout the patient room.
 12. Graphical Audio Stations shall have separate microphone to supply full-duplex conversation. Systems not providing full-duplex audio capabilities shall not be accepted.
 13. Graphical Audio Stations shall not have call devices connected to allow flexible placement for optimal staff access.

14. Graphical Audio Stations shall have anti-microbial additives embedded in the plastic to prevent breakdown due to bacterial residue.
15. Graphical Audio Stations shall provide a cleaning mode to allow staff to clean station surfaces without accidental placement of calls. Activating cleaning mode shall temporarily disable the front panel buttons for a configurable period of time.
16. Graphical Audio Stations shall have a status LED to indicate call and communication status.
17. Graphical Audio Stations shall NOT have DIP switches that require manual setting by field personnel. Systems utilizing manual DIP switches shall not be considered.
18. Graphical Audio Stations shall be hot swappable and not require system shutdown or removal of power prior to replacement.
19. Talk/Listen volume levels for each Graphical Audio Station shall be adjustable on a station-by-station basis. Systems that only allow adjustment of audio levels for a zone, wing or floor, shall not be accepted.
20. All Graphical Audio Stations shall be supervised.
21. With Locating: Graphical Audio Station shall provide a list of available staff with name, title, current location and wireless device availability.
22. Graphical Audio Station shall contain an infrared locator receiver to improve detection of IR badge transmissions from staff members wearing locator badges.
23. Normal level calls shall be automatically canceled when the assigned caregiver's locator badge is detected in the patient room. Priority or urgent calls should be manually canceled in any circumstance.

2.04 BED INTERFACE UNITS

- A. Bed Interface Units (BIUs) allow for flexible placement of the Patient Stations by removing the connection points away from the patient station. As the Patient Station is a device normally used by a staff member, they should be placed where a staff member has immediate access.
- B. The Bed Interface Unit (BIU) connects a pillow speaker, a bed and an auxiliary input to the nurse call network.
- C. Two Bed Interface Units may connect to a single patient station to individually annunciate calls from separate beds.
- D. Bed Interface Units provide relay contact isolation for entertainment and lighting, entertainment audio and lighting controls.

2.05 SIDECOM® SIDE RAIL INTERFACE

- A. The system shall support a Hill-Room Sidecom interface which allows a patient to place a call via a Hill-Rom side-raid, adjust room lighting controls, adjust television controls and audio volume, if configured.

2.06 REMOTE CALL STATIONS

- A. Remote Call Stations shall be furnished as specified. These devices are placed in ancillary areas accessible by staff as indicated by local building codes.
- B. Each location shall be capable of supporting more than six remote stations.
- C. Remote Call Stations only place calls, and do not send or receive audio.
- D. The Remote Call Stations shall have a call lever or button, a red call placed LED, and an optional call cancel button.
- E. Where indicated, Remote Call Stations shall provide a cord attached to the lever to allow a patient who has fallen to pull the cord to activate a call.
- F. Remote Call Stations connect to a room I/O board via an 8-conductor Cat 5 UTP cable, which carries device data using supervised wire-per function.

- G. Remote Call Stations are supervised by the system to alert staff in the event of a cable or switch failure.
- H. Lavatory Call Stations:
 - 1. Lavatory Call Stations are initiating devices that provide patient room call for assistance indication to the patient-staff communications system. When a Lavatory Station is activated, visual indication of the call displays at the dome light associated with the patient room, and an appropriate call indication registers on the staff console, as well as on any installed annunciators.
 - 2. Lavatory stations are call devices only, and do not send or receive audio.
 - 3. The lavatory stations have a blue nurse call lever, a red call placed LED, and a teal call cancel button.
 - 4. A cord attached to the lavatory station lever lets a patient who has fallen place an emergency call using the cord.
 - 5. Stations connect to the assigned room box via a category 5 UTP cable and RJ45 connector.
 - 6. The assigned staff console(s) and dome light will indicate the alarm condition.
- I. Shower Call Stations:
 - 1. Shower Call Stations are initiating devices that provide patient room call for assistance indication to the patient-staff communications system. When a Shower Call Station is activated, visual indication of the call displays at the dome light associated with the patient room, and an appropriate call indication registers on the staff console, as well as on any installed annunciators.
 - 2. Shower Call Stations are call devices only and do not send or receive audio.
 - 3. Shower Call Stations mount on the wall inside the shower.
 - 4. Shower Call Stations are protected from water via a gasket.
 - 5. Shower Call Stations have a blue nurse call lever and a red call placed LED.
 - 6. A cord attached to the Shower Call Station lever lets a patient who has fallen pull the lever using the cord.
 - 7. Shower Call Stations connect to the assigned room box via a category 5 UTP cable and RJ45 connector.
 - 8. The assigned staff console(s) and dome light will indicate the alarm condition.

2.07 CORRIDOR (DOME/ZONE) LIGHTS

- A. Corridor (dome) and zone light provide clear, visual annunciation of events from a particular location. Corridor Lights can help speed response time and increase caregiver efficiency by clearly indicating the status of the corresponding location. These devices are typically installed in corridors and outside patient rooms to provide staff with a visual cue as to the origin of a call placed on the system.
- B. Corridor Lights shall use LED (Light Emitting Diode) technology to eliminate the need to replace incandescent light bulbs that burn out over time. Dome lights that utilize incandescent bulbs rather than LEDs shall not be accepted.
- C. Corridor Lights shall be capable of mounting in a 1-gang back box.
- D. Corridor Lights shall have eight separate, distinguishable sections to indicate multiple, simultaneous events.
- E. Each Corridor Light section shall be capable of indicating at least six colors.
- F. Each call types shall be able to be programmed to indicate a specific dome light section(s), color(s) and flash rate.

- G. Corridor Lights shall be configurable via programming to allow multiple sections of a single light to illuminate and/or flash the same color for higher priority calls.
- H. Corridor Lights shall be able to match any existing Corridor Light schemes via programming.
- I. Corridor Lights shall allow for configurable overlays to be used to clearly distinguish calls or presence information. For example: a flashing 'N' would indicate a nurse is needed.

2.08 ROOM CONTROL BOARDS

- A. The Room Control Board shall be mounted above the corridor ceiling or next to the corridor (dome) light outside the patient room. The room board connects to the PoE switch with a Category 5/53/6 UTP cable (home run).
- B. The Room Control Board is a junction point for all room devices.
- C. Two audio stations can connect to a Room Control Board as well as the remote locator receiver(s), dome light, toilet switch, shower switch, zone light, system alarm interface, and stat clock interface.
- D. The Room Control Board is powered by the home run cable connected to the Power over Ethernet switch. LEDs on the room board indicate power and status.
- E. All connections to the room devices have LEDs to indicate if the communication channels are active.
- F. A heartbeat light indicates that software is active.

2.09 POWER OVER ETHERNET (POE) SWITCHES

- A. PoE Switches provide system power to all devices and interconnectivity with the rest of the system. The PoE switches are part of the nurse call system UL 1069 listed equipment.
- B. PoE Switches shall have 24 ports with a maximum power output of 360 watts.
- C. PoE Switches shall mount in a standard 19" network rack and shall be 1RMU high.
- D. PoE Switches connect to Room Control Boards, Staff Consoles, Annunciators, and other PoE Switches.
- E. PoE Switches shall follow standard Ethernet deployment standards.

2.10 PILLOW SPEAKERS

- A. One Pillow Speaker shall be provided for each Bed Interface Unit. Connection to the bed interface unit shall utilize a standard Champ 50 series 2-type AMP connector.
- B. Pillow Speakers shall have a minimum four button capacity, words indicating Nurse Call, TV channel and reading light.
- C. Pillow Speakers shall have LEDs for call placement and audio open indications.
- D. Pillow Speaker shall have a speaker for entertainment audio and nurse call audio.
- E. Audio shall be routed as follows: When audio channel between staff and the patient is opened, speaker audio to the patient shall go through the pillow speaker. The microphone in the Audio Station captures the patient's voice.
- F. Volume can be adjusted on a per room basis.
- G. Pillow Speaker housing shall be a high impact UL recognized, 94-VO rated or better polystyrene.
- H. Pillow Speaker internal switches shall be Micro Brand switch rated for 10 million cycles.

2.11 LOCATING EQUIPMENT

- A. An optional, integrated infrared locating system shall be supplied per owner specifications. Infrared locating system shall run off existing nurse call system network. IR locating systems requiring separate power and wiring support will not be accepted.

- B. Staff members were infrared locator badges. Each badge emits a unique, silent infrared signal. Up to 32000 IDS are possible. The infrared signal is emitted every 2 to 4 seconds. Infrared receivers located in the patient stations and Remote Locator Receivers (RLRs) detect the unique signals transmitted by the locator badge. This allows the network to track the location of a staff member and pass it along each point on the network. The locator badge uses a 3 volt lithium battery. Life expectancy is a function of battery grade and can be from 2 to 4 months.
- C. The system shall track the location of staff by two field configurable options. The first displays staff presence in an area each time the locator badge signal is picked up by an infrared receiver. This location is displayed on each staff console and graphical audio station on the network. If staff members are not found, asterisks are placed next to the staff member's name.
- D. The second method displays the last known location instead of asterisks at the staff console and graphical audio stations. The time interval since the staff member left the last known location will be displayed on the location screens at the staff console. The audio channel can be opened up to the last known location if an audio station is present.
- E. Remote Locator Receivers (RLR):
 - 1. Remote Locator Receivers contain three individual infrared photo modules. Each infrared photo module occupies a 120 degree segment and can detect a locator badge from at least 20 feet.
 - 2. Remote Locator Receivers shall connect to a Room Control Board for power and network connectivity.
 - 3. Remote Locator Receivers shall mount in a standard drop ceiling tile.
 - 4. Remote locator Receivers shall be labeled to indicate specific location as determined by owner.
 - 5. Remote Locator Receivers shall be placed in patient rooms and hallways to indicate staff presence on Corridor Lights, support automated call cancellation, automatic presence and data collection.
- F. I-Badge Locator Badge (I-Badge):
 - 1. Locator badges shall have the following specifications:
 - a. Each badge shall have a pre-coded identity that cannot be altered.
 - b. Each badge shall have Advanced Battery Management which consists of a low battery indicator. An LED on the badge will flash when the battery level is detected to be below a specified level.
 - c. Recommended battery replacement: Sanyo, CR2450, 3 volts, 500 mA hour.
 - d. Transmission Rate: selectable 2 or 4 seconds.
 - e. Default is 4 seconds, optional selection is 2 seconds.
 - f. Two packets per transmission, 36 kHz carrier frequency, 6 to 8 transmission interval.
 - g. 950 nm wavelength.
 - h. Operating temperature, 10° C (50° F) min. – 55° C (131° F) max.
 - i. Weight, 30 grams.
 - j. Badge size, 3.0" high x 2" wide x .75" deep.
 - k. Material, FR ABS plastic with VE-O rating.
 - l. Color, neutral gray.

2.12 ADDITIONAL CONTRACTOR FURNISHED EQUIPMENT

- A. Outlet and Junction Boxes:
 - 1. Staff Console: 1-gang back box and finished plate for RJ-45 connection.

2. Patient Stations: 3-gang back box.
3. Staff Stations: 3-gang back box.
4. Bed Interface: 1-gang (standard) or 2-gang back box.
5. Sidecom Interface: Connects to Bed interface.
6. Lavatory Stations: 1-gang deep back box.
7. Shower Stations: 1-gang deep back box.
8. Dome Lights: 1-gang back box.
9. Remote Infrared Receivers: 2-gang back box.

2.13 BED CONNECTIVITY AND ALERT NOTIFICATION

- A. System shall be capable of monitoring the following parameters and sending appropriate notifications if settings are not appropriate for patient risk.
 1. Status of Bed Exit (Is Bed Exit Active).
 2. Height of Bed.
 3. Status of Brakes.
 4. Side Rail Status (Head and Foot).
 5. Head of Bend Angle.
 6. Patient presence in bed.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment to comply with manufacturer's written instructions.
- B. Wiring Methods: Install wiring in compliance with ANSI/TIA-569 Commercial Building Standards, Telecom Pathways and Spaces.
- C. Terminations: Terminate cable in back boxes with 8 pin 8 wire RJ45 connectors.
- D. Identification of Conductors and Cables: Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams. Label stations, controls and indication using approved consistent nomenclature. All labels shall be machine-generated; hand-written labels shall not be acceptable.

3.02 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjusting of the system by the Contractor.
- B. Test Procedure: Conform to the following:
 1. Schedule tests a minimum of seven (7) days in advance of performance of tests.
 2. Report: Submit an as-built package with all test results and drawings.
 3. Manufacturer shall effectively coordinate the installation process. This would include but not be limited to inventory of parts, reviewing correct placement of cables, correct mounting of devices, and monitoring the installing contractor's compliance with the installation schedule.
 4. Troubleshoot and make corrections to the communications equipment.
 5. Edit computer files to customize the system within the capabilities of the software sent to the site.
 6. Coordinate the service of in hospital assigned maintenance.

7. Coordinate the proposed interfaces as outlined in the proposal. (MIS systems, code blue alarms, and special engineering interfaces as outlined in this document).
 8. Communicate the installation requirements to the installing contractors.
 9. Review project time schedule, estimate time requirements and communicate to the hospital.
 10. The Contractor shall furnish all labor, specialties, instruments, equipment, etc., required for the tests and installation.
 11. All tests shall be conducted before any equipment is connected that would be subject to damage from the test.
 12. The Contractor shall notify the owner at least one day prior to the actual test.
 13. Results of the tests shall show that the equipment and wiring shall meet the requirements of this specification. Should any of the above tests indicate the defects in materials or workmanship, the faulty installation shall be repaired or replaced at once and the necessary portions of the tests re-conducted to the approval of the Owner.
 14. The test shall demonstrate to the satisfaction of the Owner the following:
 - a. That all power and control circuits are continuous and free from short circuits.
 - b. That all circuits are free from unspecified grounds and grounded where specified.
 - c. That all circuits are properly connected in accordance with the applicable wiring diagrams.
 - d. That all circuits are operable, which demonstration shall include functioning of each control not less than five (5) times.
- C. Re-Testing: Rectify deficiencies indicated by tests and completely retest work affected by such deficiencies at Contractor's expense. Verify by the system test that the total system meets the Specifications and complies with applicable standards. Provide a written record of all retest results.
- D. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

3.03 CLEANING

- A. Prior to final acceptance, clean system components and protect from damage and deterioration.

3.04 TRAINING

- A. Contractor shall provide thorough training of all nursing staff assigned to those nursing units receiving new networked nurse/patient communications equipment. This training shall be developed and implemented to address two different types of staff. Floor nurses/staff shall receive training from their perspective, and likewise, unit secretaries (or any person whose specific responsibilities include answering patient calls and dispatching staff) shall receive operational training from their perspective. A separate training room will be set up that allows this type of individualized training utilizing in-service training unit, prior to cut over of the new system.

END OF SECTION

SECTION 28 31 00
FIRE ALARM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

- A. This Section includes fire alarm systems.
- B. Related Sections include the following:
 - 1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.
 - 2. Division 21 Section "Fire Protection."
 - 3. Division 23 Section "Temperature Control System".
 - 4. Division 26 Section "Basic Electrical Materials and Methods".
 - 5. Division 26 Section "Wiring Methods."

1.03 DEFINITIONS

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 SYSTEM DESCRIPTION

- A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.
 - 1. System shall interface with existing Simplex fire alarm system.

1.05 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. Premises protection includes all buildings including tunnels.
- C. Fire alarm signal initiation shall be by one or more of the following devices:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Verified automatic alarm operation of smoke detectors.
 - 5. Automatic sprinkler system water flow.
 - 6. Fire extinguishing system operation.
 - 7. Fire standpipe system.
 - 8. Pre-action fire extinguishing system operation.
- D. Fire alarm signal shall initiate the following actions:
 - 1. Alarm notification appliances shall operate continuously.
 - 2. Identify alarm at the FACP and remote annunciators.
 - 3. De-energize electromagnetic door holders.
 - 4. Transmit an alarm signal to the remote alarm receiving station.

5. Unlock electric door locks in designated egress paths.
 6. Release fire and smoke doors held open by magnetic door holders.
 7. Activate voice/alarm communication system.
 8. Switch heating, ventilating, and air-conditioning equipment controls to fire alarm mode.
 9. Close smoke dampers in air ducts of system serving zone where alarm was initiated.
 10. Record events in the system memory.
 11. Record events by the system printer.
- E. Supervisory signal initiation shall be by one or more of the following devices or actions:
1. Operation of a fire-protection system valve tamper.
- F. System trouble signal initiation shall be by one or more of the following devices or actions:
1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.
 2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at the FACP.
 4. Ground or a single break in FACP internal circuits.
 5. Abnormal ac voltage at the FACP.
 6. A break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at the FACP or annunciator.
 9. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- G. System Trouble and Supervisory Signal Actions: Ring trouble bell and annunciate at the FACP and remote annunciators. Record the event on system printer.

1.06 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
1. Shop Drawings shall be prepared by persons with the following qualifications:
 - a. Trained and certified by manufacturer in fire alarm system design.
 - b. Fire alarm certified by NICET, minimum Level III.
 2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
 3. Device Address List: Coordinate with final system programming.
 4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
 5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
 6. Batteries: Size calculations.
 7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

8. Ductwork Coordination Drawings: Plans, sections, and elevations of ducts, drawn to scale and coordinating the installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, the detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 9. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.
- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.
- G. Documentation:
1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and authorities having jurisdiction.
 2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
 - a. Hard copies on paper to Owner, Architect, and authorities having jurisdiction.
 - b. Electronic media may be provided to Architect and authorities having jurisdiction.
- H. Factory Training: The fire alarm vendor shall include three (3) days of factory training for two (2) individuals. Individuals will be designated by the Owner. Included cost shall cover all travel expenses including airfare, hotel, meals and training. All training materials shall also be included.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Work of this Section be performed by a UL-listed company.
- C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level II.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
 3. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.

4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
5. Keys and Tools: One extra set for access to locked and tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide system shall be provided by SimplexGrinnell LP; a Tyco International Company.

2.02 FACP

- A. General Description:
 1. Modular, power-limited design with electronic modules, UL 864 listed.
 2. The fire alarm control panel shall be Simplex Grinnell Model 4100U networked fire alarm control with one-way voice communications and full stand-alone capability.
 3. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 4. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
 1. Annunciator and Display: Liquid-crystal type, one line(s) of 80 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
 1. Signaling Line Circuits: NFPA 72, Class B.
 - a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.
 2. Notification-Appliance Circuits: NFPA 72, Class Z, Style Y.
 3. Actuation of alarm notification appliances, emergency voice communications, annunciation, smoke control, elevator recall, and actuation of suppression systems shall occur within 20 seconds after the activation of an initiating device.
 4. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.
- D. Smoke-Alarm Verification:
 1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
 2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
 3. Record events by the system printer.

4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.
- E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.
- F. The panel shall contain a master microphone module and master telephone permanently mounted behind the locked access door, visible through the viewing window and provide firefighters with the means of issuing voice message instructions to specific audio zones, groups of zones or all zones. The microphone, telephone, and the press-to-talk switches shall be supervised. This module shall contain a local speaker with volume control to monitor selected audio channels.
- G. Provide six (6) firefighter's remote telephones and separate storage cabinet next to FACP.
- H. Elevator Controls: Heat detector operation shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.
- I. Elevator Controls: Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shuts down elevators associated with the location without time delay.
 1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.
- J. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.
- K. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.
 1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
 2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
 3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.
- L. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
- M. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.
- N. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.
- O. Service Modem: Ports shall be RS-232 for system printer and for connection to a dial-in terminal unit.
 1. The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.

- P. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble), and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including the same information for device, location, date, and time. Commands initiate the printing of a list of existing alarms, supervisory, and trouble conditions in the system and a historical log of events.
- Q. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.
 - 1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
 - 2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."
- R. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.
 - 1. Batteries: Sealed lead calcium.
 - 2. Battery and Charger Capacity: Comply with NFPA 72.
- S. Surge Protection:
 - 1. Install surge protection on normal ac power for the FACP and its accessories. Comply with Division 26 Section "Transient Voltage Suppression" for auxiliary panel suppressors.
 - 2. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
- T. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.03 FIRE ALARM SUB-PANEL

- A. Where indicated on plans, provide sub-panel with all of the same features as FACP, specified hereinbefore, except the following:
 - 1. Firefighters' two-way voice communication system comprised of master microphone module, master telephone and remote telephones.

2.04 GRAPHIC COMMAND CENTER

- A. Provide Simplex 4190 Series, or approved equal, graphic command center at FACP to provide annunciation, status display and control of networked fire alarm system using a windows-based graphical interface.
- B. Arrange as desktop computer with color monitor.
- C. Furnish with manufacturer recommended printer for creating hard copy records of the fire alarm system events.

2.05 VOICE EVACUATION SYSTEM

- A. Where indicated on the drawings, provide a voice evacuation system integral with the FACP or sub-panel that is a network component of the fire alarm system. Switches shall be provided to provide all call paging and to selectively page by floor within each building. Microphones, speaker select switches, and amplifiers shall communicate with the fire alarm panel via network cable. The entire system (fire detection and voice evacuation) shall be programmable within one software package that shall be provided to the Owner. Features shall include:
 - 1. Amplifiers comply with UL 1711 and are sized to supply a minimum of 2.0 watts of power for each connected speaker.

2. Provide tone generator capable of providing a variety of tones.
3. 2-channel to permit transmission of announcements to zones or floors automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines.

2.06 MANUAL FIRE ALARM BOXES

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, breaking-glass or plastic-rod type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
 3. Station Reset: Key- or wrench-operated switch.
 4. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 5. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.07 SYSTEM SMOKE DETECTORS

- A. General Description:
1. UL 268 listed, operating at 24-V dc, nominal.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 3. Multipurpose type, containing the following:
 - a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - b. Piezoelectric sounder rated at 88 dBA at 10 feet according to UL 464.
 - c. Heat sensor, combination rate-of-rise and fixed temperature.
 4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
 7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
 - a. Rate-of-rise temperature characteristic shall be selectable at the FACP for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at the FACP to operate at 135 or 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.

- B. Photoelectric Smoke Detectors:
 - 1. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - 2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
- C. Ionization Smoke Detector:
 - 1. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
 - 2. Detector Sensitivity: Between 0.5 and 1.7 percent/foot smoke obscuration when tested according to UL 268A.
- D. Beam-Type Smoke Detector: Each detector shall consist of a separate transmitter and receiver, and shall have the following features:
 - 1. UL 268 listed, operating at 24-V dc, nominal.
 - 2. Adjustable Sensitivity: At least six sensitivity levels, settable at the receiver, measured as percent of obscuration.
 - 3. Two selectable alarm delay settings, allowing each to be associated with a corresponding sensitivity.
 - 4. Trouble signal delay, fixed at 20 seconds.
 - 5. Separate Color-Coded LEDs: Indicate normal, alarm, and trouble status.
- E. Duct Smoke Detectors:
 - 1. Photoelectric Smoke Detectors:
 - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
 - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
 - 2. Ionization Smoke Detectors:
 - a. Sensor: Responsive to both visible and invisible products of combustion. Self-compensating for changes in environmental conditions.
 - b. Detector Sensitivity: Between smoke obscuration when tested according to UL 268A.
 - 3. UL 268A listed, operating at 24-V dc, nominal.
 - 4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
 - 5. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
 - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
 - 6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
 - 7. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.
 - 8. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
 - 9. Each sensor shall have multiple levels of detection sensitivity.

10. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
11. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.08 HEAT DETECTORS

- A. General: UL 521 listed.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.
 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
 1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.09 NOTIFICATION APPLIANCES

- A. Description: Equipped for mounting as indicated and with screw terminals for system connections.
 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
- B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.
- C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.
 1. Rated Light Output: 75 candela, unless noted otherwise.
 2. Strobe Leads: Factory connected to screw terminals.

2.10 ALARM HORNS

- A. Horns to have 85 dBA output at ten (10) feet. Horns to be Wheelock ET70 series.

2.11 ALARM SPEAKERS

- A. Speakers shall be designed for high efficiency sound output with field selectable input voltage (25/70 VRMS) and field selectable taps from 1/8 to 2 watts. Strobes shall be multi candela field selectable wall: 15/30/75/110 cd or 135/185 cd. Features shall include high efficiency design for maximum output at minimum wattage across a listed frequency range of 400 to 4000 Hz.
- B. The speaker and speaker strobe appliances shall be designed for indoor surface or flush mounting. The speaker and speaker strobe shall incorporate a speaker mounting plate with a grille cover which is secured with two screws for a level, aesthetic finish and shall mount to standard electrical hardware required no additional trimplate or adapter.
- C. The finish of the Series E speakers and strobe speakers shall be white, red, or nickel plate.
- D. All speaker and speaker strobe appliance shall be backward compatible.
- E. Wall speakers shall be Wheelock Series ET70. Ceiling speakers shall be Wheelock Series ET90.

2.12 ALARM STROBES

- A. Strobe flash rate to be one flash per second with zero inrush current. In addition strobes are to meet the following conditions:
 - 1. Visual only signals shall provide a wide range of intensities and mounting options for wall or ceiling applications. Strobe intensity shall be multi candela field selectable. Wall: 15/30/75/100 cd or 135/185 cd. Ceiling: 15/30/75/95 cd or 115/177 cd.
- B. Synchronized strobes shall be required for any space where more than one strobe is visible from any location and where indicated on drawings. This will include all corridors.
 - 1. When synchronization is required, the strobe portion of the appliance shall be compatible with Wheelock's SM, DSM sync modules or Wheelock's PS-12/24-8MP Power Supply with built-in Patented Sync Protocol. The strobes shall not drift out of synchronization at any time during operation. If the sync module or Power Supply fails to operate, (i.e., contacts remain closed), the strobe shall revert to a non-synchronized flash rate.
- C. Wall mounted strobes shall be Wheelock Series RSS (square).

2.13 COMBINATION SIGNALS

- A. Combination Signals: Provide factory-combined audible and visible alarm units of type indicated in a single mounting unit where indicated.
 - 1. Visual/Speaker Device: Wheelock ET70 Series for wall mount, Wheelock ET90 Series for ceiling mount.
 - 2. Visual/Horn Device: Wheelock ET70 Series for wall mount, ceiling mount not used.
 - a. Visual/horn and horn only devices shall typically transmit tone upon notifier appliance activation, but shall be capable of delivering live voice messages.

2.14 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.
 - 1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
 - 2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
 - 3. Rating: 24-V ac or dc.
- B. Material and Finish: Match door hardware.

2.15 REMOTE ANNUNCIATOR

- A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.
 - 1. Mounting: Flush cabinet, NEMA 250, Class 1.
- B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.16 FIREFIGHTER PHONE JACKS

- A. Provide remote firefighter telephone jacks where indicated on plans.
- B. Provide two-way communication system between jacks and FACP.

2.17 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to the elevator controller to initiate elevator recall.

2.18 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Listed and labeled according to UL 632.
- B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.
- C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
- D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.19 SYSTEM PRINTER

- A. Listed and labeled as an integral part of the fire alarm system.

2.20 WIRE AND CABLE

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70 Article 760, Classification CI, for power-limited fire alarm signal service. UL listed as Type FPL, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 - 3. Multiconductor Armored Cable: NFPA 70 Type MC, copper conductors, THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.21 PROVISIONS FOR HIGH-RISE APPLICATIONS

- A. The system shall be installed for high-rise application.
- B. Signal circuits shall be circuited by floor, for floor above and floor below.
- C. Alarm speakers in stairwells shall be wired to a dedicated signal circuit (one for each stairwell).
- D. System shall include a firefighters' two-way voice communication system.
- E. System shall include an integrated voice system as specified hereinbefore.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

- A. Smoke or Heat Detector Spacing:
 - 1. Smooth ceiling spacing shall not exceed 30 feet.
 - 2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
 - 3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
- B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

- C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of the duct.
- D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- H. FACP: Surface mount with tops of cabinets not more than 72 inches above the finished floor.
- I. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.02 WIRING INSTALLATION

- A. Install wiring according to the following:
 - 1. NECA 1.
 - 2. TIA/EIA 568-A.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceways and Boxes."
 - 1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.03 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 GROUNDING

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.
 - 2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
 - 3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
 - 4. Testing: Follow procedure and record results complying with requirements in NFPA 72.
 - a. Detectors that are outside their marked sensitivity range shall be replaced.
 - 5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of final acceptance, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of final acceptance, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.
- C. Annual Test and Inspection: One year after date of final acceptance, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections and approved by SLHS.

3.07 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION