



Specifications

Woodrow Wilson Keeble Memorial Health Care Center USP Compliance

Sisseton, SD

IHS Project #

HHSI102201800141

DSGW Project #

022003.00

January 12, 2024

SECTION 00 01 01

PROJECT MANUAL TITLE AND REGISTRATION SHEET

**WOODROW WILSON KEEBLE MEMORIAL HEALTH CARE CENTER USP COMPLIANCE
SISSETON, SOUTH DAKOTA**

DATE: January 24, 2024

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IHS PROJECT NO.: HHSI102201800141

DSGW PROJECT NO.: 022003.00

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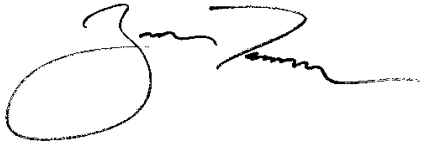
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I hereby certify that these Drawings and Specifications were prepared by me or under my direct supervision and that I am a duly registered Architect under the laws of the State of South Dakota.



Ryan Turner

Reg. 14817

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END OF SECTION

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**WOODROW WILSON KEEBLE MEMORIAL HEALTH CARE CENTER USP COMPLIANCE
FLANDREAU, SOUTH DAKOTA**

	<u>SHEET</u>	<u>TITLE</u>
<u>ARCHITECTURAL</u>	A0.1	Title Sheet
	A1.1	Life Safety Plan & Summary
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	A2.1	Ambulance Garage
	A2.2	Pharmacy
	A3.1	First Floor RCP
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END OF SECTION

**SECTION 00 31 00
AVAILABLE PROJECT INFORMATION**

PART 1 GENERAL

1.01 INFECTION CONTROL RISK ASSESSMENT

A. Assessment to be appended to this section.

1.02 TRIBAL EMPLOYMENT RIGHTS ORDINANCE (TERO)

A. Assessment to be appended to this section.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Infection Control Risk Assessment

Matrix of Precautions for Construction & Renovation

Step One:

Using the following table, *identify* the **Type of Construction Project Activity (Type A-D)**

TYPE A	<p>Inspection and Non-Invasive Activities. Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ removal of ceiling tiles for visual inspection only, e.g., limited to 1 tile per 50 square feet ▪ painting (but not sanding) ▪ wallcovering, electrical trim work, minor plumbing, and activities which do not generate dust or require cutting of walls or access to ceilings other than for visual inspection.
TYPE B	<p>Small scale, short duration activities which create minimal dust Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ installation of telephone and computer cabling ▪ access to chase spaces ▪ cutting of walls or ceiling where dust migration can be controlled.
TYPE C	<p>Work that generates a moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ sanding of walls for painting or wall covering ▪ removal of floorcoverings, ceiling tiles and casework ▪ new wall construction ▪ minor duct work or electrical work above ceilings ▪ major cabling activities ▪ any activity which cannot be completed within a single workshift.
TYPE D	<p>Major demolition and construction projects Includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ activities which require consecutive work shifts ▪ requires heavy demolition or removal of a complete cabling system ▪ new construction.

Step 1: **TYPE C** _____

Step Two:

Using the following table, *identify the Patient Risk Groups* that will be affected. If more than one risk group will be affected, select the higher risk group:

Low Risk	Medium Risk	High Risk	Highest Risk
<ul style="list-style-type: none"> ▪ Office areas 	<ul style="list-style-type: none"> ▪ Cardiology ▪ Echocardiography ▪ Endoscopy ▪ Nuclear Medicine ▪ Physical Therapy ▪ Radiology/MRI ▪ Respiratory Therapy 	<ul style="list-style-type: none"> ▪ CCU ▪ Emergency Room ▪ Labor & Delivery ▪ Laboratories (specimen) ▪ Medical Units ▪ Newborn Nursery ▪ Outpatient Surgery ▪ Pediatrics ▪ Pharmacy ▪ Post Anesthesia Care Unit ▪ Surgical Units 	<ul style="list-style-type: none"> ▪ Any area caring for immunocompromised patients ▪ Burn Unit ▪ Cardiac Cath Lab ▪ Central Sterile Supply ▪ Intensive Care Units ▪ Negative pressure isolation rooms ▪ Oncology ▪ Operating rooms including C-section rooms

Step 2 HIGH RISK

Step Three: Match the

Patient Risk Group (Low, Medium, High, Highest) with the planned ...
Construction Project Type (A, B, C, D) on the following matrix, to find the ...
Class of Precautions (I, II, III or IV) or level of infection control activities required.
Class I-IV or Color-Coded Precautions are delineated on the following page.

IC Matrix - Class of Precautions: Construction Project by Patient Risk

Patient Risk Group	Construction Project Type			
	TYPE A	TYPE B	TYPE C	TYPE D
LOW Risk Group	I	II	II	III/IV
MEDIUM Risk Group	I	II	III	IV
HIGH Risk Group	I	II	III/IV	IV
HIGHEST Risk Group	II	III/IV	III/IV	IV

Note: Infection Control approval will be required when the Construction Activity and Risk Level indicate that **Class III** or **Class IV** control procedures are necessary.

Step 3 III

Description of Required Infection Control Precautions by Class

	During Construction Project	Upon Completion of Project
CLASS I	<ol style="list-style-type: none"> 1. Execute work by methods to minimize raising dust from construction operations. 2. Immediately replace a ceiling tile displaced for visual inspection 	<ol style="list-style-type: none"> 1. Clean work area upon completion of task.
CLASS II	<ol style="list-style-type: none"> 1. Provide active means to prevent airborne dust from dispersing into atmosphere. 2. Water mist work surfaces to control dust while cutting. 3. Seal unused doors with duct tape. 4. Block off and seal air vents. 5. Place dust mat at entrance and exit of work area 6. Remove or isolate HVAC system in areas where work is being performed. 	<ol style="list-style-type: none"> 1. Wipe work surfaces with cleaner/disinfectant. 2. Contain construction waste before transport in tightly covered containers. 3. Wet mop and/or vacuum with HEPA filtered vacuum before leaving work area. 4. Upon completion, restore HVAC system where work was performed.
CLASS III	<ol style="list-style-type: none"> 1. Remove or Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Contain construction waste before transport in tightly covered containers. 5. Cover transport receptacles or carts. Tape covering unless solid lid. 	<ol style="list-style-type: none"> 1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Department. 2. Remove barrier materials carefully to minimize spreading of dirt and debris associated with construction. 3. Vacuum work area with HEPA filtered vacuums. 4. Wet mop area with cleaner/disinfectant. 5. Upon completion, restore HVAC system where work was performed.
CLASS IV	<ol style="list-style-type: none"> 1. Isolate HVAC system in area where work is being done to prevent contamination of duct system. 2. Complete all critical barriers i.e. sheetrock, plywood, plastic, to seal area from non work area or implement control cube method (cart with plastic covering and sealed connection to work site with HEPA vacuum for vacuuming prior to exit) before construction begins. 3. Maintain negative air pressure within work site utilizing HEPA equipped air filtration units. 4. Seal holes, pipes, conduits, and punctures. 5. Construct anteroom and require all personnel to pass through this room so they can be vacuumed using a HEPA vacuum cleaner before leaving work site or they can wear cloth or paper coveralls that are removed each time they leave work site. 6. All personnel entering work site are required to wear shoe covers. Shoe covers must be changed each time the worker exits the work area. 	<ol style="list-style-type: none"> 1. Do not remove barriers from work area until completed project is inspected by the owner's Safety Department and Infection Prevention & Control Department and thoroughly cleaned by the owner's Environmental Services Dept. 2. Remove barrier material carefully to minimize spreading of dirt and debris associated with construction. 3. Contain construction waste before transport in tightly covered containers. 4. Cover transport receptacles or carts. Tape covering unless solid lid. 5. Vacuum work area with HEPA filtered vacuums. 6. Wet mop area with cleaner/disinfectant. 7. Upon completion, restore HVAC system where work was performed.

SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Woodrow Wilson Keeble Memorial Health Care Center USP Compliance
- B. Owner's Name: Woodrow Wilson Keeble Memorial Health Care Center.
- C. ARCHITECT: DSGW Architects, Inc.
 - 1. 2 West 1st Street, Suite 201
 - 2. Duluth, MN 55802
 - 3. Phone: 218-727-2626
- D. STRUCTURAL ENGINEER: Northland Consulting Engineers
 - 1. 102 South 21st Avenue West, Suite 1
 - 2. Duluth, MN 55806
 - 3. Phone: 218-727-7779
- E. MECHANICAL/ELECTRICAL ENGINEER: EDI-Dolejs
 - 1. 1112 North 5th Street
 - 2. Minneapolis, MN 55411
 - 3. Phone: 612-343-5965
- F. The Project consists of the remodel of an existing area in the Woodrow Wilson Keeble Memorial Health Center in Sisseton, South Dakota. Work will include but is not limited to: demolition, including some saw cutting for new mechanical reroutes, minimum masonry work for patching in wall opening(s), carpentry, thermal properties, openings, including glazing and ballistic type pass through transaction window system, finishes, specialties, mechanical, electrical, plumbing, etc. Government title is replacement wording for any and all areas that mention "Owner".

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price.
- B. These Specifications with the accompanying Drawings are intended to describe and illustrate all work necessary to carry out the work of the project listed.
 - 1. Provide labor, materials articles, equipment, incidentals, items, tools, services, supplies, methods, operations, skills in such quantities as may be necessary to complete Project within the intent of the Contract Documents. Singular notations shall be considered plural where plural application is reasonably inferable. Mention or indication of extent of work under any work Division or Specification Section is done only for convenience of Contractor and shall not be construed as describing all work required under that Division or Section.
 - 2. Drawings: The List of Drawing Sheets is included in Section 00 01 15. Contractors and all Subcontractors shall be bound by the information and requirements provided by the complete set of Drawings. Individual Detail Sheets shall be considered with and as a part of the Drawings and the overall Contract Documents.
 - 3. The Divisions and Sections of the Technical Specifications primarily apply to the various trade divisions, but Contractor and all Subcontractors shall be bound to the information and requirements of the complete set of Specifications.
 - 4. Other Requirements: The requirements of all Sections of Divisions 00 and 01 apply to and shall govern the Contractor and all Subcontractors for this Project. Supplementary General Conditions and all Sections Division 01 shall govern Work of all technical Sections. Where provisions and requirements are referred to as the responsibility of the Contractor or a particular Subcontractor, he shall have the primary responsibility to accomplish, provide, assume, and enforce, but the Contractor and all Subcontractors shall be governed by the requirements and cooperate fully in fulfilling the requirements.

5. Examination of Site and Documents: In submitting a bid and in accepting a Contract award, the Contractor represents he has examined the site, existing conditions as well as the entire set of documents, in accordance with the General Conditions and agrees to be bound by all conditions of the site, existing conditions, and all documents, without additional cost.

1.03 WORK BY GOVERNMENT

- A. The Government reserves the right to let other contracts in connection with this Project. This Contractor shall afford other contractors' reasonable opportunity for the introduction and storage of their materials and execution of their work, and shall properly connect and coordinate his work with theirs.
- B. The Government reserves the right to jointly occupy the premises with the Contractor in the performance of his duties and functions. The Government also reserves the right to: enter into the Project and premises at all times; make installations of materials and equipment at appropriate times as the Work progresses; install equipment, furniture, and furnishings when spaces are at appropriate stages of completion. Contractor shall coordinate work and cooperate to minimize undue interferences.
- C. If any part, unit, phase, or the entire Project is substantially complete or ready for occupancy, the Government may, upon notice to the Contractor, and without prejudice to any of the rights of the Government or Contractors, enter into and make use of the Work that is substantially complete.

1.04 OCCUPANCY

- A. Government and personal intends to occupy the Project upon Substantial Completion.
- B. Cooperate to minimize conflict and to facilitate operations.
- C. Schedule the Work to accommodate occupancy.

1.05 CONTRACTOR USE OF SITE AND PREMISES

- A. Do not infringe on areas outside of the established construction limits indicated on Drawings or designated without permission. Arrange temporary easements which may be required for construction operations, maintain safety precautions, and return to original conditions upon completion of the Contract. The Government may caution Contractor about conditions which they observe but shall not be held responsible to provide such advice or for enforcing any protection.
- B. Contractors and all other persons connected with this project shall only use parking areas approved.
- C. Contractors shall use and maintain in clean condition site access route as designated. No other access shall be used for vehicles or men.
- D. Move any stored products which interfere with operations.
- E. Do not load structures with weights which will endanger the structure.
- F. Maintain site in safe condition and keep free of construction materials and debris.
- G. Maintain fire protection and access at all times. Permit immediate access by firefighting equipment.
- H. Hazardous Protection: Warning signals, barricades and other protective measures for hazard shall be in place or operate 24 hours per day.
- I. The Contractor shall do all patching of existing property on or adjacent to the site, including but not limited to: walks, pavements, roadways, structures, and utilities which are cut or damaged by construction and are not designated for removal, relocation or replacement in the course of the construction.
- J. Work occurring on public property shall be constructed in accordance with all laws, ordinances, rules, regulations, and orders of any public authority having jurisdiction.

- K. Site Management Requirements:
1. The Prime Contractor shall coordinate all work on site with the Government and Architect.
 2. General: Upon commencement of the Work at the site, the Prime Contractor shall assume the site management at areas within construction limits as agreed to by the Government and Contractor, other areas where work is to be performed and adjacent storage areas, to provide proper direction to all contractors, subcontractors, and workmen. Site management shall be coordinated and shall include maintaining areas as specified and required to be free of construction activity, parking, and storage where it is necessary to provide clear access and areas for functions.
 3. Responsibilities: Site management and maintenance shall include, but not be limited to: enforcement of access, parking, delivery, storage, noise and other restrictions; maintenance of fences in good condition; providing and maintaining temporary facilities as specified; dewatering the excavations, except water in trenches and excavations made by subcontractors solely for their own work; protection of adjacent structures as may be damaged caused by water; overall fire and safety management; protection for site features to remain; temporary partitions, closures, dust barriers and similar to separate work areas in existing building spaces; and similar overall or general management of the site and adjacent public and other property to fulfill the obligations of this Contract.
 4. Fencing: Refer to Section 01 50 00 for fencing to be provided at areas of construction and storage.
 5. Use of Streets: Where the conduct of the work requires the obstruction or use of a roadway or parking lot, it shall be the responsibility of the respective Contractor to secure all necessary permission. Contractors shall be responsible for the protection of the public in the vicinity of the work and nothing in these specifications shall be construed to relieve him of said responsibility. Protective devices shall conform to the requirements of the Highway Department having jurisdiction and/or the proper public authorities and shall be installed as required by the Government.
- L. Provide access to and from site as required by law and by Government:
1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 2. Do not obstruct roadways, sidewalks, or other public ways without permit.

1.06 WORK SEQUENCE

- A. Begin work when scheduled by general contractor to achieve substantial completion as scheduled to prevent delay in the work by others.
- B. Deviations in the schedule must be authorized by the architect and Government.
- C. Time Set by Schedule: Where the constraints, completion and timing of Work specified in this or other Sections do not have specific dates or time imposed by the Contract Documents, they shall be considered and incorporated as established dates in the final Construction Schedule of the Prime Contractor. Where the activity affects, the time or dates established in the construction schedule shall be maintained, as the Government will plan activities accordingly.
- D. Other Considerations: In addition to the time of commencement, substantial completion and final completion dates, all other events, fasteners, and constraints shall be carefully considered in establishing the work program and schedule of the Project. The Contractor and subcontractors shall work closely in timing of operations and shall have materials, equipment and other elements ready to be able to immediately fulfill their obligations in the overall schedule.
- E. Final Completion: Within 10 days after substantial completion.

F. Time of Completion:

1. The Contractor agrees that said work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will ensure full completion thereof within the time specified. It is expressly understood and agreed, by and between the Contractor and the Government, that the time for completion of the same, taking into consideration the average climatic range and usual industrial conditions prevailing in this locality.
2. Delays and Extension of Time: All time limits stated in the Contract Documents are of the essence of the Contract. The Contractor may be granted an extension of time and/or relief of Liquidated Damages because of causes beyond the Contractor's control which constitute a justifiable delay. The Government will extend the time subject to the following provisions:
 - a. Claims for extension of time.
 - b. Written notice of the delay, an explanation of the cause and an estimate of the length of delay shall be forwarded to the Architect within five days of the beginning of such delay.
 - c. Claims for extension of time shall be stated in numbers of whole calendar days. The actual dates on which the delay(s) occurred must be stated. In the case of claims for extension of time because unusual inclement weather prevented the execution of major items of the Work on normal working days, calendar days shall be computed by multiplying normal workdays (five days per week) by a factor of 1.4. Contractor must provide documentation of all weather-related delays and claims for the extension will be allowed only if the weather is distinctly out of line with the ten-year average.
 - d. Any claim for extension of time for strikes or lockouts shall be supported by a situation of facts concerning the strike, including but not limited to, the dates, the craft concerned, and the reason for the strike, efforts to resolve the dispute, and efforts to minimize the impact of the strike in progress.
 - e. Any claims for extension of time for delays in transportation or for failure of suppliers shall be supported by a citation of facts demonstrating that the delays are beyond the Contractor's control, including, but not limited to, his efforts to overcome such delays.
 - f. The time extensions for changes in the Work will depend upon the extent, if any, by which the changes cause delay in the completion of various elements of construction.
 - g. A Change Order granting the time extension may provide that the Contract Completion Date will be extended only for those specific elements so delayed and that the remaining work will not be altered. Further, the amended completion date shall be of essence to this contract and shall be subject to the same conditions as the original completion time.
3. Project Schedule:
 - a. General: The General Contractor shall prepare the Final Contractors Construction Schedule for the Work. The location and nature of the Project, the requirement to maintain the operation, functions, and services of the Owner dictates careful planning, scheduling and close cooperation between the Contractor, subcontractors and the Government. The Contractor shall keep advised of his intended operations and schedule and be guided by other constraints or timing of work that may develop during construction. It is the intent cooperate as far as possible to minimize hampering of operations and the Contractor may suggest schedules and timing which will facilitate progress.
 - b. Within ten work days after award of the Contract, prepare, submit and review with the Owner and Architect a detailed schedule addressing work activities and estimate duration of the activities. This schedule shall be prepared in such detail and form as the Architect may require and will be subject to the Approval of the Architect and Government.

- c. In general, the schedule shall indicate the various phases of work coordinated and integrated time-wise with the other work. The schedule shall also indicate the various activities of each of the areas, stages, and phases of work, with integrated and coordinated commencement and completion times. After review, including any revised sequencing proposed by the Contractor or Government to improve the progress or minimize the disruption of the Owner's functions, the Contractor shall revise the schedule as the "final" schedule, which will provide the planning information for relocation and other operations.
 - d. Submit schedule updates and Material Status Report updates with applications of payments as requested by the Architect.
 - e. Furnish manpower staffing information as requested by the Government or Architect.
 - f. Coordinate the letting of subcontracts, material purchases, shop drawings submissions, delivery of materials, sequence of operations, etc., to conform to the Project Schedule and furnish proof of same as may be required by the Architect.
 - g. Revise and periodically update the Project Schedule as necessary to conform to the current status of the project and furnish copies to the Government, Architect, and subcontractors.
4. Commencement of Work:
- a. No Contractor shall commence Work nor allow any Subcontractor or Sub-subcontractor to commence the Work until:
 - 1) The Contract has been fully executed; and the Owner, has issued a Notice to Proceed.
 - 2) The Government has approved the Contractor's Performance and Payment Bonds.
 - 3) The Government has approved evidence of the Contractor's Liability Insurance and any other insurance required to be purchased by the Contractor.
5. Performance/Payment Bond: Furnish a Performance/Payment Bond in accordance with the Section I of the Government Contracts.
6. Other Bonds, Permits, Fees:
- a. The GENERAL CONTRACTOR shall secure and pay the cost of the building permit for the Project. Included will be the building permit fees, plan check fees, State surcharge, and other fees customarily charged for the building permit.
 - b. The GENERAL CONTRACTOR shall secure and pay any additional costs for the Certificate of Occupancy for the Project.
 - c. Each CONTRACTOR OR SUBCONTRACTORS shall secure and pay for all other bonds, permits, governmental fees, license and inspections required necessary for the proper execution and completion of this work.
 - d. The GENERAL CONTRACTOR and EACH CONTRACTOR OR SUBCONTRACTOR shall pay TERO fees. TERO information – See Section 00 31 00, Available Project Information.
7. Layout of the Work:
- a. The PRIME CONTRACTOR shall be responsible for and shall assist Subcontractors and Prime Trade Contractors in the location of walls, partitions, columns, beams, floors, ceilings, and openings therein where their work must be located and placed prior to the erection of these items.
 - b. The Contractor and/or Subcontractor is responsible for the accuracy with respect to layout of his work. Immediately report any perceived discrepancies or errors in the Drawings to the Architect and make adjustments in accordance with instructions given by the Architect.

- c. The contractor and subcontractor shall recognize that the drawings necessarily are diagrammatic in many instances. All work and in particular exposed piping, ducts, conduit and similar items shall be neatly and carefully laid out to provide the most useful space utilization and the most orderly appearance. Piping and similar work shall be installed as close to ceilings and walls as conditions permit, located to prevent interference with other work or with the use of the spaces in the manner required by the functions of the room and staff. Valves shall be located in inconspicuous but accessible places. Before proceeding with any work, particularly where exposed, the Contractor shall carefully plan the layout and review it with the Architect for acceptability of location.
8. Openings, Blocking, Backing and Grounds:
 - a. Each Trade Contractor shall be responsible for providing backing and grounds in all walls and above ceilings necessary for the installation of all contracted work.
 - b. Make suitable preparations for the hangers, inserts, anchors, grounds and supports that are to be embedded in concrete, masonry walls, floors, partitions or structural members, or that are to pass through or be attached thereto. Provide and install proper sleeves, boxes, receptacles or chases for all openings or recesses to receive work occurring in or passing through any such members, all of which shall be located accurately and secured firmly in place before any such masonry has been erected, concrete poured or walls/ceilings enclosed.
 9. Field Dimensions: The need to obtain accurate field dimensions in ample time to permit fabrication of materials and equipment, for delivery and installation in accordance with the schedule, shall be recognized. Each Contractor and all subcontractors shall cooperate in completing work phases to accommodate the schedule for obtaining dimensions and to prevent fabrication delay. In the event it is impractical to have work in place to permit field dimensions, the Contractor shall guarantee necessary dimensions, before construction, to the various fabricators and be responsible to insure the dimensions.
 10. Reference to Standards and Codes:
 - a. Notice of Variance: If a Contractor observes that the drawings and specifications are at variance with any applicable code or regulation of a governmental unit having authority, he shall promptly notify the Architect in writing, and any necessary changes shall be adjusted as provided in writing. If a Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to the Architect, he shall bear all costs and damages arising therefrom.
 - b. Reference Standards: For products specified by association or trade standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes and other standards.
 - c. Effect of Standards: The standards referred to, such as ASTM, Federal Specifications, NFPA and similar standards, shall have full force and effect as though printed in the Specifications, except as modified in the Specification. These standards are not furnished to bidders and Contractors as it is assumed that these standards are readily available and that the manufacturers and trades involved are familiar with their requirements.
 - d. Date of Standard: Any material specified by reference to the number, symbol or title of a specific standard, such as ASTM, Commercial Standard, a Federal Specification, a trade association standard, or other similar standard, shall comply with the requirements in the latest revision thereof and any amendment or supplement thereto in effect on the date of the Contract Documents, unless otherwise noted.
 - e. Certificate: For products specified in accordance with a Federal Specification, ASTM Standard, American National Standards Institute or similar association standards, upon request the Contractor shall provide an acceptable affidavit by independent testing laboratory or other source approved by the Architect, certifying that product furnished for this Project complies with the particular standard specifications. Where necessary, requested or specified, supporting test data shall be submitted to substantiate compliance. The manufacturer is subject to Architect's acceptance.

11. Coordination Requirements:
 - a. General: The nature of the Project makes it imperative the Contractor and all subcontractors and prime trade contractors coordinate their work and cooperate with each other and the Government from the start of the Project to completion. PRIME CONTRACTOR shall be the Prime Coordinator for the Project and shall establish the overall schedule for the progress of the Project, the sequence of completion and general use of the site.
 - b. Off-Site Fabrication: With the restricted site, off site fabrication is encouraged as much as possible and schedule of deliveries so materials and equipment can be installed immediately after delivery. The Project Coordination Administrator shall alert and advise subcontractors and suppliers of the need to hold deliveries until they are notified the materials are required on the site.
 - c. Equipment: With respect to mechanical and electrical features of equipment, complete data must be exchanged directly between the Contractors and subcontractors involved as the progress of the Project requires. The person requesting the information shall advise when it will be required. The suppliers of equipment are expressly required to provide large scale layout drawings showing the required rough-in locations of all services (dimensioned from building features) service characteristics. In the event of incorrect, incomplete, delayed or improperly identified information, the party causing the delay or error shall be responsible and pay for any modifications or replacements necessary to provide a correct, proper and new installation, including relocations required.

1.07 GENERAL PROTECTION AND SAFETY

- A. General: In accordance with best construction practices, the Prime Contractor shall be responsible for conditions of the job site, including safety of all persons and property affected directly or indirectly by his operations during the performance of the Work. This requirement shall apply continuously 24 hours per day until acceptance of the Work by the Government and shall not be limited to normal working hours.

1.08 PHOTOGRAPHS / PRESS RELEASES

- A. Do not take, or cause any photographs to be taken at the job site without prior approval of the Government / Architect.
- B. Do not issue any press releases or disseminate information concerning the project to the news media without prior approval of the Owner / Architect.

1.09 WORKING HOURS

- A. This project shall be scheduled by the Prime Contractor to operate on a 5-day, 40-hour per week basis. Contractors employing trades who work other than the above hours must provide for coordination of their work as it relates to the work of other trades which work the above hours at no additional cost to the Owner. This schedule may be changed or modified with the approval of the Government / Architect.

1.10 HAZARDOUS MATERIAL REMOVAL

- A. If during the construction of the Project hazardous material is suspected or encountered by the Contractor, the Contractor shall promptly notify the Architect and the Government, with their own forces or by separate contract, shall be responsible for complete removal and disposition of the hazardous material.
- B. If the Contractor claims that delay and additional cost is involved because of this action, they shall make claim as provided elsewhere in the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00
PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.

1.02 SCHEDULE OF VALUES

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

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- C. Forms filled out by hand will not be accepted.
- D. Execute certification by signature of authorized officer.
- E. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored Products.
- F. Round off all figures on all progress payments to the nearest dollar, any adjustment required shall be made on the final application for payment.
- G. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of Work.
- H. Submit electronic copies of each Application for Payment. Upon review and approval, the Architect will sign and forward electronic copies to the Government with their recommendations.
- I. Include the following with the application:
 - 1. Affidavits attesting to off-site stored products.
 - a. No payment will be made to a contractor on account of materials and equipment in transit or stored at off site locations unless prior approval is received from the Government and Architect. Proof of proper insurance must be submitted for materials stored of site before approval will be considered.

2. Lien Waivers: Will be required for each payment request by each Contractor and Subcontractor. First lien waivers to be submitted with Payment Request No. 2 covering payment for Payment Request No. 1. They shall then continue with subsequent payment requests covering the preceding payment.
 - a. With submission of the final payment request, or upon request for reduction of retainage, the Contractor shall provide lien waivers from all subcontractors and suppliers covering all dollar amounts for which a lien waiver has not yet been submitted.
 3. Payroll Records: Will be required for each pay request by each Contractor and Subcontractor carrying out work on the site. Each application for payment submitted shall be accompanied by payroll records current to within twenty-one (21) days of the date of the application.
 - a. Final payment to a contractor will not be made until payroll records are submitted covering completed project.
- J. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.04 RETAINAGE

- A. To ensure the proper performance of the Contract, the Owner will retain FIVE PERCENT of the amount of each Certificate for Payment issued by the Architect. Such amount will be retained by the Government until Substantial Completion. At substantial completion the withholding amount will be reduced to Two Percent.
- B. In event of a very minor amount of work, incomplete or not corrected due to weather, unsuitable conditions for testing or similar conditions preventing the General Contractor from proceeding, the retained amount may be reduced to three times the value of the incomplete work upon recommendation of the Architect and approved by the Owner.

1.05 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Price or Contract Time, Architect will issue instructions directly to Contractor.
 1. Please refer to the Construction Contract Administrator; see 2019 A/E Design Guide.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 10 days.
- D. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the Work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00.
- E. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
 1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.

3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- F. Substantiation of Costs: Provide full information required for evaluation.
1. Provide following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 2. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
- G. Percentages allowed for Overhead and Profit shall be as listed.
- H. Execution of Change Orders: Contracting officer issues C/O's (Change Orders). Process is listed in 2019 A/E Guide.
- I. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- J. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
- K. Promptly enter changes in Project Record Documents.

1.06 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preconstruction meeting.
- B. Progress meetings.
- C. Construction progress schedule.
- D. Coordination drawings.
- E. Submittals for review, information, and project closeout.
- F. Number of copies of submittals.
- G. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Stages of the Work, Work covered by each contract, occupancy.
- B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 PROJECT COORDINATION

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRECONSTRUCTION MEETING

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

- B. Attendance Required:
 1. Government/Owner.
 2. Architect.
 3. Contractor.
- C. Agenda:
 1. Execution of Government- Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 5. Designation of personnel representing the parties to Contract and Architect.
 6. Designation of personnel representing the parties to Contract, General Contractor, Major Subcontractors, Government and Architect.
 7. Procedures and processing of field decisions, submittals, and substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 8. Rules and regulations governing performance of Work.
 9. Procedures for safety and first aid, security, quality control housekeeping, and other related matters.
 10. Scheduling.
 11. Any additional Owner or Architect/Engineer requirements.
- D. Record minutes and distribute electronically within two days after meeting to participants, with copies to Architect, Government, participants, and those affected by decisions made.

3.02 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum monthly intervals.
- B. Architect will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, Government, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
 1. Review minutes of previous meetings.
 2. Review of Work progress.
 3. Field observations, problems, and decisions.
 4. Identification of problems that impede, or will impede, planned progress.
 5. Review of submittals schedule and status of submittals.
 6. Review of off-site fabrication and delivery schedules.
 7. Maintenance of progress schedule.
 8. Corrective measures to regain projected schedules.
 9. Planned progress during succeeding work period.
 10. Maintenance of quality and work standards.
 11. Effect of proposed changes on progress schedule and coordination.
 12. Other business relating to Work.
- E. Record minutes and distribute copies electronically within two days after meeting to participants, with copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PRE-INSTALLATION CONFERENCES

- A. When required in individual specification section, the Architect shall convene a pre-installation conference at work site prior to commencing work of the Section. When possible this shall be scheduled to coincide with a regular progress meeting.

- B. Attendance will be required by all parties directly affecting, or affected by, work of the specific Section.
- C. Notify all parties seven days in advance of meeting date.
- D. The Architect shall, preside at conference, record minutes, and distribute copies electronically to all participants.
- E. Review conditions of installation, preparation and installation procedures, and coordination with related work.

3.04 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule electronically defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule electronically within 10 days.
- C. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule electronically for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- D. Within 10 days after joint review, submit complete schedule electronically.
- E. Submit updated schedule with each Application for Payment.

3.05 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- C. Samples will be reviewed only for aesthetic, color, or finish selection.
- D. Allow for at least two weeks review of submittals to avoid delay of work.
- E. Include with submittal preparation, field construction criteria, verification of catalog numbers and similar data, and coordination of Work requirements and Contract Documents.
- F. Make all submittals to the Architect through the project coordination administrator unless specified otherwise.
- G. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - CLOSEOUT SUBMITTALS.

3.06 SUBMITTALS FOR INFORMATION

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

- B. No shop drawings of equipment brochures, cuts of fixtures, etc. Such copies of standard manufactured items in the form of manufacturer's catalog sheets showing sizes, dimensions, performance characteristics, capacities, clearances, wiring diagrams, and shall be furnished electronically unless otherwise specified. Copies will be stamped, and electronic copy will be returned to the Project Coordination Administrator for distribution to the subcontractor or supplier. If notations and marks indicate that revised information is required before shop fabrications (or other work represented) can proceed, revised or corrected information shall be submitted.
- C. Unless otherwise specified, submit to the Architect two representative samples of size and nature representing typical qualities. Where required, submit a sufficient number of samples to demonstrate the complete range of variations of the material or quality. Written acceptance of the Architect is required prior to ordering any item for which samples are required.
- D. Submit samples to Architect securely packaged, with the name of the Project clearly indicated on the package exterior. Firmly attach a label or tag to the sample, with the following information: a) Name of Project; b) Name of Supplier; 3) Name of Trade Contractor, and, d) Product information such as manufacturer's designation, finish, type, class, grade, etc., as is appropriate.
- E. Erect field samples and mock-ups at the project site, unless otherwise specified in the Contract Documents, at a location acceptable to the Project Coordination Administrator, Architect and Owner.
- F. Review of shop drawings, product data and samples by the Architect or their consultant does not relieve the Contractor, Subcontractor or Supplier of responsibility for compliance with the Contract Documents, confirming and correlating quantities and dimensions, selecting fabrication processes and techniques of construction, coordination of the work represented by each submittal with other trades, performing the work in a safe and satisfactory manner, compliance with the Project Schedule and all other provisions of the agreements.
- G. The Architect's/Engineer's notation on the submittals is not an authorization for additional work or additional cost. If any notations represent a change to the Contract Sum, submit a cost proposal to the Architect, through the Project Coordination Administrator for the change in accordance with the procedures specified before proceeding with the work. Notify the Project Coordination Administrator by letter within five days of returned submittal. Resolve such issues before proceeding with the work.
- H. The Contractor, Subcontractor or supplier shall not begin fabrication until all specified submittal procedures have been fulfilled.
- I. In order to guarantee the delivery of materials for timely completion of the work, and to relieve the Contractor of direct responsibility in the event of materials shortages or transportation delays, the Supplier shall, within two (2) weeks after the receipt of Notice to Proceed, furnish to the Architect, confirmed orders showing the anticipated date of delivery to the site, for materials for all of the principle parts of the work and for such others as the Architect/Engineer or Owner may direct.
- J. In addition to Warranty provisions of the Government Contract, provide all extended warranties, bonds and service contracts as required by individual specification sections.
- K. Assemble and submit to the Architect warranties, bonds, and service and maintenance contracts as specified in the respective section of the Specifications. In conjunction with the submittals of Section 01 78 00, the table of contents for this submittal shall include the product of work item, the form, with the name of the principal, address and telephone number, scope, date of beginning of the warranty, bond or service maintenance contract, duration, information for the Owner's personnel providing the proper procedure in case of a failure and instances which might affect the validity of the warranty or bond.
- L. The beginning date of the warranty will be the date that the project is substantially completed.

- M. Reports of inspections, tests and approvals required by the Contract Documents shall be submitted to the Architect, through the Project Coordination Administrator, in the quantities indicated.
- N. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.

3.07 SUBMITTALS FOR PROJECT CLOSEOUT

- A. When the following are specified in individual sections, submit them at project closeout:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- B. Submit for Owner's benefit during and after project completion.

3.08 NUMBER OF COPIES OF SUBMITTALS (Electronic Submittals)

- A. Documents for Review:
 - 1. Transmit electronic copies of each shop drawing to Project Coordination Administrator.
 - a. The Project Coordination Administrator shall generally review shop drawings for compliance with the Drawings and Specification.
 - b. Electronic copies of shop drawings individually stamped by Project Coordination Administrator will be sent to Architect for review.
 - 2. Architect or his consultant will review all shop drawings and will return electronic copies to the Project Coordination Administrator stamped to indicate action taken.
 - a. The electronic copies of any shop drawings that are not satisfactory to the Architect or his consultant will be returned to the Project Coordination Administrator for necessary revision and resubmittal.
 - b. Electronic copies of shop drawings that do not require major revisions, will have corrections, if any, noted, and will be stamped to indicate Architect's action.
- B. Documents for Information: Submit electronic copies.
- C. Documents for Project Closeout: Make one reproduction of submittal originally reviewed. Submit one extra of submittals for information.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.

3.09 SUBMITTAL PROCEDURES

- A. Transmit each submittal with a copy of approved submittal form.
- B. Transmit each submittal with letter of transmittal.
- C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate on each copy.
- E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- F. Deliver submittals electronically to Architect at email address. Deliver samples to Architect at business address.
- G. Schedule submittals to expedite the Project, and coordinate submission of related items.
- H. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.

- I. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- J. Provide space for Contractor and Architect review stamps.
- K. When revised for resubmission, identify all changes made since previous submission.
- L. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- M. Submittals not requested will not be recognized or processed.

END OF SECTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. References and standards.
- B. Control of installation.
- C. Tolerances.
- D. Testing and inspection services.
- E. Manufacturers' field services.

1.02 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008.
- B. ASTM C1077 - Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation; 2013a.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2012.
- D. 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.
- E. ASTM E329 - Standard Specification for Agencies Engaged Construction Inspection and/or Testing; 2011.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2009.

1.03 SUBMITTALS

- A. Test Reports: After each test/inspection, promptly submit electronic copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 - 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents, or for Owner's information.
- B. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 - 1. Indicate material or product conforms to 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.

- C. Manufacturer's Instructions: When specified in individual specification sections, submit instructions electronically for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- D. Manufacturer's Field Reports: Submit reports electronically for Architect's benefit as contract administrator or for Government.
 - 1. Submit report electronically within 30 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
- E. Erection Drawings: Submit drawings electronically for Architect's benefit as contract administrator or for Government.
 - 1. Submit for information for the limited purpose of assessing conformance with information given and the design concept expressed in the contract documents.
 - 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or Owner.

1.04 REFERENCES AND STANDARDS

- A. For products and workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- C. Obtain copies of standards where required by product specification sections.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.
- E. Should specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of Architect shall be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.05 TESTING AND INSPECTION AGENCIES

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

PART 2 EXECUTION

2.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.

- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

2.03 TESTING AND INSPECTION

- A. Testing Agency Duties:
 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.
 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-conformance of Work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-conformance to specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-conformance to specified requirements shall be paid for by Contractor.

2.04 MANUFACTURERS' FIELD SERVICES

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

2.05 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the Work, Architect will direct an appropriate remedy or adjust payment.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 TEMPORARY UTILITIES

- A. Government/Owner to provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. Temporary Light and Power:
 - 1. Prime Contractor Responsibilities:
 - a. The Prime Contractor shall coordinate temporary light and power during construction phases of the project.
 - b. The Prime Contractor shall pay for all electrical energy used.
 - c. Coordinate with the sitework contractor.
 - 2. Electrical Sub-Contractor responsibilities:
 - a. Provide temporary ties into an existing panel/panels within the general proximity of the remodeling and new construction.
 - b. Provide at least one 20 amp., 120 volt, temporary branch circuit with three grounding, duplex receptacles for each 7500 sq. ft. of floor area. Locate receptacles so that extension cords will not exceed 100 feet in length. The temporary branch circuits may be used for portable tools, portable lights and other small power loads.
 - c. Provide at least one 200 watt incandescent lamp, or the equivalent lighting for each 625 sq. ft. of floor area with at least one light in each room. Provide additional lights in corridors and stairwells as necessary to provide adequate illumination. Furnish all light bulbs for the temporary lighting system.
 - d. Maintain the temporary electrical service and lighting during the normal work week which is defined as five days a week, including one-half hour before regular working hours and one-half after regular working hours for each trade. (10 hours per day)
 - e. Remove the temporary light and power system and the temporary service terminals when no longer required, and repair any damage caused by the temporary system.
 - 3. Separate Contractor/Subcontractor responsibilities:
 - a. If 3-phase power or voltage higher than 120 volts is required, provide the necessary temporary wiring, and pay the cost thereof. Coordinate installation with Electrical Contractor.
 - b. Do not use the temporary light and power system for electric welders, hoists, or heating.
 - c. Maintain temporary electrical service and lighting if used beyond the normal work week.
 - d. Each subcontractor shall make arrangements and pay the costs for electrical service, lighting and power for his field office, storage sheds, and other temporary buildings.

- e. Each Sub-Contractor shall furnish extension cords and contractors requiring supplemental lights shall furnish their own portable lights.
 - 4. Use of permanent electrical system: when installation of the permanent electric system is sufficiently complete to be operated safely and system may be used to provide construction light and power, and testing and operating of permanent equipment.
 - 5. Permanent light and power: The Government/Owner will assume the responsibility and pay the costs of providing electrical light and power including the energy cost on the date of his occupancy or the date of Substantial Completion of the Project, whichever is sooner.
- C. Water:
- 1. Water is available at the site for use by the Contractor. Contractors shall make every effort to conserve the use of water.
 - 2. Water consumption cost will be paid by the Government/Owner.
 - 3. Until such time as the permanent water service utilities are provided to the site EACH TRADE CONTRACTOR shall provide all water required to carry out the work of their contract.
 - 4. After permanent water supply is in place, the General Contractor shall make arrangements for a supply of water as required and water consumption cost will be paid by the General Contractor.
 - 5. Contractors/Subcontractors are responsible for providing their own hoses to bring water from the temporary water source to their work areas. Only heavy duty 3/4" hose in good condition will be permitted. The discharge end of each hose will be equipped with a means of positive shut-off. Do not use hoses which leak at connections or elsewhere throughout their length. Disconnect all hoses from hose bibs when not in use and before the end of the work day.
 - 6. Each Contractor/Subcontractor shall provide remote sanitary drinking water dispensers for use of their own personnel, convenient of work stations.
 - 7. Those using the water shall protect or remove water supply during freezing temperatures.

1.03 CONSTRUCTION HEAT PRIOR TO ENCLOSURE

- A. It is not anticipated that construction heat will be required prior to enclosure of the project.
- B. Adhere to the approved Project Schedule, regardless of weather conditions, during the period when work is scheduled to be performed. All required work and the cost thereof to meet this obligation will be included in the Contractor's base proposal and in the resulting Contract Sum. No claim for an extension of Contract Time, or for an increase in Contract Sum will be honored by the Owner, if such claim is based upon the cost of providing construction heat as specified above.
- C. Each Contractor or Subcontractor to be responsible for providing temporary weather-tight enclosures as approved by the Government and Architect, as work progresses, and as necessary to provide acceptable working conditions to accomplish their work without causing a delay in the project.

1.04 CONSTRUCTION HEAT AFTER ENCLOSURE

- A. For construction heat purposes, the building or portion thereof will be declared enclosed when all enclosing walls are erected, roof or floor construction above is installed, and all doors, windows, or openings in the exterior walls are covered.
- B. After enclosure, if required, the General Contractor shall provide, operate, and maintain a temporary system for heating the enclosed area of the building. This system shall consist of direct fired L.P. gas, temporary heat units or other devices as required to maintain the specified temperatures.

- C. After enclosure of the building, a minimum temperature of 50 degrees F. shall be maintained at all times. During the placing of interior millwork, resilient flooring, acoustic tile, ceramic tile, plaster, painting and decorating, and similar finish materials, and continuing until the Owner assumes responsibility for heating the building, the minimum temperature shall be 60 degrees F. It shall be the responsibility of each Contractor to coordinate with the General Contractor to assure that all temporary enclosures remain in the closed position.
- D. The General Contractor shall arrange for the ventilation of enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, and gases.
- E. This temporary heating and ventilation shall remain in place until the permanent heating and ventilation systems are installed, including ductwork.

1.05 USE OF PERMANENT HEATING AND VENTILATING SYSTEMS:

- A. If required, the General Contractor and the Heating Contractor shall operate and maintain the equipment during its use for temporary heating.
- B. The cost of fuel and utilities used in the operation of the permanent heating system will be paid for by General Contractor.
- C. Warranties shall begin upon Substantial Completion.
- D. The permanent system shall be operated, after final review and acceptance, with a full complement of disposable filters which shall be replaced by the Mechanical Contractor upon completion of the project.

1.06 VENTILATION

- A. The General Contractor shall arrange for the ventilation of enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, and gases.

1.07 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.
- B. The General Contractor shall provide and maintain telephone service within his office for his own use and use by all contractors, subcontractors, and representatives of the Government and the Architect. Toll charges shall be paid by the party initiating the call using credit cards, watts lines or reverse charges.
- C. Each contractor shall be responsible for installation, payment of charges, and removal of any telephone he may require in his office or storage trailer.
- D. Use of cellular phones will be permitted.
- E. Telecommunications services shall include:

1.08 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.
- C. The Prime Contractor shall provide & maintain one or more portable "Satellite type" temporary toilets convenient to each major area of construction, for the use of all Contractors, subcontractors, their personnel and employees.
- D. Permanent toilet facilities are not to be used by construction personnel.

1.09 BARRIERS

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

- B. Each Contractor shall furnish and maintain all necessary informational signs required to help maintain the safety and health at the work site such as "Danger" "High Voltage", etc.
- C. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.10 EXTERIOR ENCLOSURES

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

1.11 INTERIOR ENCLOSURES

- A. Provide temporary partitions and ceilings as indicated to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.
- B. Construction: Framing and reinforced polyethylene sheet materials with closed joints and sealed edges at intersections with existing surfaces:

1.12 CONSTRUCTION ACCESS AND BARRIERS

- A. Each Contractor shall provide temporary construction access consisting of OSHA approved ladders and/or scaffolding required to carry out the work of their contract. These shall be placed at a location approved by the General Contractor.
- B. Each Contractor and Subcontractor shall provide hoisting facilities for his own use.
- C. Each Contractor shall provide temporary sheeting and shore and brace excavations and new construction as necessary for the safe and proper execution of the Work. Remove temporary supports when backfilling is complete or new construction can safely support the loads.
- D. The General Contractor shall provide protective fences, barricades and lights as required to prevent unauthorized entry to construction areas to meet all safety requirements of OSHA and to protect existing facilities and adjacent properties from damage from their construction operations.
 - 1. Any contractor carrying out excavation or requiring excavations shall protect excavations, trenches, etc. from accidental access by placing protective fencing around openings.
- E. Protective fencing at all excavations shall be provided by the Excavator.
- F. Protective fencing at storage areas shall be provided by the Contractor whose materials require fencing.
- G. Fencing shall be a minimum of 48 inch high snow fence mounted on steel posts not over six feet on center.

1.13 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. The General Contractor shall be responsible for security of the building and site. Exterior openings at which work cannot be completed within one working day's time will be closed to prevent entry into existing buildings or new construction.
- C. This shall include those temporary closures as required under Construction Heat after enclosure.
- D. Each Contractor will be responsible for the security of his own property.

1.14 VEHICULAR ACCESS AND PARKING

- A. Coordinate access and haul routes with governing authorities and Owner.
- B. Provide and maintain access to fire hydrants, free of obstructions.

- C. Provide means of removing mud from vehicle wheels before entering streets.
- D. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.
- E. Parking locations will be designated by the General Contractor.
- F. Trucks and other vehicles belonging to Contractors, Subcontractors and suppliers may be parked on the site provided space is available and the vehicles are identified. Such parking shall be subject to the direction of the General Contractor.
- G. Perform cleaning of concrete equipment at location designated by the General Contractor. Remove from the site all residue accumulated from the cleaning operations of concrete equipment.
- H. Contractors failing to adequately clean vehicles or otherwise causing dirt or debris to be deposited on any public street or highway shall be responsible for all costs in connection with the cleaning thereof whether performed by the General Contractor, or at the direction of any public authority having jurisdiction.
- I. Access to the site shall be by roadways, approved by the Government/Owner.
- J. Access Roads shall be established and maintained by the Earthwork Contractor, as directed the General Contractor.
- K. Snow Removal:
 - 1. General Snow removal from site access roads, parking areas, and building access will be carried out by the General Contractor.
 - 2. Each Contractor will be responsible for the removal of snow from their work, stored materials, and access to same.

1.15 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.
- E. Each contractor/subcontractor shall collect waste from the construction areas & dispose of in dumpsters as provided by the Prime Contractor.
- F. If contractor/subcontractor does not remove this waste on a timely basis, the Owner/Architect may direct the prime contractor to remove waste and the contractor/subcontractor may be back charged by the prime contractor for this removal.
- G. Separate construction waste & recycle dumpsters may be provided, and if so, all contractors shall separate all waste materials as directed and place into proper dumpster.

1.16 PROTECTION OF INSTALLED WORK

- A. Each Contractor shall see to it that protection is provided for work as follows:
 - 1. Protect installed Work and provide special protection where specified in individual specification Sections.
 - 2. Provide temporary and removable protection for installed Products. Control activity in immediate work area to minimize damage.
 - 3. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
 - 4. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

5. 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.
- B. The Contractor shall arrange for the correction of any damage caused by the operations of himself or any Subcontractor and shall deduct the cost of corrections from monies due the Contract.

1.17 PROJECT IDENTIFICATION

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

1.18 FIELD OFFICES

- A. None required.
- B. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- C. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- D. If space is available, contractors may provide a field office for their own use, installed at a suitable location on the site as designated by the General Contractor. Provide and pay for all utilities used in conjunction with field office.
- E. Locate offices a minimum distance of 30 feet from existing and new structures.

1.19 TEMPORARY STORAGE

- A. Contractors may provide storage sheds and/or trailers as their needs may require, and as space is available, coordinate the location with the General Contractor. All temporary structures will be removed before final acceptance of the Work.
- B. Limit use of the premises for work and for storage. Cooperation with all separate contractors on the project shall be under the direction of the General Contractor.

1.20 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing facilities used during construction to original condition.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by the Contract Documents.
- B. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Government, or otherwise indicated as to remain the property of the Government, become the property of the Contractor; remove from site.
- C. Reused Products: Reused products include materials and equipment previously used in this or other construction, salvaged and refurbished as specified.

2.02 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by the Contract Documents.
- B. Sustainably Harvested Wood:
 - 1. Definition: Wood-based materials include but are not limited to structural framing, dimension lumber, flooring, wood doors, finishes, and furnishings that are permanently installed in the project. Wood and wood-based products not permanently installed in the project are not included in the definition.
 - 2. Overall Project Requirement: Provide a minimum of 50 percent of all wood-based materials made of sustainably harvested wood.
 - 3. Specific Wood-Based Fabrications: Fabricate of sustainably harvested wood when so specified elsewhere.
 - 4. Certification: Provide wood certified or labeled by an organization accredited by one of the following:
 - a. The Forest Stewardship Council, The Principles for Natural Forest Management; for Canada visit <http://www.fscanada.org>, for the USA visit <http://www.fscus.org>.
- C. Provide interchangeable components of the same manufacture for components being replaced.

2.03 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.04 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. Instructions to Bidders specify time restrictions for submitting requests for substitutions during the bidding period. Comply with requirements specified in this section.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- D. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure:
 - 1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
 - 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence. Burden of proof is on proposer.
 - 3. The Architect will notify Contractor in writing of decision to accept or reject request.

3.02 OWNER-SUPPLIED PRODUCTS

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

3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- B. Transport and handle products in accordance with manufacturer's instructions.
- C. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- D. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- E. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- F. Replace damaged materials at no additional cost to the owner.
- G. Deliver items required to be built into masonry or concrete promptly to the site so they may be built in as the work progresses. Provide templates showing exact locations.
- H. Do not deliver materials subject to damage unduly long before they are required in the work and suitable storage facilities are available at the site.
- I. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
- G. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- H. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.
- L. Arrange storage of products to permit access for inspection. Periodically inspect to ensure products are undamaged and are maintained under specified conditions.
- M. Replace damaged materials at no additional cost to the owner.

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, except payment procedures.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in conformance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of Owner or separate Contractor.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.03 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
- B. For survey work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of Surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate.
- C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in the State in which the Project is located.

1.04 PROJECT CONDITIONS

- A. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddles or running water. Provide water barriers as required to protect site from soil erosion.
- C. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

- D. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
- E. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- F. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
- G. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- H. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.
- I. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

1.05 COORDINATION

- A. This PROJECT COORDINATION ADMINISTRATOR shall coordinate the work of this project, including the work of his subcontractors.
- B. This PROJECT COORDINATION ADMINISTRATOR shall coordinate all work of the project with the Owner, the Architect and other contractors carrying out work at the site.
- C. Each Sub-Contractor and Material Supplier shall coordinate the work of his and that of related contractors, subcontractors and material suppliers with the aid of the Project Coordination Administrator.
- D. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- E. Notify affected utility companies and comply with their requirements.
- F. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- G. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- H. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- I. Coordinate completion and clean-up of work of separate sections.
- J. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or errors in fabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a pre-installation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.

- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations; and any related work associated.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations, and miscellaneous associated work.
- H. Periodically verify layouts by same means.
- I. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
 - 1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 - 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
 - 2. Relocate items indicated on drawings.
 - 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 - 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications: Remove, relocate, and extend existing systems to accommodate new construction.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 - 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.

3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 4. Verify that abandoned services serve only abandoned facilities.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
1. When existing finished surfaces are cut so that a smooth transition with new work is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to Architect.
 2. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
 3. Where a change of plane of 1/4 inch or more occurs in existing work, submit recommendation for providing a smooth transition for Architect review and request instructions.
 4. Trim existing wood doors as necessary to clear new floor finish. Refinish trim as required.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.
- L. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 1. Complete the work.
 2. Fit products together to integrate with other work.
 3. Provide openings for penetration of mechanical, electrical, and other services.
 4. Match work that has been cut to adjacent work.
 5. Repair areas adjacent to cuts to required condition.
 6. Repair new work damaged by subsequent work.
 7. Remove samples of installed work for testing when requested.

- 8. Remove and replace defective and non-conforming work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- F. Patching work shall be done by skilled mechanics experienced in the particular type of work involved. Patching work shall conform to the standards of the Specifications where applicable and where not specified, work shall conform to the highest standards of the trade.
- G. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
- H. Restore work with new products in accordance with requirements of Contract Documents.
- I. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- J. As necessary, at penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material, to full thickness of the penetrated element.
- K. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- L. Patch or replace surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. Repair substrate prior to patching finish. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

3.08 PROGRESS CLEANING

- A. The Contractor and Subcontractors will be responsible for their own cleanup as specified and removal of their own debris. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.
- E. Do not throw waste material and rubbish down from upper levels.
- F. Hammer in or bend over flush with the wood protruding nails in boards, planks, timbers, etc.
- G. Dispose of hazardous wastes in accordance with applicable laws and regulations.
- H. Promptly remove from the work area all waste materials and rubbish resulting from the performance of the work. Clean up on a day-to-day basis throughout the construction period.
- I. Perform continuous clean-up of flammable debris to prevent accumulation.
- J. Contractors and Subcontractors shall provide for the removal of stains and overages caused by operations, such as mastics, mortar, concrete, joint compounds, paint, caulking, etc.

- K. The Contractor shall provide periodic broom cleaning of project areas using sweeping compound as required to prevent airborne dust.
- L. The Architect may require the Contractor to broom clean any area or areas of the project at any time he feels there is excess dust or dirt, which inconveniences building occupants or finishing operations.
- M. If the premises and the site are not maintained properly at all times, the Owner may have any accumulation of waste materials or trash removed and charge the cost to the Contractor who is responsible.
- N. In addition to cleaning above, each Contractor or Subcontractor shall thoroughly clean and vacuum floors prior to the installation of the finish flooring, such as sealing exposed slabs, ceramic or quarry tile, sheet vinyl flooring, V.C.T., carpet, etc.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle plastic coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

- D. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of owner personnel.
- E. 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.
- 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 that specified in individual sections.

3.12 ADJUSTING

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

3.13 FINAL CLEANING

- A. At Completion of the Work promptly remove tools, equipment, machinery, and surplus materials from the Project site.
- B. The Masonry Trade Contractor is responsible for final cleaning of all masonry surfaces.
- C. Use cleaning materials that are nonhazardous.
- D. Leave all surfaces broom clean and ready for final cleaning unless otherwise required by the Specifications.
- E. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- F. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- G. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- H. The Mechanical Contractor shall clean all ductwork and grills (in and out), and polish all plumbing fixtures, trim, etc.
- I. If air handling equipment is operated during construction, filters for air handling equipment shall be replaced or thoroughly cleaned according to manufacturer's instructions, by the HVAC contractor. Clean filters of operating equipment.
- J. The electrical subcontractor shall wash, vacuum, dust or otherwise clean light fixtures and other electrical work in finished spaces as necessary to remove all stains, dust and dirt. Other electrical equipment in mechanical rooms, transformer vaults, switch gear rooms, and similar unfinished spaces shall be left "broom clean". Burned out lamps shall be replaced.
- K. All areas within lights, ducts, chases and other items, areas or equipment which will be "closed up" by the Contractor, as a part of the work of their contract, shall be thoroughly cleaned by the Contractor prior to closing up.
- L. Clean debris from roofs, gutters, downspouts, and drainage systems.
- M. Clean site; sweep paved areas, rake clean landscaped surfaces.
- N. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.
- O. The Contractor shall arrange for professional cleaners or experienced workmen for other final cleaning, to remove dust, dirt, finger prints and labels from all interior and exterior surfaces and to polish glossy surfaces to a clear shine.
- P. The Work shall be maintained in a clean condition until the Architect determines that the Project is substantially complete.

- Q. Cleaning required by subsequent work done after Substantial Completion shall be carried out by the Contractor or Subcontractor of the required work and shall be accomplished prior to Final Completion.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Notify Architect when work is considered ready for Substantial Completion.
 - 1. When the Work is considered Substantially Complete, as defined in the General Conditions THE PRIME OR PRIME TRADE CONTRACTOR shall submit to the Architect:
 - a. A written notice that the Work, or designated portion thereof, is substantially complete.
 - b. A list of items to be completed or corrected.
 - 2. Within a reasonable time after receipt of such notice, Architect will make a pre-final inspection to determine the status of completion.
 - 3. Should the Architect determine that the Work is not Substantially Complete:
 - a. Architect will promptly notify the Contractor in writing, giving the reasons therefor.
 - b. Contractor will remedy the deficiencies in the Work, and send a second written notice of Substantial Completion to the Architect.
 - c. The Architect will re-inspect the Work.
- C. Should the Architect determine that the Work is not Substantially Complete:
 - 1. Architect will promptly notify the Contractor in writing, giving the reasons therefor.
 - a. Contractor will remedy the deficiencies in the Work, and send a second written notice of Substantial Completion to the Architect.
 - b. The Architect will re-inspect the Work.
 - c. When the Architect finds that the Work of all Contractors is Substantially Complete, the Architect will execute and deliver to Certificates of Substantial Completion to the Prime contractor with a revised list of items to be completed or corrected before final payment.
- D. Submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's review.
- E. Correct items of work listed in executed Certificates of Substantial Completion and comply with requirements for access to Owner-occupied areas.
- F. Notify Architect when work is considered finally complete.
 - 1. When the Work is considered complete, submit written certification to the Architect along with a copy of the punch list confirming completion of each individual item listed, that:
 - a. Contract Documents have been reviewed.
 - b. Work has been inspected for compliance with Contract Documents.
 - c. Work has been completed in accordance with Contract Documents.
 - d. Equipment and systems have been tested in the presence of the Owner's Representative and are operational.
 - e. Work is clean and ready for final inspection.
 - 2. Upon receipt of the above certification, the Architect/Engineer shall set a date for final inspection to be made only when the project is complete and when all deficiencies of the pre-final inspection have been corrected.
 - 3. One week prior to this date, the Architect will inform the Owner and contractors of this inspection in writing.
 - 4. Immediately following this inspection, the Architect shall prepare a written report listing the names of all persons present at the inspection and the Architect shall prepare a punch list of all deficiencies for completion and correction. Copies of this report will be provided to the Owner, General contractor and the bonding company.

5. Should Architect consider that the Work is incomplete or defective:
 - a. Architect will promptly notify the Contractor or Contractors in writing, listing the incomplete or defective work.
 - b. Contractor will take immediate steps to correct the stated deficiencies, and send a second written certification to Architect that the Work is complete.
 - c. Architect will re-inspect the Work.
 - d. Contractor or Contractors will be responsible for any re-inspection cost incurred by Owner due to the necessity of the Architect's re-inspection.
- G. Final Completion:
1. Test Reports and Certificates: Provide all test reports and certificates required in the technical sections, prior to final payment. Provide a check list of required reports and certificates, by Specifications sections.
 2. Retention of Records: Retain all records as required by law and good business practice.
 3. Remove all temporary utilities as the job progress permits.
 4. Temporary Facilities: As the job progresses and facilities are no longer needed, they shall be removed by the Contractor. Prior to final payment, remove temporary sheds, fences, barricades, surplus materials, debris and other material or items not part of the Project.
- H. Closeout Submittals:
1. When the Owner has determined that the Work is acceptable under the Contract Documents and the Contract fully performed, Contractor shall prepare and submit final Application for Payment to the Architect together with the following:
 - a. Insurance: Refer to Section 00 73 00.
 - 1) The specified Property Insurance (Multiple Peril Builder's Risk) shall be maintained until final acceptance by the Owner of the entire Project.
 - b. Contractor's Affidavit of Payment of Debts and Claims, AIA Document G706.
 - c. Consent of surety to final payment of Consent of Surety Company to Final Payment, AIA Document G707. The Consent of the Surety Company must be obtained prior to any reduction of retained percentage and prior to final payment.
 - d. North Dakota Department of Revenue "Withholding Affidavit for Contractors" document IC-134, fully completed and certified.
 - e. Evidence of Compliance with requirements of governing authorities:
 - 1) Certificate of Inspection from all required agencies and departments.
 - 2) Certificate of Occupancy.
 - f. Operating and Maintenance Data, Instructions to Owner's Personnel.
 - g. Warranties and Bonds.
 - h. Project Record Documents.
 - i. Special tools required for Owner maintenance.
 2. Submit four copies each of Items "b" and "c" above, and two copies each of Items "a" and "d" through "f".
- I. Complete items of work determined by Architect's final inspection.
- J. Final Adjustment of Accounts:
1. Submit a Final Statement of accounting to the Architect.
 2. Reflect all adjustments to the Contract Sum in the statement as follows:
 - a. The original Contract Sum.
 - b. Additions and deductions resulting from:
 - 1) Previous Change Orders
 - 2) Unit Prices.
 - 3) Deductions for uncorrected Work.
 - 4) Deductions for Re-inspection Payments.
 - 5) Other Adjustments.
 - c. Total Contract Sum, as adjusted.

- d. Previous Payments.
- e. Sum Remaining Due.
- 3. Submit the final Application for Payment in accordance with procedures and requirements stated in the Conditions of the Contract.
- K. Corrective Work & Follow-Up Inspections: The Owner shall notify the Contractor of required corrective work after completion, and the Contractor shall actively supervise such Work. The Institution shall not be inconvenienced as to prompt service and/or corrections by the Contractor that may be necessary.

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- C. Individual Product Sections: Specific requirements for operation and maintenance data.
- D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Prepare data in the form of an instructional manual for use by the Owner's personnel.
 - 2. Format shall conform to the following:
 - a. Size 8-1/2" x 11"
 - b. Text: Manufacturer's printed data, or neatly typewritten.
 - c. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - 1) Title of Project
 - 2) Identity of separate structure as applicable.
 - 3) Identity of general subject matter covered in the manual.
 - d. Provide fly-leaf for each separate product, or each piece of operating equipment.
 - 1) Provide typed description of product, and major component parts of equipment.
 - 2) Provide indexed tabs.
 - e. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - 1) Title of Project
 - 2) Identity of separate structure as applicable.
 - 3) Identity of general subject matter covered in the manual.
 - 3. Binders
 - a. Commercial quality three-ring binders with durable and cleanable plastic covers.
 - b. When multiple binders are used, correlate the data into related consistent groupings.
- C. Content of Manual:
 - 1. Arrange neatly a typewritten table of contents for each volume, in the following systematic order.
 - a. Trade Contractor, name of responsible principal, address and telephone number.
 - b. A list of each product required to be included, indexed to the content of the volume.
 - c. List, with each product, the name, address and telephone number of:
 - 1) Trade Contractor or installer
 - 2) Maintenance contractor, as appropriate
 - 3) Identify the area of responsibility of each
 - 4) Local source of supply for parts and replacement

- d. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 2. Product Data
 - a. Include only those sheets which are pertinent to the specific product.
 - b. Annotate each sheet to:
 - 1) Clearly identify the specific product or part installed.
 - 2) Clearly identify the data applicable to the installation.
 - 3) Delete references to inapplicable information.
 3. Written text, as required to supplement product data for the particular installation:
 - a. Organize in a consistent format under separate headings for different procedures.
 - b. Provide a logical sequence of instructions for each procedure.
 - c. Do not use Project Record Documents as maintenance drawings.
 4. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 5. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 6. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 7. Submit two sets of revised final documents in final form within 10 days after final inspection.
- D. Warranties and Bonds:
1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.
 4. Copy of each warranty, bond and service contract issued.
 - a. Provide information sheet for Owner's personnel, give:
 - 1) Proper procedures in the event of failure.
 - 2) Instances which might affect the validity of warranties or bonds.
 - b. Provide a logical sequence of instructions for each procedure.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 1. Drawings.
 2. Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
 7. Architect/Engineer Field Orders or written instructions.
 8. Field test records.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress.
- E. Maintain record documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.

- F. Make record documents and samples available at all times for inspection by Architect and/or Owner.
- G. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 - 1. Manufacturer's name and product model and number.
 - 2. Product substitutions or alternates utilized.
 - 3. Changes made by Addenda and modifications.
- H. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 - 1. Measured depths of foundations in relation to finish first floor datum.
 - 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4. Field changes of dimension and detail.
 - 5. Changes made by Field Order or by Change Orders.
 - 6. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
 - 2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- C. Include color coded wiring diagrams as installed.
- D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- E. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

- F. Provide servicing and lubrication schedule, and list of lubricants required.
- G. Include manufacturer's printed operation and maintenance instructions.
- H. Include sequence of operation by controls manufacturer.
- I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- J. Provide control diagrams by controls manufacturer as installed.
- K. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- N. Include test and balancing reports.
- O. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- B. Prepare data in the form of an instructional manual.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.
- G. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- H. Arrange content by systems under section numbers and sequence of Table of Contents of this Project Manual.
- I. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:
 - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
 - 2. 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:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - 3. Part 3: Project documents and certificates, including the following:
 - a. Shop drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.

- d. Photocopies of warranties and bonds.
- J. Provide a listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.
- K. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect, Consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

1.02 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 SCOPE

- A. Remove portions of existing buildings in the following sequence:
 - 1. Perform demolition as required by the construction sequence.
- B. Remove other items indicated, for salvage, relocation, and recycling.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 3. Provide, erect, and maintain temporary barriers and security devices.
 - 4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
 - 5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 6. Do not close or obstruct roadways or sidewalks without permit.
 - 7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- E. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- F. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.

- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as shown.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
 - 1. Provide, erect, and maintain temporary dustproof partitions of steel stud construction and polyethylene covering.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; 2010.
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute; 2010.

1.04 DESIGN REQUIREMENTS

- A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements; resultant concrete to conform to required shape, line and dimension.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 347, ACI 301, and ACI 318.

1.06 REGULATORY REQUIREMENTS

- A. Conform to applicable code for design, fabrication, erection and removal of formwork.

PART 2 PRODUCTS

2.01 FORMWORK - GENERAL

- A. Provide concrete forms, accessories, shoring, and bracing as required to accomplish cast-in-place concrete work.
- B. Design and construct to provide resultant concrete that conforms to design with respect to shape, lines, and dimensions.
- C. Comply with applicable State and local codes with respect to design, fabrication, erection, and removal of formwork.

2.02 WOOD FORM MATERIALS

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

2.03 REMOVABLE PREFABRICATED FORMS

- A. Preformed Steel Forms: Minimum 16 gage matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- B. Preformed Plastic Forms: Thermoplastic polystyrene form liner, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

2.04 FORMWORK ACCESSORIES

- A. Form Ties: Removable type, galvanized metal, fixed length, cone type, with waterproofing washer, free of defects that could leave holes larger than 1 inch in concrete surface.
- B. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bug holes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
- C. Form Release Agent: Colorless mineral oil that will not stain concrete, absorb moisture, impair natural bonding of concrete finish coatings, or affect color characteristics of concrete finish coatings.
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with drawings.

3.02 ERECTION - FORMWORK

- A. Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of ACI 301.
- B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.
- D. Align joints and make watertight. Keep form joints to a minimum.

3.03 APPLICATION - FORM RELEASE AGENT

- A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

3.04 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for items to be embedded in passing through concrete work.
- B. Locate and set in place items that will be cast directly into concrete.
- C. Coordinate with work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.
- D. Install accessories in accordance with manufacturer's instructions, so they are straight, level, and plumb. Ensure items are not disturbed during concrete placement.

3.05 FORM CLEANING

- A. Clean forms as erection proceeds, to remove foreign matter within forms.
- B. Clean formed cavities of debris prior to placing concrete.
 - 1. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
 - 2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.06 FORMWORK TOLERANCES

- A. Construct formwork to maintain tolerances required by ACI 117, unless otherwise indicated.

3.07 FORM REMOVAL

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

- B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

END OF SECTION

**SECTION 03 20 00
CONCRETE REINFORCING**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2010.
- B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2011.
- C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
- D. ASTM A185/A185M - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete; 2007.
- E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2013.
- F. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2011.
- G. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2009.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Comply with requirements of ACI SP-66. Include bar schedules, shapes of bent bars, spacing of bars, and location of splices.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301.
- B. Welders' Certificates: Submit certifications for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M Grade 60 (60,000 psi).
 - 1. Deformed billet-steel bars.
 - 2. Unfinished.
- B. Reinforcement Accessories:
 - 1. Tie Wire: Annealed, minimum 16 gage.
 - 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.02 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice.
- B. Welding of reinforcement is permitted only with the specific approval of Architect. Perform welding in accordance with AWS D1.4.
- C. Locate reinforcing splices not indicated on drawings at point of minimum stress.

PART 3 EXECUTION

3.01 PLACEMENT

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

END OF SECTION

SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete for replacing existing areas shown on drawings.
- B. Concrete curing.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 01 – Masonry Veneer: Work related.
- B. Section 07 90 05 - Joint Sealers: Sealants for saw cut joints and isolation joints in slabs.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- B. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (errata 2007).
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- E. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- F. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- G. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
- H. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- J. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2013.
- K. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2012.
- L. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- M. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- N. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.
- O. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2012.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Submit concrete mix design to the Architect for approval
- C. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- D. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- E. Submit color chart for Parge Coating color selection.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Follow recommendations of ACI 305R when concreting during hot weather.

- C. Follow recommendations of ACI 306R when concreting during cold weather.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Comply with requirements of Section 03 10 00.

2.02 REINFORCEMENT

- A. Comply with requirements of Section 03 20 00.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150, Type I - Normal Portland type.
- B. Fine and Coarse Aggregates: ASTM C 33.
 - 1. Course Aggregate Material: Strong, clean crushed granite or limestone gravel, are subject to approval as to use, other inert material having similar characteristics, free from adherent coatings and injurious amount of friable or fragile pieces, flake organic matter, or other deleterious substances, all meeting the following gradation requirements:
 - a. 3/8" or as recommended by concrete contractor.
 - 2. Fine Aggregate Material: Clean, strong, natural are subject to approval and authorization as to use, other inert material suitable for the work to be done, having characteristics similar to natural sand, free of frozen materials, all meeting the following grading limits:
 - a. Passing No. 4 Sieve: 95% to 100%
 - b. Passing No. 14 Sieve: 45% to 80%
 - c. Passing No. 50 Sieve: 10% to 30%
 - d. Passing No. 100 Sieve: 2% to 10%
- C. Fly Ash: ASTM C618, Class F.
- D. Silica Fume: ASTM C1240, proportioned in accordance with ACI 211.1.
- E. Water: Clean and not detrimental to concrete.
- F. Fiber Reinforcement: Synthetic fiber shown to have long-term resistance to deterioration when exposed to moisture and alkalis; 3/4 inch length.
 - 1. Acceptable Products:
 - a. Honeywell - Caprolan - RC.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C 260 to produce Air Entrainment of between 5% to 7%. None - N/A Air entrainment admixture shall be used in strict accordance with the manufacturers recommendations and shall be one of the following or approved equal:
 - 1. W.R. Grace - Darex AEA
 - 2. Protex Industries - Pro-Air
 - 3. W.R. Meadows - Sealtight Air Entrainment Agent
 - 4. Sika - Sika AER
 - 5. Euclid - Air Mix
- C. Chemical Admixtures: ASTM C 494/C 494M, Type A - Water Reducing.
 - 1. Provide products manufactured by Sika Corporation or The Euclid Chemical Company.
 - 2. Water reducing admixtures are required for concrete slabs on grade to produce a water to cement ratio of 0.45. Submit manufacturer's literature for the specific water reducing admixture to be provided based on mix designers experience for results to be achieved based on specific conditions of the concrete pour.

2.05 ACCESSORY MATERIALS

- A. Moisture-Retaining Cover: ASTM C171; clear polyethylene.

- B. Parge Coating as/if needed, applicable— Portland-cement based coating for concrete and masonry. Where noted on the drawings.
 - 1. Manufacturer: BASF Corporation Construction Systems, 800-433-9517
master-builders-solutions.basf.us
 - 2. Product:
 - a. Standard Coating: MasterSeal 581 by BASF Corporation
 - b. Color to be determined by Architect.

2.06 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Furnish the following types of concrete:
 - 1. Concrete - 1" aggregate, 4000 psi, air entrained.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- D. Fiber Reinforcement: Add to mix at rate of 1 pound per cubic yard.

2.07 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.
- B. Parge Coating: Mix material per manufacturer instructions allowing material to rest 10 minutes before remixing and application.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- B. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- C. Parge Coating: Ensure that substrates are sound and free of dust, dirt, laitance, paints, oils, grease, curing compounds, and other contaminants.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Architect not less than 24 hours prior to commencement of placement operations.
- D. Ensure reinforcement, inserts, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- E. Finish floors level and flat, unless otherwise indicated, within the tolerances specified below.

3.04 SLAB JOINTING

- A. Locate joints as indicated on the drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.
- D. Separate slabs from vertical surfaces with bond breaker.
- E. Apply sealants in joint devices in accordance with Section 07 90 05.
- F. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

3.05 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 - 1. Smooth Rubbed Finish: Wet concrete and rub with carborundum brick or other abrasive, not more than 24 hours after form removal.

3.06 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than 7 days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Parge Coating: Do not apply in rain or when rain is expected within 24 hours. Do not apply above 90 degrees F (32 degrees C) or below 40 degrees F (4 degrees C) or when temperatures are expected to fall below 40 degrees F (4 degrees C) within 24 hours. For hot and cold temperature applications, store materials and water at 50 degrees F (10 degrees C) to 70 degrees F (21 degrees C) before use.

3.07 FIELD QUALITY CONTROL

- A. Provide free access to concrete operations at project site and cooperate with appointed firm.
- B. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- C. Tests of concrete and concrete materials may be performed at any time to ensure conformance with specified requirements.
- D. Compressive Strength Tests: ASTM C39/C39M. For each test, mold and cure three concrete test cylinders. Obtain test samples for every 50 cu yd or less of each class of concrete placed.
- E. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.
- G. Slab Moisture Content: Test concrete slabs on grade in accordance with ASTM F2170 - 02, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes. Flooring materials shall not be installed over floors with a relative humidity greater than 80%.
- H. Parge Coating to be installed at Project site or pre-selected area of building as an area for field sample, as directed by Architect.
- I. Apply Parge Coating material in strict accordance with manufacturer's written application instructions.

END OF SECTION

**SECTION 04 20 01
MASONRY VENEER**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- B. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- D. ASTM A951/A951M - Standard Specification for Steel Wire for Masonry Joint Reinforcement 2016, with Editorial Revision (2018).
- E. ASTM C55 - Standard Specification for Concrete Building Brick 2017.
- F. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2020.
- G. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
- H. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale) 2019.
- I. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
- J. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete 2016.
- K. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2017.
- L. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.
- M. BIA Technical Notes No. 46 - Maintenance of Brick Masonry 2017.
- N. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

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

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, and mortar.
- C. Samples: Submit four samples of decorative block units to illustrate color, texture, and extremes of color range.

1.06 QUALITY ASSURANCE

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

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

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.
- B. Handle and store ceramic glazed masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

1.08 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 BRICK UNITS

- A. Manufacturers: Design intent is to match that of existing conditions, see drawings.
 1. Endicott Clay Products Co; Face Brick: www.endicott.com/#sle.
 2. General Shale Brick: www.generalshale.com/#sle.
 3. Meridian Brick LLC: www.meridianbrick.com/#sle.
 4. Metro Brick: www.metrothinbrick.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
- B. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.
- C. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi) yield strength, deformed billet bars; galvanized.
- B. Joint Reinforcement Type: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- C. Joint Reinforcement Standard: ASTM A951/A951M.
- D. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 3. Vertical adjustment: Not less than 3-1/2 inches.

2.04 FLASHINGS

- A. Metal Flashing Materials:
 1. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gauge, 0.0187 inch thick; finish 2B to 2D.
- B. Membrane Asphaltic Flashing Materials:
 1. Rubberized Asphalt Flashing: Self-adhering polymer modified asphalt sheet; 40 mils (0.040 inch) minimum total thickness; 8 mil cross-laminated polyethylene bonded to adhesive rubberized asphalt, with a removable release liner.

2.05 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.

- B. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self-expanding; in maximum lengths available.
- C. Building Paper: ASTM D226/D226M, Type I ("No. 15") asphalt felt.
- D. Weeps:
 - 1. Type: Preformed aluminum vents with sloping louvers.
- E. Cavity Vents:
 - 1. Type: Polyester mesh.
- F. Drainage Fabric: Polyester mesh bonded to a water and vapor-permeable fabric.
- G. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR AND GROUT MIXING

- A. Mortar for Unit Masonry: ASTM C270, Proportion Specification.
- B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Brick Units: Design intent is to match that of existing conditions, including all accessories for masonry, etc. See drawings.
 - 1. Bond: Running.
 - 2. Coursing: Three units and three mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.03 PLACING AND BONDING

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

3.04 WEEPS/CAVITY VENTS

- A. Install weeps in veneer walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.
- B. Install cavity vents in veneer walls at 32 inches on center horizontally below shelf angles and lintels and at top of walls.

3.05 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

3.06 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.07 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

3.08 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.09 TOLERANCES

- A. Install masonry within the site tolerances found in TMS 402/602.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- D. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

3.10 CUTTING AND FITTING

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

3.11 CLEANING

- A. Clean soiled surfaces with cleaning solution.

3.12 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

**SECTION 05 50 00
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items.

1.02 RELATED REQUIREMENTS

- A. Section 04 20 01 – Masonry Veneer: Placement of metal fabrications in masonry.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- E. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2018.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2014, with Editorial Revision (2017).
- H. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021.
- I. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing 2014.
- J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- K. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes 2019a.
- L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.
- M. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).
- N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- P. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).
- Q. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
- R. SSPC-SP 2 - Hand Tool Cleaning 2018.

1.04 SUBMITTALS

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

- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- F. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

- A. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of / and as shown on drawings; prime paint finish.
- B. Lintels: As detailed; prime paint finish.

2.04 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prime Painting: One coat.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.

- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

**SECTION 06 10 00
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-structural dimension lumber framing.
- B. Rough opening framing for doors, windows, and roof openings.
- C. Wall and roof sheathing.
- D. Preservative treated wood materials.
- E. Miscellaneous framing and sheathing.
- F. Communications and electrical room mounting boards.
- G. Concealed wood blocking for support of wall mounted accessories, etc.

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers.

1.03 REFERENCE STANDARDS

- A. AFPA (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; American Forest and Paper Association; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
- E. AWPA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2012.
- F. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; National Institute of Standards and Technology, U.S. Department of Commerce; 2010.
- G. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology, Department of Commerce; 2010.
- H. WWPA G-5 - Western Lumber Grading Rules; Western Wood Products Association; 2011.
- I. International Building Code and the State of Minnesota Building Code.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials and fire treated materials.
- C. Structural Composite Lumber: Submit manufacturer's published structural data including span tables, marked to indicate which sizes and grades are being used; if structural composite lumber is being substituted for dimension lumber or timbers, submit grading agency structural tables marked for comparison.

1.05 QUALITY ASSURANCE

- A. Lumber: Comply with PS 20 and approved grading rules and inspection agencies.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. 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.
- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Grading Agency: Western Wood Products Association (WWPA).
- B. Sizes: Nominal sizes as indicated on drawings, S4S.
- C. Moisture Content: S-dry or MC19.
- D. Dimensional Lumber for framing (2x4 and 2x6 as required):
 - 1. Species: Spruce, Pine, Fir.
 - 2. Grade: No. 2 or better, with minimum design values as shown on drawings.
- E. Dimensional Lumber (2x8, 2x10, 2x12 as required):
 - 1. Species: Douglas Fir or Southern Yellow Pine
 - 2. Grade: No. 2, with minimum design values as shown on drawings.
- F. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.
- G. Miscellaneous Blocking, Furring, and Nailers:
 - 1. Lumber: S4S, No. 2 or Standard Grade.

2.03 CONSTRUCTION PANELS

- A. Subfloor/Underlayment Combination: Any PS 2 type, rated Single Floor.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 48.
 - 3. Performance Category: 1-1/8 PERF CAT.
 - 4. Thickness: 3/4 inches, nominal.
- B. Roof Sheathing: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Structural 1 Sheathing.
 - 2. Bond Classification: Exposure 1.
 - 3. Span Rating: 32/16.
 - 4. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 500 days.
 - 5. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
 - 6. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
- C. Wall Sheathing: Oriented strand board wood structural panel; PS 2.
 - 1. Grade: Structural 1 Sheathing.
 - 2. Bond Classification: Exposure 1.
 - 3. Performance Category: 5/8 PERF CAT.
 - 4. Span Rating: 40/20.
 - 5. Edges: Square.
 - 6. Exposure Time: Sheathing will not delaminate or require sanding due to moisture absorption from exposure to weather for up to 500 days.

7. Provide fastening guide on top panel surface with separate markings indicating fastener spacing for 16 inches and 24 inches on center, respectively.
 8. Warranty: Manufacturer's standard lifetime limited warranty against manufacturing defects and that panels will not delaminate or require sanding due to moisture absorption damage from exposure to weather for up to the stated period.
- D. 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.
- E. Other Applications:
1. Other Locations: PS 1, C-D Plugged or better.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
1. Metal and Finish: Hot-dipped galvanized steel per ASTM A 153/A 153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Die-Stamped Connectors: Hot dipped galvanized steel, sized to suit framing conditions.
1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing per ASTM A653/A653M.
- C. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
- D. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls. Provide Sill Sealer manufactured by Certainteed.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Fire Retardant Treatment: AWPA Treatment C27 for plywood, Interior Type A Low Temperature (low hygroscopic), chemical treatment pressure impregnated; capable of providing a maximum flame spread/smoke development rating of 25 or less / 25 or less. Provide Dricon manufactured by Hickson Corporation or approved equal.
- C. Preservative Pressure Treatment of Lumber above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 lb/cu ft retention.
1. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - a. Treat lumber in contact with roofing, flashing, or waterproofing.
 - b. Treat lumber in contact with masonry or concrete.
 - c. Treat lumber less than 18 inches above grade.
 - d. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
 - 1) Kiln dry plywood after treatment to maximum moisture content of 19 percent.
 - 2) Treat plywood in contact with roofing, flashing, or waterproofing.
 - 3) Treat plywood in contact with masonry or concrete.
 - 4) Treat plywood less than 18 inches above grade.
- D. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative to 0.4 lb/cu ft (6.4 kg/cu m) retention.
- E. Preservative Pressure Treatment of Critical Structural Members in Contact with Soil: AWPA Use Category UC6A, Commodity Specification A (Treatment C2) using waterborne preservative to 0.6 lb/cu ft retention.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION - GENERAL

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

3.03 FRAMING INSTALLATION

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- D. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- E. Install structural members full length without splices unless otherwise specifically detailed.
- F. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AFPA Wood Frame Construction Manual.
- G. Install horizontal spanning members with crown edge up and not less than 1-1/2 inches of bearing at each end.
- H. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- I. Provide bridging at joists in excess of 8 feet span as detailed. Fit solid blocking at ends of members.
- J. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In 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.
- C. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- D. Specifically, provide the following non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.

3.05 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

- B. Provide miscellaneous members as indicated or as required to support finishes, fixtures, specialty items, and trim.

3.06 INSTALLATION OF ACCESSORIES AND MISCELLANEOUS WOOD

- A. Place sill gasket directly on cementitious foundation. Puncture gasket cleanly and fit tightly to protruding foundation anchor bolts.
- B. All finished work shall be scribed and coped as required for an accurate fit and erected plumb, true square and in accordance with the drawings. Correlate location of nailers, blocking grounds and similar supports to allow proper attachment or other work. All work shall be secured in place with screws or nails as required. Countersink and fill all nail and screw heads exposed to view.
- C. This Contractor shall furnish and install all nails, spikes, screws, bolts and other similar items of rough hardware required in the progress of his work and shall install all items of finish hardware furnished by others.
- D. As finish hardware is delivered, this Contractor shall check all items against approved hardware listing and assume full responsibility for same until completion of building. He shall inspect the work of other trades which are to receive hardware and report in writing any defects found in same before installing. Installation of any hardware by this contractor shall imply his acceptance of the work of others.

3.07 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension parallel to wall studs, with ends over firm bearing using nails. Stagger vertical joints at least one stud space. Allow 1/8" spacing at panel ends and edges. Attach APA rated wall sheathing to framing members with 6d common nails spaced 6" on center at the edges and 12" on center at intermediate supports.
- B. Roof Sheathing: Install APA rated roof sheathing with long dimension at right angles to framing members. Stagger end joints at each alternate course. Allow 1/8" spacing at panel ends and edges. Attach APA rated roof sheathing to decking members with 10d common nails spaced 4" on center at the edges, 6" on center at supports, and 12" on center throughout the field of the panel.
- C. 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.

END OF SECTION

**SECTION 06 20 00
FINISH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ANSI A135.4 - Basic Hardboard 2012 (R2020).
- C. ANSI A208.1 - American National Standard for Particleboard 2016.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- F. ASTM C1036 - Standard Specification for Flat Glass 2016.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- I. AWI (QCP) - Quality Certification Program Current Edition.
- J. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).
- K. AWMAC (GIS) - Guarantee and Inspection Services Program Current Edition.
- L. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
- M. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
- N. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- O. GSA CID A-A-1936 - Adhesive, Contact, Neoprene Rubber 1996a (Validated 2013).
- P. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- Q. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- R. NHLA G-101 - Rules for the Measurement & Inspection of Hardwood & Cypress 2015.
- S. PS 1 - Structural Plywood 2009 (Revised 2019).
- T. PS 20 - American Softwood Lumber Standard 2020.
- U. WDMA I.S. 4 - Industry Specification for Preservative Treatment for Millwork 2015a.
- V. WI (CCP) - Certified Compliance Program (CCP) Current Edition.
- W. WI (CSIP) - Certified Seismic Installation Program (CSIP) Current Edition.
- X. WI (MCP) - Monitored Compliance Program (MCP) Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with plumbing rough-in, electrical rough-in, installation of associated and adjacent components, and related.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.
 - 2. Provide data on fire retardant treatment materials and application instructions.
 - 3. Provide instructions for attachment hardware, finish hardware, and related.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
 - 3. Include certification program label.
- D. Samples: Submit two samples of wood trim 6 inches long or as standard practice.

1.06 QUALITY ASSURANCE

- A. Fabricators:
 - 1. Perform work in accordance with Woodwork Institute Manual of Millwork, grades as indicated.
- B. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Quality Certification:
 - 1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
 - 2. Provide labels or certificates indicating that the work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.07 MOCK-UP

- A. Locate where directed.
- B. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
- B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- C. Protect from moisture damage.
- D. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

2.02 WOOD-BASED COMPONENTS

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

2.03 LUMBER MATERIALS

- A. Hardwood Lumber: indicated species, plain sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

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FINISH CARPENTRY

2.04 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Adhesive for factory-fabricated units: Manufacturer's recommended adhesive for application.
- C. Fasteners: Of size and type to suit application; standard finish in concealed locations and standard finish in exposed locations.
- D. Concealed Joint Fasteners: Threaded steel, or hardwood biscuits.

2.05 ACCESSORIES

- A. Lumber for Shimming, Blocking, and furring: Softwood lumber of indicated species.
- B. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 FABRICATION

- A. All shall be fabricated in accordance with Architectural Woodwork Standards 1st edition.
- B. Shop assemble work for delivery to site, permitting passage through building openings.
- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- D. Door frames for all doors shall be fabricated to AWI Quality Standards Section 9, Custom Grade.

2.07 SHOP FINISHING

- A. Apply wood filler in exposed nail and screw indentations.
- B. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- C. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
- D. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.
- C. See Section 06 10 00 for installation of recessed wood blocking.

3.02 INSTALLATION

- A. Install custom fabrications in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. All finished work shall be scribed and coped as required for an accurate fit and erected plumb, true, square and in accordance with the drawings. Correlate location of nailers, blocking grounds and similar supports to allow proper attachment or other work. All work shall be secured in place with screws or nails as required. Countersink and fill all nail and screw heads exposed to view.
- E. This Contractor shall furnish and install all nails, spikes, screws, bolts and other similar items of rough hardware required in the progress of his work and shall install all items of finish hardware furnished by others.

- F. Install moldings to the following standards:
1. Moldings to receive transparent finish shall be selected for compatibility of grain and color.
 2. No warped or twisted molding shall be allowed.
 3. All moldings to be set plumb, level and true.
 4. Moldings and trim shall be installed in maximum lengths possible to minimize joints.
 5. All field joints to be tightly fitted and flush.
 6. Field joints in running trim to be diagonal ("scarfed") joints.
 7. Exposed ends of running trim shall have profiled or self-mitered returns.
 8. All exposed fastenings (nails or trim head screws) shall be deep set.
 9. Miters on large members (4" or larger) shall be doweled or splined and glued.
 10. Blind nailing and concealed type fasteners to be used whenever possible.
 11. Cope or miter inside corners where applicable, to produce tight fitting joints.
 12. Miter outside joints to produce tight fitting joints.
- G. Install indicated items as shown on drawings, level and plumb.
- H. Install hardware in accordance with manufacturer's instructions.

3.03 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

**SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops & window sills.
- C. Cabinet Hardware.
- D. Solid Surface Fabrications

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 06 20 00 - Finish Carpentry: Related work.

1.03 REFERENCE STANDARDS

- A. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1 2017, with Errata (2019).
- B. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- C. GSA CID A-A-1936 - Adhesive, Contact, Neoprene Rubber 1996a (Validated 2013).
- D. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.
- C. Product Data: Provide data for hardware accessories.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
- B. Perform work in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Custom quality, unless other quality is indicated for specific items.

1.07 MOCK-UP

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Wood Veneer Faced Cabinets with Flush Door/Drawer Panels & Stile and Rail Wood Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Wood.
 - 2. Finish - Exposed Interior Surfaces: Wood.
 - 3. Finish - Concealed Surfaces: Wood.
 - 4. Door and Drawer Front Edge Profiles:
 - a. Wood Veneer Faced Flush Cabinets: Square edge with 1/8" applied solid wood edge-banding.
 - b. Wood Stile and Rail Cabinets: Profiles as indicated in schedule.
 - 5. Casework Construction Type: Type A - Frameless.
 - 6. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
 - 7. Cabinet Style: Flush overlay.
 - 8. Cabinet Doors and Drawer Fronts:
 - a. Wood Veneer Faced Flush Cabinets: Flush Style.
 - b. Wood Stile and Rail Cabinets: Profiles as indicated in schedule.
 - 9. Drawer Side Construction: Multiple-dovetailed.
 - 10. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

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

2.03 PANEL MATERIALS

- A. Medium Density Fiberboard (MDF): ANSI A208.2; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated; composed of wood fibers pressure bonded with moisture resistant adhesive to suit application; sanded faces; thickness as required.
- B. Particleboard: ANSI A208.1; type as specified in AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, composed of wood chips, medium density, made with moisture resistant; of grade to suit application; sanded faces.

2.04 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Arborite; ColorEdge: www.arborite.com/#sle.
 - 2. Formica Corporation: www.formica.com/#sle.
 - 3. Panolam Industries International, Inc; Nevamar Standard HPL: www.panolam.com/#sle.
 - 4. Wilsonart LLC: www.wilsonart.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as indicated.
 - 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
 - 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as indicated, finish as indicated.
 - 3. Flame Retardant Surfaces: HGF, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.

4. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors as indicated, finish as indicated, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.05 COUNTERTOPS

- A. Quality Standards: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) OR AWMAC/WI.
- B. Plastic Laminate Countertops: Medium density fiberboard substrate covered with HPDL, conventionally fabricated with 3mm PVC edge-banding.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 1. Flat Sheet Thickness 1/2" (12 mm).
 2. Solid Surfacing Sheet & Plastic Resin Castings: Complying with ISFA 201 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. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 4. Other Components Thickness: 1/2" minimum.
 5. Edges, Backs and End Splashes: Same sheet material, square top, minimum 4 inches high.
 6. Fabricator and installer must follow the DuPont Corian Solid Surface Commercial Food Service Technical Bulletin where applicable.

2.06 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
 1. GSA CID A-A-1936 contact adhesive.
- B. 3mm PVC banding, machine applied with waterproof hot melt adhesive with external edges and outside corners of doors and drawer fronts, and countertops, machine profiled to 1/8" radius for safety.
- C. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- D. Grommets: plastic material for cut-outs. Outwater Plastics #35-3 or equal, 3 inch diameter grommet.
- E. Steel Angle Support for wide openings in countertops shall be 3/4 x 3/4 x 1/8 inch steel angles.
- F. Counter Support Brackets: Metal angle support brackets with 3" x 3" x 45 degree notch at the wall for wall cleat and wire run clearance. Brackets shall be fabricated from 1/8 inch thick steel and shall be 24 x 29 inches, finished in a textured powder coat, color as selected by Architect from manufacturer's standard line of colors. Counter Support Brackets shall be as manufactured by Wizard Products; 800-286-5471.
- G. Shelf Standards & Brackets:
 1. Standards - shelving standards shall be fabricated from 12 gauge steel, 7/8" wide x 11/16" high with 2" increment adjusting furnished in lengths required as shown on the drawings. Shelving standards shall have an anochrome finish. Shelving standards shall be Knappe & Vogt - 87 ANO Extra Heavy Duty Standards or equal.
 2. Brackets - shelving brackets shall be fabricated from 12 gauge steel with an anochrome finish, depth as shown on the drawings. Shelving brackets shall be Knappe & Vogt - 187LL ANO Extra Heavy Duty Brackets in lengths as shown on drawings or equal.
- H. Fasteners: Size and type to suit application.
- I. Concealed Joint Fasteners: Threaded steel.

2.07 HARDWARE

- A. Shelf Brackets: 1/8" diameter steel pins that fit into predrilled holes in the cabinet sides. Pins to have a flattened exposed surface to support the shelf.
- B. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, black finish locks at wood cabinets, chrome finish locks at plam cabinets.
- C. Catches: Magnetic.
- D. Drawer Slides:
 - 1. Type: Full extension.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Features: Provide self-closing/stay closed type.
- E. Hinges: Concealed European style, steel with chrome finish, soft-close.
- F. Fire Hanger Hardware: Fabricators standard hardware for front to back hanging files.
- G. Floating Shelf Hardware: Knappe and Vogt Floating Shelf Kit or similar.
- H. Metal Coat Rod: Fabricators standard chrome metal rod with receiver ends.
- I. Trash Drawer: HDL Rev-A-Shelf TWC Series Pullout Waste Bins or similar.
- J. Door/Drawer Pulls:

2.08 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. All casework shall conform to the standards of the Architectural Woodworking Institute - Section 10 Casework, Custom Grade, Flush Overlay Design. All body members and tops shall be thickness as shown on the drawings or as specified herein, medium density fiberboard or plywood covered on the exposed side with decorative plastic laminate and unexposed side with laminate backing sheet. Wood veneer shall be glued to the particle board under pressure.
- C. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- D. Door and Drawer Fronts: 3/4 inch thick; flush style.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- G. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- H. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use concealed joint fasteners to align and secure adjoining cabinet units.
- C. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

3.05 SCHEDULES

- A. P-LAM
 - 1. P-LAM 1: Premium Price Point (highest cost)
 - 2. P-LAM 2: Premium Price Point (highest cost)
 - 3. P-LAM CABINETS: Premium Price Point (highest cost)
 - 4. P-LAM COUNTERTOPS: Premium Price Point (highest cost)
 - a. Standard spec with top-set backsplash and sidesplash.
 - b. 3mm PVC edge banding on counter edges
- B. Solid Surfacing
 - 1. SSM -1: Premium Price Point (highest cost)

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at areas shown on drawings and as required.
- B. Batt insulation in wall, ceiling, and roof construction as shown on drawings and as required.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Separate air barrier and vapor retarder materials.
- B. Section 07 84 00 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

1.03 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2019.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: ASTM C 578, Type IV; Extruded polystyrene board with natural skin surfaces; with the following characteristics:
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Board Size: 48 x 96 inch (1220 x 2440 mm).
 - 4. Board Thickness: as shown on drawings.
 - 5. Board Edges: Square.
 - 6. Thermal Conductivity (R-Value): Standard.
 - 7. Compressive Resistance: 25 psi (173 kPa).
 - 8. Water Absorption, maximum: 0.1 percent, volume.
 - 9. Manufacturers:
 - a. Dow Chemical Co: Square Edge
 - b. Owens Corning Corp: Foamular 250
 - c. Greenguard: CM Insulation Board
 - d. Minnesota Diversified Products Inc.: Certifoam.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BATT INSULATION MATERIALS

- A. Batt Insulation: ASTM C 665; preformed batt; friction fit, conforming to the following:
 - 1. Thermal Resistance: R of standard.
 - 2. Thickness: as shown on drawings.
 - 3. Facing: Unfaced.
 - 4. Manufacturers:
 - a. CertainTeed Corporation: High Performance Batt Insulation

- b. Johns Manville International, Inc: Unfaced Insulating Blankets
- c. Owens Corning Corp: Pink Fiberglass R-21 Thermal Insulation
- d. Guardian Fiberglass, Inc. - R-Best High Density Batts.

2.03 ACCESSORIES

- A. Sheet Vapor Retarder: Specified in Section 07 25 00.
- B. Insulation Fasteners: Fasteners for holding above grade foundation insulation to wall shall be expansion type anchors with integral plastic disc washers made specifically to hold insulation in place. Insulation fasteners shall be Styro Tapit Fasteners as manufactured by Styro Industries; P.O. Box 8098 Madison, WI 53708; www.styro.net; or equal.
- C. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION

- A. Install boards vertically on foundation perimeter.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and to protrusions.
 - 4. Install rigid insulation at the perimeter foundation wall from top of footings to just below grade as shown on drawings against masonry or concrete walls after waterproofing and drainage board has been installed, just prior to backfilling operations.
 - 5. Support insulation as required until sufficient pressure of backfill will hold insulation in place without displacement.
 - 6. Insulation shall be installed in parallel courses with end joints staggered. Joints shall be tightly butted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install batt insulation into the hollow ends of precast concrete planks to the depth shown on drawings. Insulation shall be packed with sufficient density to hold it in place but not so tight as to impair its effectiveness.
- C. Install in exterior wall, roof, and ceiling spaces without gaps or voids. Do not compress insulation.
- D. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- E. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- F. Coordinate work of this section with requirements for vapor retarder specified in Section 07 25 00.

3.04 PROTECTION

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

END OF SECTION

**SECTION 07 25 00
WEATHER BARRIERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Weather Barrier: Under exterior wall cladding, over sheathing or other substrate.
- B. Vapor Retarders: Materials to make exterior walls and ceilings water vapor-resistant.
- C. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Water-resistive barrier under exterior cladding
- B. Section 07 21 00 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.
- C. Section 07 90 05 - Joint Sealers: Sealant materials and installation techniques.

1.03 DEFINITIONS

- A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.
- B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.
- C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
 - 1. Water Vapor Permeance: For purposes of conversion, $57.2 \text{ ng}/(\text{Pa s sq m}) = 1 \text{ perm.}$
- D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.04 REFERENCE STANDARDS

- A. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2020.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- C. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.
- D. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.
- E. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2019.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, limitations, and information on all accessory products to be included for a complete installation.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Samples: Submit samples of materials to be used as vapor barrier, sample size shall be 6 inches square.
- E. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company accredited and certified under the Air Barrier Association of America (ABAA) Quality Assurance Program (QAP).

1.07 ADMINISTRATIVE REQUIREMENTS

- A. After product has been selected, applicator or said contractor to comply with technical training by manufacturer for proper installation practices, etc.
- B. Upon completion of the installation by the applicator. Product manufacturer to provide certification that all work has been done in strict accordance with the contract specifications and manufacturer's requirements, an inspection shall be made by a Technical Representative of product(s) manufacturer to review the installed system.

1.08 QUALITY ASSURANCE

- A. Vapor Permeability (Perm): Measure in accordance with ASTM E 96 Procedure E.

1.09 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 WEATHER BARRIER ASSEMBLIES

- A. BASIS OF DESIGN IS BASED ON DUPONT TYVEK WEATHER BARRIER SYSTEMS*
- B. Water-Resistive Barrier: Provide on exterior walls under exterior cladding.
 - 1. Use building paper unless otherwise indicated.
- C. Interior Vapor Retarder:
 - 1. On inside face of studs of exterior walls, under cladding, use mechanically fastened vapor retarder sheet.

2.02 WATER-RESISTIVE BARRIER MATERIALS (NEITHER AIR BARRIER NOR VAPOR RETARDER)

- A. Building Paper: Asphalt-saturated Kraft building paper complying with requirements of ICC-ES AC38 Grade D.

2.03 WEATHER BARRIER MATERIALS (WATER VAPOR PERMEABLE AND WATER-RESISTIVE)

- A. Air Barrier Sheet, Mechanically Fastened:
 - 1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.
 - 2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant procedure).
 - 3. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 6 months weather exposure.
 - 4. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, when tested in accordance with ASTM E84.
 - 5. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches wide, compatible with sheet material; unless otherwise specified.
 - 6. Products:
 - a. DuPont Building Innovations; Tyvek Commercial Wrap D with Tyvek Fluid Applied Flashing - Brush Formulation, Tyvek Fluid Applied Flashing and Joint Compound, FlexWrap NF, StraightFlash, StraightFlash VF, Tyvek Wrap Caps, and Tyvek Tape: www.dupont.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Air Barrier, Fluid Applied: Vapor permeable, elastomeric waterproofing.
- C. Air Barrier Coating:
 - 1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M, Procedure B.

2.04 APPLICATIONS

- A. Inside Surface of Exterior Stud Walls: Sheet seal applied to stud faces.
- B. Outside Surface of Gypsum Sheathing: Commercial Wrap D.

2.05 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

- A. Stud Walls and Truss Type Ceilings:
 1. Cross Laminated polyethylene meeting the requirements of ASTM E 1745, Class C and with the following minimum characteristics:
 - a. Tensile Strength per ASTM E154, Section 9: 13.6 lbf/in.
 - b. Puncture Resistance per ASTM D 1709, Method B: 475 grams.
 - c. Permeance per ASTM E96: 0.045 perms.
 2. Wall and Ceiling Vapor Retarders shall be as manufactured by one of the following or approved equal:
 - a. Raven Industries Inc. - Vapor Block 10; 1812 E. Ave., Sioux Falls, SD 57104; phone 800-635-3456.
 - b. Reef Industries, Inc. - Type - 65; PO Box 750250, Houston, TX 77275-0250; phone 713-507-4200.
 - c. Stego Industries LLC - Stego Wrap 10 mil Class C, 27442 Calle Arroyo, Suite A, San Juan, CA 92675; phone 877-464-7834.

2.06 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.
- B. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement is waived if not installed on a roof.
 1. Products:
 - a. DuPont Building Innovations; FlexWrap NF: www.dupont.com.
 - b. DuPont Building Innovations; StraightFlash: www.dupont.com.
 - c. DuPont Building Innovations; StraightFlash VF: www.dupont.com.
- C. Furnish all sealants, sealing tapes, pipe boots and other accessories as required by the manufacturer for a complete installation.
- D. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Water-Resistive Barriers: Install continuous barrier over surfaces indicated, with sheets lapped to shed water but with seams not sealed.
- C. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- D. Vapor Retarders: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- E. Mechanically Fastened Sheets - On Exterior:
 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.

2. Overlap seams as recommended by manufacturer but at least 6 inches.
 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
 4. For applications specified to be air tight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.
 5. Install water-resistive barrier over jamb flashings.
 6. Install air barrier and vapor retarder UNDER jamb flashings.
 7. Install head flashings under weather barrier.
 8. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- F. Mechanically Fastened Sheets - Vapor Retarder on Interior:
1. When insulation is to be installed in assembly, install vapor retarder over insulation.
 2. Seal seams, laps, perimeter edges, penetrations, tears, and cuts with self-adhesive tape, making air tight seal.
 3. Locate laps at a framing member; at laps fasten one sheet to framing member then tape overlapping sheet to first sheet.
 4. Seal entire perimeter to structure, window and door frames, and other penetrations.
 5. Where conduit, pipes, wires, ducts, outlet boxes, and other items are installed in insulation cavity, pass vapor retarder sheet behind item but over insulation and maintain air tight seal.
- G. Coatings:
1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
 2. Use flashing to seal to adjacent construction and to bridge joints.
- H. Openings and Penetrations in Exterior Weather Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches wide; do not seal sill flange.
 3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
 6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.04 INSTALLATION - WALLS AND CEILINGS

- A. Install air and vapor seal materials and assemblies in conjunction with materials described in other sections to provide continuous sealed barrier in the exterior enclosure of the building.
- B. In exterior stud-framed walls, attach sheet seal to inside stud faces with tape. Lap edges over stud faces, seal laps with tape. Lap ends onto adjacent construction; seal ends with sealant.
- C. At pipes and other penetrations vapor barrier shall be tightly fit around penetration and tape sealed to it. At electrical boxes vapor barrier shall be tucked around the back side of the box and sealed. Vapor barrier shall be fastened to the bearing plate at the building's exterior walls and shall completely seal off the insulation from the inside of the building.
- D. At junction of exterior wall and roof lap wall sheet seal onto roofing vapor retarder and attach with tape. Seal lap with tape. Position lap seal over firm bearing.

- E. At window openings install sheet seal between frame and adjacent wall seal material and attach with adhesive. Seal laps with tape. Position lap seal over firm bearing.
- F. Apply sealants and adhesives within recommended application temperature ranges. Consult manufacturer if temperature is out of this range.

END OF SECTION

**SECTION 07 53 00
ELASTOMERIC MEMBRANE ROOFING**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers.

1.03 REFERENCE STANDARDS

- A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2013.
- B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2006a (Reapproved 2013).
- D. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 1998 (Reapproved 2010).
- E. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers; 2000 (Reapproved 2012).
- F. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact; 2014.
- G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).
- H. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2013.
- I. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2014.
- J. FM DS 1-28 - Wind Design; 2007.
- K. NRCA ML104 - The NRCA Roofing and Waterproofing Manual; National Roofing Contractors Association; Fifth Edition, with interim updates.
- L. SPRI RP-4 - Wind Design Standard for Ballasted Single-Ply Roofing Systems; 2008.
- M. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of associated counterflashings installed under other sections.
- B. Pre-installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, and vapor retarder.

- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, and setting plan for tapered insulation. Submit shop drawings of tapered insulation.
- D. Samples of Aggregate: Submit two one lb. containers of aggregate ballast.
- E. Manufacturer's Installation Instructions: Indicate membrane seaming precautions and perimeter conditions requiring special attention.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer. Warranty shall be a ten year warranty.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with NRCA Roofing and Waterproofing Manual and manufacturer's instructions.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section 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.

1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.
- B. Review preparation and installation procedures and coordinating and scheduling required with related work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- B. Store materials in weather protected environment, clear of ground and moisture.
- C. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- D. Protect foam insulation from direct exposure to sunlight.

1.09 PROJECT CONDITIONS

- A. Coordinate the work with installation of associated counterflashings installed by other sections as the work of this section proceeds.

1.10 FIELD CONDITIONS

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

1.11 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten year manufacturer's material and labor warranty to cover failure to prevent penetration of water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. EPDM Membrane Materials:
 1. Carlisle SynTec: www.carlisle-syntec.com.
 2. Firestone Building Products, LLC: www.firestonebpco.com.
 3. GenFlex Roofing Systems, LLC: www.genflex.com.

4. Versico.
 5. Johns Manville.
- B. Insulation:
1. Insulation shall be brand as manufactured by, or as recommended by the roofing manufacturer as compatible with the roofing system and capable of giving a complete roofing system warranty for. Insulation shall be of the following type:
 - a. Polyisocyanurate.

2.02 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

- A. Membrane: Ethylene-propylene-diene-monomer (EPDM); externally reinforced with fabric; complying with minimum properties of ASTM D4637/D4637M.
1. Thickness: 0.060 inch.
 2. Color: White.
 3. Tensile Strength: 1630 psi, measured in accordance with ASTM D 412.
 4. Ultimate Elongation: 520 percent, measured in accordance with ASTM D412.
 5. Tear Strength: 150 lbf/inch, measured in accordance with ASTM D624.
 6. Water Absorption: Standard percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
 7. Water Vapor Permeability: 05 perm inch, measured in accordance with ASTM E 96.
 8. Brittleness Temperature: measured in accordance with ASTM D746.
- B. Seaming Materials: Double faced tape system.
- C. Vapor Retarder: Reinforced Kraft paper laminate, complying with requirements of fire rating classification; compatible with roofing and insulation materials.
1. Tape seams with seaming tape or as furnished by the vapor retarder manufacturer.
 2. ASTM 1745 Class C.
 3. Vapor permeability: 0.045 perm inch, measured in accordance with ASTM E 96, Method A.
 4. Puncture Resistance: ASTM D1709, Method B - 1.19 lb.
 5. Tensile Strength: ASTM E154 - 6960 psi.
 6. Vapor as manufactured by the following are considered equal:
 - a. Reef Industries: Griffolyn Type - 65; phone 800-231-6074.
 - b. Sto-Cote Products, Inc.: Tu-Tuf; phone 888-786-2683.
 - c. Barrier-Bac Inc.: Barrier Bac 250, phone 877-237-2841.
 - d. Stego Industries, LLC: Stego Wrap 10 mil Class C, phone 877-946-0797.
- D. Flexible Flashing Material: Same material as membrane.

2.03 DECK SHEATHING AND COVER BOARDS

- A. Deck Sheathing: Glass mat faced gypsum panels, ASTM C 1177/C 1177M, fire resistant type, 5/8 inch thick, Dens Deck as manufactured by Georgia Pacific.

2.04 INSULATION

- A. Polyisocyanurate Board Insulation: (Flat and Tapered) Rigid cellular foam, complying with ASTM C 1289, and with the following characteristics:
1. Facing: Fiberglass mat facing each face.
 2. Board Size: 48 by 96 inch.
 3. Thermal Resistance: R-value of minimum of 5.7 per inch; R=35.
 4. Board Edges: Square.
 5. Manufacturers:
 - a. Celotex Corporation: www.celotex.com
 - b. Dow Chemical Co: www.dow.com.
 - c. GAF; EnergyGuard PolyIso Insulation: www.gaf.com/sle.
 - d. R-Max.
 - e. Hunter.
 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES

- A. Stack Boots: Prefabricated flexible boot and collar for pipe stacks through membrane; same material as membrane.
- B. Sheathing Joint Tape: Paper type, self-adhering.
- C. Membrane Adhesive: As recommended by membrane manufacturer seams shall be seamed with double faced tape.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 METAL DECK PREPARATION

- A. Install preformed acoustical glass fiber insulation strips specified within roof deck flutes. Install in accordance with manufacturer's instructions.
- B. Install deck sheathing on metal deck.
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
 - 3. Tape joints.
- C. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations.
 - 1. Over entire roof area, fasten sheathing using 6 fasteners with washers per sheathing board.
 - 2. At roof perimeter to a distance of 4 ft in from edges, fasten sheathing using 6 fasteners with washers per board.

3.03 VAPOR RETARDER AND INSULATION - UNDER MEMBRANE

- A. Apply vapor retarder to deck surface in accordance with manufacturer's instructions.
 - 1. Unroll vapor retarder with the longest dimension of the area to be roofed for that day's work with enough left over to provide a lap for the next section to be roofed and pull out the folds to the full width of the product.
 - 2. Lap vapor barrier up the edge of intersecting walls and parapets to the height of the roof insulation.
 - 3. Seal around pipe penetrations and duct penetrations with pipe boots and sealing tape to the full height of the roof insulation at each location.
 - 4. Holes or tears in the insulation shall be patched with a section of vapor retarder lapped as recommended by the manufacturer and sealed with sealing tape.
 - 5. All joints shall be sealed with tape or sealant supplied by the manufacturer. Vapor barrier shall be sealed tight to all penetrations through the roof deck.
- B. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
- C. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer. Insulation shall be installed in a minimum of 2 layers.
- D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- E. On metal deck, place boards parallel to flutes with insulation board edges bearing on deck flutes.

- F. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- G. Do not apply more insulation than can be covered with membrane in same day.

3.04 MEMBRANE APPLICATION

- A. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
- B. Shingle joints on sloped substrate in direction of drainage.
- C. Overlap edges and ends and seal seams by contact adhesive, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- D. At intersections with vertical surfaces:
 - 1. Extend membrane up a minimum of 10 inches onto vertical surfaces.
 - 2. Fully adhere flexible flashing over membrane and up to reglets.
- E. At gravel stops, extend membrane under gravel stop and to the outside face of the wall.
- F. Around roof penetrations, seal flanges and flashings with flexible flashing.
- G. Install roofing expansion joints where indicated. Make joints watertight.
- H. Coordinate installation of roof drains and sumps and related flashings.

3.05 CLEANING

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

3.06 PROTECTION

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

END OF SECTION

**SECTION 07 84 00
FIRESTOPPING**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- C. ITS (DIR) - Directory of Listed Products; current edition.
- D. FA (AG) - FM Approval Guide; Factory Mutual Research Corporation; current edition.
- E. UL (FRD) - Fire Resistance Directory; current edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration.
- C. Product Data: Provide data on product characteristics.
- D. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- E. Certificate from authority having jurisdiction indicating approval of materials used.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in the current-year classification or certification books of UL, FM, or ITS (Warnock Hersey) will be considered as constituting an acceptable test report.
 - 2. Current evaluation reports published by CABO, ICBO, or BOCA will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Verification of minimum three years documented experience installing work of this type.

1.05 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.01 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

2.02 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use any system that is listed by FM, ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814 or ASTM E119 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.
- B. Manufacturer's:
 - 1. Fire stopping and fire safing products shall be UL or Warnock Hersey Rated Systems as manufactured by one of the following or approved equal:
 - a. Rectorseal Corporation, Metacaulk
 - b. Isolatek International, Cafco
 - c. 3M
 - d. The General Electric Company
 - e. Nelson Firestop Products
 - f. Hilti Construction Chemicals
 - g. Tremco Construction Division
 - h. United States Gypsum Company

2.03 MATERIALS

- A. Elastomeric Silicone Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
- B. Foam Firestopping: Single component foam compound.
- C. Fibered Compound Firestopping: Formulated compound mixed with incombustible non-asbestos fibers.
- D. Fiber Packing Material: Mineral fiber packing insulation.
- E. Firestop Devices: Mechanical device with incombustible filler and sheet stainless steel jacket;
- F. Intumescent Putty: Compound which expands on exposure to surface heat gain.
- G. Firestop Pillows: Formed mineral fiber pillows
- H. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Clean adjacent surfaces of firestopping materials.

B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 07 90 05
JOINT SEALERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sealants and joint backing.

1.02 REFERENCE STANDARDS

- A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- B. ASTM D1667 - Standard Specification for Flexible Cellular Materials--Poly(Vinyl Chloride) Foam (Closed-Cell); 2005 (Reapproved 2011).

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics.
- C. Samples: Submit two samples, in size illustrating sealant colors for selection.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.

1.05 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories which fail to achieve airtight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 SEALANTS

- A. Non-sag Urethane - Caulking compound shall be one-part polyurethane caulking compound, that meets or exceeds the requirements of Fed. Spec. TT-S-00230C. Compound shall be as recommended by the manufacturer for use without a paint finish and shall form a tough elastic film on the surface, but remain plastic underneath. It shall contain no ingredients which will stain masonry or corrode metals. Color of compound shall be as selected by the Architect. At the contractors option he may use two-part caulking compound of the same materials as those specified herein. Caulking compound shall be one of the following or approved equal:
 - 1. Mameco International - Vulkem 116 or 227
 - 2. Sika Chemical Co. - Sika-Flex 1a or 2c NS
 - 3. Sonneborne - Sonolastic NP1 or NP2
 - 4. Tremco - Dymonic or Dymeric
 - 5. Pecora - Dynatrol I or Dynatrol II
 - 6. PRC - Permapol RC1 or Permapol RC2
 - 7. Bostick - Chem-Calk 500
 - 8. May National Associates - Bondaflex PUR 25
- B. Interior Silicone - Silicone sealant for joints along backsplash on counters, shelves, cabinets and plumbing fixtures shall be one of the following or approved equal:
 - 1. General Electric - Sanitary 1700
 - 2. Dow Corning - 786 Mildew resistant
 - 3. May National Associates - Sil 100 WF

- C. Self-Leveling Horizontal Urethane – Self-Leveling caulking compound shall be self-leveling or slope grade Two-component Polyurethane Sealant for expansion and contraction joints in concrete floors, walks, paving and decks both interior and exterior, and joints in hard surface floor finish materials such as quarry tile, ceramic tile and terrazzo. Horizontal grade urethane shall remain flexible to -400, shall be abrasion resistant and resist deterioration caused by weather, stress, movement, traffic, water, oils, and road chemicals. Self-Leveling caulking shall be suitable for continuous water immersion. Self-Leveling Caulking shall be as manufactured by one of the following or approved equal:
1. Sonneborn - SL 2 Sealant
 2. Pecora - Urexpan NR-300
 3. Tremco - THC-900/901
 4. Sika Chemical Co. - Sikaflex 2c SL
 5. Mameco International - Vulkem 245
 6. PRC - Permapol RC-2SL
 7. Bostick - Chem-Calk 550
 8. May National Associates - Bondaflex PUR 2 NS & SL

2.02 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D 1667, closed cell PVC; oversized 30 to 50 percent larger than joint width. Sub-caulking shall be one of the following or approved equal:
1. Dow Chemical - Etha-Foam.
 2. Williams Products - Expand-O Foam.
 3. Grace Co. - Foam Joint Filler.
 4. Sonneborn - Sonofoam Closed Cell Backer Rod.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.

- H. Pre-compressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

- A. Clean adjacent soiled surfaces.

3.05 PROTECTION

- A. Protect sealants until cured.

3.06 SCHEDULE

- A. Caulking and sealants specified under this Section shall be installed at the intersection of all dissimilar materials not mechanically or adhesively attached to each other, at the expansion and contraction joints of similar or dissimilar materials, and where it is necessary to provide a smooth transition between materials of differing shapes. The following list of areas to be caulked or sealed is intended as a general guide to this Contractor and does not relieve the contractor of providing caulking to all areas shown on the drawings and that fit the above definition:
 - 1. Non-sag Urethane:
 - a. Gypsum Drywall Control Joints as shown on drawings.
 - b. Around the frames of Doors, Windows & Louvers - each exposed side.
 - c. Vertical concrete, and masonry control and expansion joints.
 - d. Under door thresholds - at the inside and outside edge of the threshold.
 - e. Flashing reglet terminations.
 - f. Where gypsum drywall intersects concrete, masonry, wood or other dissimilar material.
 - g. Where exterior window sills intersect walls and window frames.
 - h. Joints in vertical ceramic tile and other hard surface materials.
 - i. All other Joints noted on Drawings as "Caulk" or "Sealant".
 - j. All joints which meet the definition of paragraph "A" above.
 - 2. Interior Silicone:
 - a. Along Backsplash of Counters & Edges of Casework at Walls.
 - b. Along the Edges of Plumbing Fixtures at Walls
 - c. Along the edges, or as seating for Toilet Accessories.
 - d. As a seating for sinks and other items mounted into countertops.
 - 3. Self-Leveling Horizontal Urethane:
 - a. Horizontal and sloped expansion joints in floors and decks.
 - b. Horizontal and sloped expansion and control joints in interior hard surface flooring materials.

END OF SECTION

SECTION 08 12 13
HOLLOW METAL FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal frames for non-hollow metal doors.
- B. Fire-rated hollow metal frames for non-hollow metal doors.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Hardware, silencers, and weatherstripping.
- B. Section 09 90 00 – Painting and Coatings: Field painting.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) ; 2014.
- D. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- F. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2015.
- G. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2014.
- H. ICC A117.1 - Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).
- I. ICC A117.1 - Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).
- J. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- K. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- L. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

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 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Frames with Integral Casings:
 - 1. Ceco Door Products: www.cecodoor.com.
 - 2. Republic Doors: www.republicdoor.com.
 - 3. Steelcraft: www.steelcraft.com.
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DESIGN CRITERIA

- A. Door Frame Type: Provide hollow metal door frames with integral casings.
- B. Steel used for fabrication of frames shall comply with one or more of the following requirements; Galvanized steel conforming to ASTM A653/A653M, cold-rolled steel conforming to ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel conforming to ASTM A1011/A1011M, Commercial Steel (CS) Type B for each.
- C. Accessibility: Comply with ICC A117.1 and ADA Standards.
- D. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior frame that is also indicated as being sound-rated must comply with the requirements specified for exterior frames and for sound-rated frames; where two requirements conflict, comply with the most stringent.
- E. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

2.03 HOLLOW METAL DOOR FRAMES WITH INTEGRAL CASINGS

- A. Requirements for All Frames:
 - 1. Accessibility: Comply with ANSI/ICC A117.1.
 - 2. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.
- B. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) per ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 2. Weatherstripping: Refer to Section 08 71 00.

2.04 ACCESSORIES

- A. 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.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10 , door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

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

- B. Coat inside of other frames with bituminous coating to a thickness of 1/16 inch.

3.03 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Coordinate installation of hardware.

3.04 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edges, crossed corner to corner.

3.05 SCHEDULE

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

END OF SECTION

**SECTION 08 14 16
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Doors; flush and flush glazed configuration; fire rated, non-rated, standard.

1.02 RELATED REQUIREMENTS

- A. Section 08 12 13 - Hollow Metal Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014 with Errata (2018).
- B. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; National Fire Protection Association; 2019.
- D. UL (BMD) - Building Materials Directory; Underwriters Laboratories Inc.; current edition.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- F. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; Window and Door Manufacturers Association; 2013. (ANSI/WDMA I.S. 1A)

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Specimen warranty.
- E. Samples: Submit two samples of door veneer, illustrating wood grain, stain color, and sheen.
- F. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AWS Architectural Woodwork Standards, Section 9, Custom Grade.
- B. Finish doors in accordance with AWS Architectural Woodwork Standards, Section 5.

1.06 REGULATORY REQUIREMENTS

- A. Fire Door Construction: Conform to NFPA 252.
- B. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire-rating as indicated.
- C. Smoke and Draft Control Doors: In addition to required fire rating, comply with air leakage requirements of UBC Std 7-2, Part II; with "S" label; if necessary, provide additional gasketing or edge sealing.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.

- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.08 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Provide warranty for the following term:
 - 1. Interior Doors: Life of installation.
- D. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors: Basis of Design – VT Industries.
- B. Veneer Doors, 5 Ply:
 - 1. Marshfield Door Systems, Inc.
 - 2. Construction Specialties Inc.
 - 3. VT Industries
 - 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Level: Custom Grade, in accordance with AWI/AWMAC Architectural Woodwork Quality Standards Illustrated, Section 1300.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to 20 minutes, 60 minutes, 90 minutes, and ratings as indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc. (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - 3. Smoke and Draft Control Doors: Tested to ratings indicated on drawings in accordance with International Building Code; UL labeled if required by applicable code; provide gasketing as specified by listing.
 - 4. Wood veneer facing for field transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound Rated Doors: Equivalent to type, with particleboard core (PVC) construction as required to achieve STC rating specified; plies and faces as indicated.

2.04 DOOR SCHEDULE

- A. Veneer Facing: Grade in accordance with quality standard indicated, with book match, running match leaves assembled on door or panel face.
- B. Wood Doors: VT Industries; To match existing.

2.05 ACCESSORIES

- A. Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
- C. Fabricate fire rated doors in accordance with UL requirements. Attach fire rating label to door.
- D. Provide solid blocks at lock edge for hardware reinforcement.
 - 1. Provide solid blocking for other through bolted hardware.
- E. Vertical Exposed Edge of Stiles - Veneer Faces: Of same species as veneer facing.
- F. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- G. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- H. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
 - b. Stain: As selected by Architect.
 - c. Sheen: Flat.
- B. Seal door top edge with color sealer to match door facing.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Trim door height by cutting bottom edges to a maximum of 3/4 inch (19 mm).
 - 1. Trim fire door height at bottom edge only, in accordance with fire rating requirements.
- D. Use machine tools to cut or drill for hardware.
- E. Coordinate installation of doors with installation of frames and hardware.
- F. Coordinate installation of glazing.

3.03 TOLERANCES

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

3.04 ADJUSTING

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

3.05 SCHEDULE

- A. See paragraph 2.04 above, coordinate with drawings.

END OF SECTION

**SECTION 08 31 00
ACCESS DOORS AND PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Access door and frame units.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Openings in ceilings.
- B. Section 09 90 00 - Painting and Coating: Field paint finish.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of all access door units.

PART 2 PRODUCTS

2.01 ACCESS DOOR AND PANEL APPLICATIONS

- A. Floor Access Doors, Interior:
 - 1. Size: 24 by 24 inches or as shown on drawings.

2.02 MANUFACTURERS

- A. Wall and Ceiling Access Doors:
 - 1. Acudor Products Inc: Model DW-5040 for gypsum board ceilings; Model AT-5020 for masonry wall applications with Recess for tile. www.acudor.com.
 - 2. Karp Associates, Inc: Model KDW for gypsum board ceilings; Model DSC-210 for masonry wall applications with Recess for tile. www.karpinc.com.
 - 3. J.L. Industries, 4450 W. 78th St. Circle, Bloomington, MN 55435 (612) 835-6850, - Model WB for gypsum board ceilings; Model CT for masonry wall applications with Recess for tile.
 - 4. Nystrom, Inc., 1701 N.E. Madison Street, Minneapolis, MN 55413, (612) 781-3491, - Model NW for gypsum board ceilings; Model RA for masonry wall applications with Recess for tile.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESS DOORS AND PANELS

- A. All Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.

2.04 WALL AND CEILING UNITS

- A. Access Doors: Factory fabricated door and frame units, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
 - 1. Material: Steel.
 - 2. Door Style: Single thickness with rolled or turned in edges.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION

**SECTION 08 33 13
COILING COUNTER DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Openings.
- B. Section 09 21 16 - Gypsum Board Assemblies: Openings.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2014.
- D. ITS (DIR) - Directory of Listed Products; Intertek Testing Services NA, Inc.; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's standard literature showing materials and details of construction and finish. Include data on electrical operation.
- C. Shop Drawings: Indicate rough and actual opening dimensions, anchorage methods, hardware locations, and installation details.
- D. Samples: Submit two slats, 4 inches long illustrating shape, color and finish texture.
- E. Manufacturer's Instructions: Indicate installation sequence and installation, adjustment, and alignment procedures.
- F. Operation and Maintenance Data: Indicate modes of operation, lubrication requirements and frequency, and periodic adjustments required.
- G. Project Record Documents: Include as-built electrical diagrams for electrical operation and connection to fire alarm system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coiling Counter Doors:
 - 1. Alpine Overhead Doors, Inc: www.alpinedoors.com.
 - 2. Cornell Iron Works: www.cornelliron.com
 - 3. Overhead Doors: www.overhaddoor.com
 - 4. CHI Overhead Doors: www.chiohd.com
 - 5. Raynor Garage Doors: www.raynor.com
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COILING COUNTER DOORS

- A. Coiling Counter Doors, Non-Fire-Rated: Stainless steel slat curtain.
 - 1. Mounting: Exterior face mounted.
 - 2. Provide integral frame and sill of same material and finish.
 - 3. Nominal Slat Size: 1-1/4 inches wide.
 - 4. Slat Profile: Flat, perforated.
 - 5. Finish: Stainless Steel.
 - 6. Guides: Formed track; same material and finish unless otherwise indicated.
 - 7. Operation: Manual.
 - 8. Exterior keyed lock and latch handle.

2.03 OPERATION

- A. Manual operation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- E. Coordinate installation of electrical service with Section 26 27 17.
- F. Complete wiring from disconnect to unit components.

3.03 ADJUSTING

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

3.04 CLEANING

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

END OF SECTION

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- A. Section 07 90 05 - Joint Sealers: Perimeter sealant and back-up materials.
- B. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- C. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2012.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric]; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 PERFORMANCE REQUIREMENTS

- A. Design and size components to withstand the following load requirements without damage or permanent set, when tested in accordance with ASTM E 330, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - 1. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
- B. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
- C. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at a reference differential pressure across assembly of 1.57 psf as measured in accordance with ASTM E 283.
- D. Water Leakage: None, when measured in accordance with ASTM E 331 with a test pressure difference of 2.86 lbf/sq ft.
- E. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
- F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
- G. Glazing is required to have U-factor of .29 or better and a SHGC of .4 or better, in addition, the glass entry doors need a u factor of .77 to meet MN Energy Codes compliance.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- D. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- E. Submit manufacturer's standard samples indicating quality of finish. Where normal texture or color variations are expected, include additional samples illustrating range of variation. Submit samples for each glass type, 12 x 12 inch size.

1.07 QUALITY ASSURANCE

- A. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. To ensure quality of appearance and performance, obtain materials for systems from either a single manufacturer or from manufacturer approved by systems manufacturer.

1.08 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.10 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.11 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers: Basis of design; Kawneer – Match existing finishes.
 - 1. United States Aluminum Corp.
 - 2. Oldcastle Building Envelope.
 - 3. Tubelite.
 - 4. YKK AP.
 - 5. Kawneer North America
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Position: Centered (front to back).
 - 2. Vertical Mullion Dimensions: 2 inches wide by 4-1/2 inches deep.

3. Finish: Match existing.
4. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
5. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
6. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
7. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
8. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
9. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
 1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
 3. Cross-Section: 2 x 4-1/2 inch nominal dimension.

2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Perimeter Sealant: Type as specified in Section 07 90 05.
- D. Glass: As specified in Section 08 80 00.
- E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.05 FINISHES

- A. Design intent is to match that of existing conditions.

2.06 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware and door operators.
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.

- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Set thresholds in caulking bead each edge and secure. Caulking as specified in Section 07 90 05.
- J. Install glass and infill panels in accordance with Section 08 80 00, using glazing method required to achieve performance criteria.
- K. Install perimeter sealant in accordance with Section 07 90 05.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.05 PROTECTION

- A. Protect installed products from damage during subsequent construction.
- B. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.
- C. Protect finished work from damage.

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 - GENERAL

1.1 CONDITIONS

- A. Conditions of the contract (General and Supplementary Conditions) and Division One General Requirements, govern the work of this section.
- B. This section includes all material, and related service necessary to furnish all finish hardware indicated on the drawings or specified herein.
- C. Furnish UL listed hardware for all labeled and 20 min. openings in conformance with the requirements for the class of opening scheduled. Underwriters' requirements shall have precedence over specification where conflicts exist.
- D. All work shall be in accordance with all applicable state and local building codes. Code requirements shall have precedence over this specification where conflicts exist.

1.2 WORK INCLUDED

- A. This section includes the following:
 - 1. Furnish door hardware (for hollow metal, wood and aluminum doors) specified herein, listed in the hardware schedule, and/or required by the drawings.
 - 2. Cylinders for Aluminum Doors
 - 3. Thresholds and Weather-stripping (Aluminum frame seals to be provided by aluminum door supplier)
 - 4. Electro-Mechanical Devices
 - 5. Access Control components and or systems specified within this section.
- B. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.3 RELATED WORK IN OTHER SECTIONS

- A. This section includes coordination with related work in the following sections:
 - 1. Division 6 Section "Finish Carpentry".
 - 2. Division 6 Section "Cabinet Hardware"
 - 3. Division 8 Section "Hollow Metal Doors and Frames".
 - 4. Division 8 Section "Wood Doors"
 - 5. Division 8 Section "Aluminum Entrances and Storefronts"
 - 6. Division 28 Sections "Electrical".

1.4 REFERENCES

- A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.
 - 1. DHI - Recommended Locations for Builders' Hardware.
 - 2. NFPA 80 - Standards for Fire Doors and Windows.
 - 3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
 - 4. UL - Building Material Directory.
 - 5. DHI - Door and Hardware Institute
 - 6. WHI - Warnock Hersey
 - 7. BHMA - Builders Hardware Manufacturers Association
 - 8. ANSI - American National Standards Institute
 - 9. ANSI ICC500 - Standard for the Design and Construction of Storm Shelters
 - 10. IBC 2018 - International Building Code 2018 Edition (as amended by local building code)

1.5 SUBMITTALS

- A. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 1 - General Conditions.
- B. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
 - 1. Door number, location, size, handing, and rating.
 - 2. Door and frame material, handing.
 - 3. Degree of swing.
 - 4. Manufacturer
 - 5. Product name and catalog number
 - 6. Function, type and style
 - 7. Size and finish of each item
 - 8. Mounting heights
 - 9. Explanation of abbreviations, symbols, etc.
 - 10. Numerical door index, indicating the hardware set/ group number for each door.
- C. When universal type door closers are to be provided, the schedule shall indicate the application method to be used for installation at each door: (regular arm, parallel arm, or top jamb).
- D. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC), or certified Door Hardware Consultant (DHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed or stamped with the DHI certification seal of the supervising AHC or DHC. The supervising AHC or DHC shall attend any meetings related to the project when requested by the architect.
- E. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.
- F. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or incompatible items, and proposed substitutions in the hardware schedule.
- G. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.
- H. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 1 - General Conditions.
- I. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.
- J. Furnish with first submittal, a list of required lead times for all hardware items.
- K. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 1 - General Conditions.
- L. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.
- M. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

- N. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner's representative to determine keying requirements. Upon completion of initial key meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities as required by Division 1 – General Conditions. Wiring diagrams shall be included in final submittals transmitted for distribution of field use.

1.6 QUALITY ASSURANCE

- A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality, may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division One General Requirements.
- B. Where indicated in this specification, products shall be independently certified by ANSI for compliance with relevant ANSI/BHMA standards A156.1 - A156.36 – Standards for Hardware and Specialties. All products shall meet or exceed certification requirements for the respective grade indicated within this specification. Supplier shall provide evidence of certification when requested by the architect.
- C. Obtain each type of hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. Electrical drawings and electrical specifications are based on the specific electrified hardware components specified in hardware sets. When electronic hardware components other than those indicated in hardware sets are provided, the supplier shall be responsible for all costs incurred by the design team and their consultants to review and revise electrical drawings and electrical specifications. Supplier shall also be responsible for any additional costs associated with required changes in related equipment, materials, installation, or final hook up to ensure the system will operate and function as indicated in the construction documents, including hardware set operational / functional descriptions.
- E. All hardware items shall be manufactured no earlier than 6 months prior to delivery to site.
- F. Hardware supplier shall be factory trained and certified by the manufacture to provide and support all computer managed locks and system components.
- G. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years' experience in successful completion of projects similar in size and scope.
- H. Provide hardware for all labeled fire doors, which complies with positive pressure fire testing UL 10C.
- I. Comply with all applicable provisions of the standards referenced within section 1.4 of this specification.
- J. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.
- B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.

- C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.
- D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.
- E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.8 PRE-INSTALLATION MEETING

- A. Schedule a hardware pre-installation meeting on site to review and discuss the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.
- B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.
- C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.9 WARRANTY

- A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division One General Requirements.
- B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. All exposed fasteners shall be Phillips head or as otherwise specified and shall match the finish of the adjacent hardware. All fasteners ex-posed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.
- B. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.2 BUTT HINGES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Stanley</u>	<u>Hager</u>	<u>McKinney</u>
1. Standard Weight, Plain Bearing	5PB1	F179	****	T2714
2. Standard Weight, Ball Bearing	5BB1	BB179	BB1279	TB2714
3. Standard Weight, Ball Bearing, Non-Ferrous	5BB1	FBB191	BB1191	TB2314
4. Heavy Weight, Ball Bearing	5BB1HW	FBB168	BB1168	T4B3786
5. Heavy Weight, Ball Bearing, Non-Ferrous	5BB1HW	FBB199	BB1199	T4B3386

- B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.1 (2006). Hinges shall meet or exceed the following ANSI grade requirements as indicated below:
 - 1. Standard Weight, Plain Bearing Hinges: Grade 3
 - 2. Standard Weight, 2 Ball Bearing Hinges: Grade 2
 - 3. Heavy Weight, 4 Ball Bearing Hinges: Grade 1
- C. Unless otherwise specified, furnish the following hinge quantities for each door leaf.
 - 1. 3 hinges for doors up to 90 inches.
 - 2. 1 additional hinge for every 30 inches on doors over 90 inches.
 - 3. 4 hinges for Dutch door applications.

- D. Unless otherwise specified, top and bottom hinges shall be located as specified in division 8 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.
- E. Unless otherwise specified, furnish hinge weight and type as follows:
 - 1. Standard weight: plain bearing hinge 5PB1 or ball bearing hinge 5BB1 for interior openings through 36 inches wide without a door closer.
 - 2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
 - 3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
 - 4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.
 - 5. Heavyweight: 4 ball bearing hinge 5BB1HWSS 5" for all exterior doors or 4 ball bearing hinge 5BBHW 5" for interior doors, that have an automatic operator.
- F. Unless otherwise specified, furnish hinges for exterior doors, fabricated from brass, bronze, or stainless steel. Unless otherwise specified, hinges for interior doors may be fabricated from steel.
- G. Unless otherwise specified, furnish hinges in the following sizes:
 - 1. 5" x 5" 2-1/4" thick doors
 - 2. 4-1/2" x 4-1/2" 1-3/4" thick doors
 - 3. 3-1/2" x 3-1/2" 1-3/8" thick doors
- H. Furnish hinges with width to accommodate trim and allow for 180-degree swing.
- I. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior, and out-swinging lockable interior doors.
- J. Unless otherwise specified, furnish all hinges to template standards.

2.3 LOCKS AND LATCHES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Schlage</u>	<u>No Substitution</u>
1. Grade 1 Cylindrical	ND Series SPA	
- B. Bored locks shall be independently certified by ANSI for compliance with ANSI A156.2 (2011). Interconnected locks shall be independently certified by ANSI for compliance with ANSI A156.12 (2013). Mortise locks shall be independently certified by ANSI for compliance with ANSI A156.13 (2012).
- C. Minimize transmission of heat to lock trim. Provide temperature control modules (TCM) on all electrified locks when cataloged by the lock manufacturer.
- D. Unless otherwise specified, all locks and latches to have:
 - 1. 2-3/4" Backset
 - 2. 1/2" minimum throw latchbolt
 - 3. 1" throw deadbolt
 - 4. 6 pin cylinders
 - 5. ANSI A115.2 strikes
- E. Provide guarded latch bolts for all locksets, and latch bolts with throw to maintain fire rating of both single and paired door assemblies.
- F. Provide strike with lip length adequate to clear surrounding trim.
- G. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.

2.4 PULLS, PUSH BARS, PUSH/PULL PLATES

A. Acceptable manufacturers and respective catalog numbers:

	<u>Burns</u>	<u>Hager</u>	<u>Ives</u>
1. Straight Pull (1" dia., 10" CTC)	26C	4J	8103-0
2. Straight Pull (3/4" dia., 8" CTC)	25B	3G	8102-8
3. Offset Pull / Push-Bar (1" dia., 10" CTC Pull)	422 x 39C	159	9190-0
4. Push Plate (.050 4"X 16")	54	30S 4 x 16	8200 4 x 16
5. Push Plate (.050 6"X 16")	56	30S 6 x 16	8200 6" X 16"

B. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.

C. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile & rail or full glass doors.

2.5 CLOSERS

A. Acceptable manufacturers and respective catalog numbers:

	<u>LCN</u>	<u>Yale</u>	<u>Norton</u>
1. 4050 / 4050 EDA		R4400 / PR4400	R7500 / PR7500

B. Door closers shall be independently certified by ANSI for compliance with ANSI A156.4, Grade 1 (2013).

C. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. Provide extra heavy-duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.

E. Hardware supplier shall coordinate with related trades to ensure aluminum frame profiles will accommodate specified door closers.

F. Closers shall use aluminum cylinders.

G. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.

H. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.

I. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.

J. Provide closers with adjustable spring power. Size closers to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.

K. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.

L. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.

M. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100-hour salt spray test.

2.6 LOW ENERGY ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

- A. Acceptable manufacturers and respective catalog numbers:
- | | <u>LCN</u> | <u>Besam</u> | <u>No Substitution</u> |
|-------------------------------|------------|--------------|------------------------|
| 1. Electro-Hydraulic Operator | 4640 | PowerSwing | |
- B. Low energy operators shall be independently certified by ANSI for compliance with ANSI A156.19 (2002).
- C. Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA for opening force and time to close standards.
- D. The closing action shall be controlled by modern type cast iron door closer cylinder filled with a flat viscosity fluid, stable from +120F to -30F that would require no seasonal adjustments. The closer shall have field adjustable spring power; have two independent closing speed adjustment valves, and hydraulic back-check.
- E. Full closing force shall be provided when the power or assist cycle ends.
- F. All power operator systems shall include the following features and functions:
1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
 2. The operator will be designed with an electronically controlled mechanical clutching mechanism to prevent damage to the operator if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
 3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
 4. UL listed for use on labeled doors.
 5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.
 6. The power operator shall incorporate microprocessor controlled digital controls including factory default memory settings, on-board diagnostics, non-volatile memory, and integrated delay and relay for controlling door release devices.
 7. Provisions in the control box or module shall provide control {inputs and outputs} for; electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, and stop side sensors.
 8. Wall mounted actuators shall consist of a 4-1/2 inches diameter stainless steel touch plate with a blue filled handicapped symbol. Switches shall be weather resistant and mount on a single gang electrical box furnished by Division 16.
- G. All electrically powered operators shall include the following features or functions:
1. When an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
 2. Easily accessible main power and maintain hold open switches will be provided on the operator.
 3. An electronically controlled clutch to provide adjustable opening force.
 4. A microprocessor to control all motor and clutch functions.
 5. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.
 6. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
 7. If electrical failure occurs, the unit shall operate as a standard door closer.
- H. Power Operators shall be warranted by the manufacture to be free from defects in material and workmanship for a period of two years.

2.7 KICK PLATES AND MOP PLATES

- A. Furnish protective plates as specified in hardware groups.
- B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.
- C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk.
- D. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16" are provided for labeled doors, the plate shall be labeled.
- E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.
- F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.8 OVERHEAD STOPS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Glynn-Johnson</u>	<u>Rixson</u>	<u>Sargent</u>
1. Heavy Duty Surface Mount	GJ900 Series	9 Series	590
- B. Unless otherwise specified, furnish GJ900 series overhead stop for hollow metal or 1-3/4" solid core doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for hollow metal or 1-3/4" solid core doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.
- C. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.
- D. Do not provide holder function for labeled doors.

2.9 WALL STOPS AND HOLDERS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Hager</u>	<u>Burns</u>
1. Wrought Convex Wall Stop	WS406CVX	232W	570
2. Wrought Concave Wall Stop	WS406CCV	236W	575
- B. Furnish a stop or holder for all doors. Furnish floor stops or hinge pin stops only where specifically specified.
- C. Provide concave style wall stop at all adjacent integral push button locks; provide convex style wall stop at all other locations.
- D. Where wall stops are not applicable, furnish overhead stops.
- E. Do not provide holder function for labeled doors.

2.10 ELECTRIC STRIKES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Von Duprin</u>	<u>Hes</u>
1. Type 1	6200 Series	1006 Series
- B. Provide electric strikes compatible with the type of locks shown at each opening where specified.
- C. Electric strikes shall be UL listed as Burglary-Resistant Electric Door Strikes and where required shall be UL listed as Electric Strike for Fire Doors.

- D. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.11 POWER SUPPLIES

- A. Provide quantities and types as specified in hardware sets. Shared power supplies will not be accepted without prior approval from the owner.
- B. All power supplies shall have the following features:
 1. 12/24 VDC Output, field selectable.
 2. Class 2 Rated power limited output.
 3. Universal 120-240 VAC input.
 4. Low voltage DC regulated and filtered.
 5. Polarized connector for distribution boards.
 6. Fused primary input.
 7. AC input and DC output monitoring circuit w/LED indicators.
 8. Cover mounted AC Input indication.
 9. Tested and certified to meet UL294.
 - 10.NEMA 1 enclosure.
 - 11.Hinged cover w/lock down screws.
 - 12.High voltage protective cover.
- C. All power supplies shall incorporate fused distribution boards.
- D. All electro-mechanical systems requiring fail safe circuits shall be capable of interfacing with the fire alarm system to cut power to appropriate system components. Unless already provided in another system component, all power supplies utilized in fail safe circuits shall include an integral relay which when connected to the N/C fire alarm contact will cut power to all openings connected to the individual power supply. Power supply, unless otherwise specified, will automatically reset itself when fire alarm relay returns to normal state following a fire alarm.

2.12 FINISHES AND BASE MATERIALS

- A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

<u>HARDWARE ITEM</u>	<u>BHMA FINISH AND BASE MATERIAL</u>
1. Butt Hinges: Exterior, or Non-Ferrous	630 (US32D - Satin Stainless Steel)
2. Butt Hinges: Interior	652 (US26D - Satin Chromium)
3. Locks and Latches	626 (US26D - Satin Chromium)
4. Pulls and Push Plates/Bars	630 (US32D - Satin Stainless Steel)
5. Closers	689 (Powder Coat Aluminum)
6. Protective Plates	630 (US32D - Satin Stainless Steel)
7. Overhead Stops	630 (US32D - Satin Stainless Steel)
8. Wall Stops and Holders	630 (US32D - Satin Stainless Steel)
9. Miscellaneous	626 (US26D - Satin Chromium)

2.13 KEYING

- A. Provide all cylinders in keyways as required to accommodate owners existing Schlage key system.
- B. Provide interchangeable cores for all locks and cylinders if required by the existing key system..
- C. All locks under this section shall be keyed as directed by the owner to an existing Master Key System.
- D. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.
- E. Master keys, control keys, and change keys shall be delivered by registered mail to the owner. Construction keys shall be delivered to the contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, installer shall examine door frame installation to ensure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely affect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

- A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.
- B. Install all hardware in accordance with the approved hardware schedule and manufacturer's instructions for installation and adjustment.
- C. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Provide blocking or reinforcement for all hardware mounted to drywall construction, including wall mounted door stops and holders.
- E. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- F. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.
- G. Shim doors as required to maintain proper operating clearance between door and frame.
- H. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute.
- I. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.
- J. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- K. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.
- L. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.
- M. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.
- N. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.
- O. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.
- P. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.
- Q. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.

- R. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.
- S. Adjust spring power of door closers to the minimum force required to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to ensure opening force does not to exceed 5 lbs.
- T. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door throughout the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.
- U. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.
- V. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.
- W. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water-resistant seal.
- X. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 FIELD QUALITY CONTROL

- A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware supplier shall submit a list of all hardware that has not been installed correctly.
- B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.4 ADJUSTMENT AND CLEANING

- A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. Lubricate moving parts with type lubrication recommended by the manufacturer.
- B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.5 HARDWARE SCHEDULE

- A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

HW SET: 1

	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE SET	ND10S	SCH
1	EA	SURFACE CLOSER	4050 REG OR EDA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HW SET: 2

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4050 REG OR EDA AS REQ	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	PS902 2RS	VON
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE.
AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. PRESENTATION OF VALID
CREDENTIAL MOMENTARILY ENERGIZES ELECTRIC STRIKE.

HW SET: 3

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1		REMOTE RELEASE	BY SECURITY	
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURF. AUTO OPERATOR	4642	LCN
1	EA	ACTUATOR	8310-856 @ INSIDE	LCN
1	EA	ACTIVATION RECEIVER	8310-865	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	POWER SUPPLY	PS902 4RL	VON
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE.
AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. REMOTE RELEASE MOMENTARILY
ENERGIZES ELECTRIC STRIKE.

HW SET: 4

	EA	HINGE	AS REQUIRED	IVE
1	EA	ENTRANCE LOCK	ND53	SCH
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	COAT AND HAT HOOK	582	IVE

FUNCTION: ENTRANCE LOCK TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSH-BUTTON LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE LEVER.

HW SET: 5

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1		REMOTE RELEASE	BY SECURITY	
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURF. AUTO OPERATOR	4642	LCN
1	EA	ACTUATOR	8310-856 @ INSIDE	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	POWER SUPPLY	PS902 4RL	VON
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. REMOTE RELEASE MOMENTARILY ENERGIZES ELECTRIC STRIKE.

HW SET: 6

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1		REMOTE RELEASE	BY SECURITY	
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	OH STOP	90S	GLY
1	EA	SURF. AUTO OPERATOR	4642	LCN
1	EA	ACTUATOR	8310-856 @ INSIDE	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	POWER SUPPLY	PS902 4RL	VON
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. REMOTE RELEASE MOMENTARILY ENERGIZES ELECTRIC STRIKE.

HW SET: 7

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4050A REG OR EDA AS REQ	LCN
1	EA	ARMOR PLATE	8400 34" X 2" LDW B-CS	IVE
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	PS902 2RS	VON
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK

LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. PRESENTATION OF VALID CREDENTIAL MOMENTARILY ENERGIZES ELECTRIC STRIKE.

HW SET: 08

	EA	HINGE	AS REQUIRED	IVE
1	EA	DOOR PULL, 1" ROUND	8103 10"	IVE
1	EA	PUSH PLATE	8200 6" X 16"	IVE
1	EA	SURFACE CLOSER	4050A SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

HW SET: 09

	EA	HINGE	AS REQUIRED	IVE
2	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	LEVER	4600	ADA
1	EA	DEAD LATCH	4900	ADA
2	EA	PUSH/PULL BAR	9190 10"	IVE
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4050A HREG	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR	8310-856	LCN

HW SET: 10

	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	ND80	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4050A REG	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	PS902 2RS	VON
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: STOREROOM LOCK
 LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE.
 AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED. PRESENTATION OF VALID
 CREDENTIAL MOMENTARILY ENERGIZES ELECTRIC STRIKE.

HW SET: 11

	EA	HINGE	AS REQUIRED	IVE
1	EA	ENTRANCE LOCK	ND53	SCH
1	EA	OH STOP	90S	GLY
1	EA	COAT AND HAT HOOK	582	IVE

FUNCTION: ENTRANCE LOCK TURN/PUSH-BUTTON LOCKING; PUSHING AND TURNING BUTTON LOCKS
 OUTSIDE LEVER, REQUIRING USE OF KEY UNTIL BUTTON IS MANUALLY UNLOCKED. PUSH-BUTTON
 LOCKING; PUSHING BUTTON LOCKS OUTSIDE LEVER UNTIL UNLOCKED BY KEY OR BY TURNING INSIDE
 LEVER.

Door / Hardware Index

Door Numbers	HwSet#
101	10
102	04
104	11
105	04
106	04
107	04
108	04
109	04
110	04
RX101A	02
RX101B	08
RX104	04
RX105	04
RX106	01
RX107	01
RX108A	02
RX108B	05
RX109	04
RX110	02
RX110B	03
RX111	09
RX112A	02
RX112B	06
RX113A	07
RX113B	07
RX114	02

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass.
- B. Glazing compounds and accessories.
- C. Transaction Window.

1.02 RELATED REQUIREMENTS

- A. Section 08 12 13 - Hollow Metal Frames: Glazed borrowed lites.
- B. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
- C. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing furnished by storefront manufacturer; shall meet state Energy Compliances.

1.03 REFERENCE STANDARDS

- A. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2011).
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2014.
- C. ASTM C1036 - Standard Specification for Flat Glass; 2011.
- D. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2012.
- E. ASTM E773 - Standard Test Method for Accelerated Weathering of Sealed Insulating Glass Units; 2001.
- F. ASTM E774 - Standard Specification for the Classification of the Durability of Sealed Insulating Glass Units; 1997.
- G. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- H. GANA (GM) - GANA Glazing Manual; 2009.
- I. GANA (SM) - GANA Sealant Manual; 2008.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Convene a pre-installation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data on Glass Types: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA Glazing Manual and FGMA Sealant Manual for glazing installation methods.

1.07 PRE-INSTALLATION MEETING

- A. Convene one week before starting work of this section.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Sealed Insulating Glass Units: Provide a ten (10) year warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

- A. Float Glass Manufacturers:
 - 1. AGC Flat Glass North America, Inc: www.na.agc-flatglass.com.
 - 2. Guardian Industries Corporation: www.guardian.com.
 - 3. Pilkington North America Inc: www.pilkington.com/na.
 - 4. PPG Industries, Inc: www.ppgideascales.com.
 - 5. Visteon Glass Systems: www.visteon.com/floatglass.
 - 6. Viracon.
 - 7. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Float Glass: Provide float glass based glazing unless noted otherwise.
 - 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality-Q3.
 - 2. Heat-Strengthened and Fully Tempered Types: ASTM C1048, Kind HS and Kind FT.
 - 3. Tinted Types: ASTM C1036, Class 2 - Tinted, color and performance characteristics as indicated.
 - 4. Thicknesses: As indicated; for exterior glazing comply with requirements indicated for wind load design regardless of thickness indicated.
- C. Fire Resistance-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
 - 1. IBC Fire Resistance Rating: W-45, minimum.
 - 2. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
 - 3. Safety Certification: 16 CFR 1201 Category II.
- D. Fire-Protection-Rated Glazing: Type, thickness, and configuration as required to achieve indicated ratings.
 - 1. IBC Fire Protection Rating: As indicated on drawings.
 - 2. Provide products listed by Underwriters Laboratories or Intertek Warnock Hersey.
 - 3. Labeling: Provide permanent label on each piece giving the IBC rating and other information required by the applicable code.
- E. Clear Float Glass: Clear, annealed.
 - 1. Comply with ASTM C 1036, Type I, transparent flat, Class 1 clear, Quality Q3 (glazing select).
 - 2. Comply with ASTM C 1048, Condition A uncoated, Type I, transparent flat, Class 1, Quality q3 glazing select.
 - 3. 1/4 inch thick.
- F. Safety Glass: Clear; fully tempered with horizontal tempering.
 - 1. Comply with ASTM C 1048, Condition A uncoated, Type I, transparent flat, Class 1, Quality q3 glazing select.
 - 2. Comply with ANSI Z97.1.
 - 3. 1/4 inch thick, interior glazing.
- G. Laminated Glass: 1/2" Laminated Glazing.
 - 1. Comply with ASTM C 1048
- H. Ballistic Glazing: Total Security Solutions or approved equal; level 8.

2.02 SEALED INSULATING GLASS UNITS

- A. Manufacturers:
 - 1. Any of the manufacturers specified for float glass.
 - 2. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Sealed Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.

2. Edge Spacers: Aluminum, bent and soldered corners.
 3. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 4. Purge interpane space with dry hermetic air.
- C. Insulated Glass Units: Double pane with glass to elastomer edge seal.
1. Outer pane of 1/4 inch glass, inner pane of 1/4 inch glass
 2. Place reflective coating on No. 3 surface within the unit.
 3. Comply with ASTM E 774 and E 773, Class CBA.
 4. Purge interpane space with dry hermetic air.
 5. Total unit thickness of 1 inch.
- D. Tempered Insulated Glass Units : Double pane with glass to elastomer edge seal.
1. Outer pane of 1/4 inch tempered glass, inner pane of 1/4 inch tempered glass.
 2. Place reflective coating on No. 3 surface within the unit.
 3. Comply with ASTM E 774 and E 773, Class CBA.
 4. Purge interpane space with dry hermetic air.
 5. Total unit thickness of 1 inch .
- E. Insulated Spandrel Glass Units (Type SG): Double Pane with glass to elastomer edge seal.
1. Outer pane of 1/4 inch heat strengthened glass, inner pane of 1/4 inch ceramic frit fused to the outer surface, color as selected by Architect.
 2. Comply with ASTM C 1048, Condition B spandrel glass one surface coated Type II pattern flat, Class 2 tinted heat absorbing and light reducing, Quality q7 decorative.
 3. Comply with ASTM C 1036 Type I, transparent flat, Class 2 tinted heat absorbing and light reducing.
 4. Total unit thickness of 1 inch.
- F. Insulated Silkscreen Glass Units (Silkscreen & Tempered): Triple Pane with glass to elastomer edge seal.
1. Outer panes of 1/4 inch heat strengthened glass, inner pane of 1/4 inch ceramic frit fused to the outer surface, color as selected by Architect.
 2. Comply with ASTM C 1048, Condition C other coated glass one surface coated Type II pattern flat, Class 2 tinted heat absorbing and light reducing, Quality q7 decorative.
 3. Comply with ASTM C 1036 Type I, transparent flat, Class 2 tinted heat absorbing and light reducing.
 4. Total unit thickness of 1 inch.

2.03 GLAZING COMPOUNDS

- A. Manufacturers:
1. Dow Corning Corp: www.dowcorning.com.
 2. GE Plastics: www.geplastics.com.
 3. Pecora Corporation: www.pecora.com.
 4. Substitutions: Refer to Section 01 60 00 - Product Requirements.
- B. Butyl Sealant: Single component; ASTM C920, Grade NS, Class 12-1/2, Uses M and A, Shore A hardness of 10 to 20; black color.
- C. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.04 GLAZING ACCESSORIES

- A. Manufacturers:
1. Norton Performance Plastics Corp.
 2. Pecora Corporation: www.pecora.com.
 3. Tremco, Inc: www.tremcosealants.com.
 4. Substitutions: Refer to Section 01 60 00 - Product Requirements.

- B. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- C. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self-adhesive on one face.
- D. Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
- E. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option I; .
- F. Glazing Clips: Manufacturer's standard type.
- G. Transaction Window: CRL Cashier windows or approved equal.
 - 1. Stainless steel shelf with built-in deal tray and speak through.
 - 2. 30" width x 18" depth or as shown on drawings.
 - 3. See paragraph 2.01, item H above.
- H. Ballistic Glass Boxes: CRL Bullet Protection Hand Package Receiver or approved equal.
 - 1. Aluminum extrusion framing with level 3 ballistic clear glazing.
 - 2. 16" width x 16" or as shown on drawings.
 - 3. CPR31/CPR32; See drawings for handed direction(s).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant.
- D. Install sealants in accordance with manufacturer's instructions.

3.03 INSTALLATION - EXTERIOR WET/DRY METHOD (PREFORMED TAPE AND SEALANT)

- A. Cut glazing tape to length and set against permanent stops, 3/16 inch below sight line. Seal corners by butting tape and dabbing with butyl sealant.
- B. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete the continuity of the air and vapor seal.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
- E. Install removable stops, with spacer strips inserted between glazing and applied stops 1/4 inch below sight lines.
 - 1. Place glazing tape on glazing pane of unit with tape flush with sight line.
- F. Install removable stops, with spacer strips inserted between glazing and applied stops, 1/4 inch below sight line. Place glazing tape on glazing pane or unit with tape flush with sight line.
- G. Fill gap between glazing and stop with silicone type sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch below sight line.

- H. Apply cap bead of silicone type sealant along void between the stop and the glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.

3.04 INSTALLATION - INTERIOR WET/DRY METHOD (TAPE AND SEALANT)

- A. Cut glazing tape to length and install against permanent stops, projecting 1/16 inch above sight line.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against tape to ensure full contact at perimeter of pane or unit.
- D. Install removable stops, spacer shims inserted between glazing and applied stops at 24 inch intervals, 1/4 inch below sight line.
- E. Fill gaps between pane and applied stop with silicone type sealant to depth equal to bite on glazing, to uniform and level line.
- F. Trim protruding tape edge

3.05 CLEANING

- A. Remove glazing materials from finish surfaces.
- B. Remove labels after Work is complete.
- C. Clean glass and adjacent surfaces.

END OF SECTION

**SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Cementitious backing board.
- F. Gypsum wallboard.
- G. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire rated walls.
- B. Section 07 90 05 - Joint Sealers: Acoustic sealant.

1.03 REFERENCE STANDARDS

- A. AISI SG02-1 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2001 with 2004 supplement. (replaced SG-971)
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2013.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2018.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2020.
- J. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2020.
- N. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009, (reapproved 2016).
- O. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- P. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2016.
- Q. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2015.

- R. ICC (IBC) - International Building Code; Most recent edition adopted by the Authorities Having Jurisdiction.
- S. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board application and finishing, with minimum 3 years of documented experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. Fire Rated Partitions: UL listed assembly No. U419; 1 hour rating.
 - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL Fire Resistance Directory.

2.02 METAL FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - 5. Furring: "Z" shaped sections, minimum depth of 2 inches.
 - a. Contractors Option: Alternate "Z" Shaped Section: EcoStud, 100% recycled plastic studs as manufactured by Superior Polymer, phone 906-337-3355.
- B. Metal Framing: Drywall and Plaster Ceilings:
 - 1. Chicago Metallic Corporation - System 640 and fire Front 650.
 - 2. USG - Drywall Suspension System Flat for Ceilings, rated and non-rated one hour.
 - 3. Armstrong - Quickstix Drywall Ceiling Framing.
- C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- D. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.
 - 2. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
 - 3. Provide components UL-listed for use in UL-listed fire-rated head of partition joint systems indicated on drawings.
 - 4. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
 - b. Acceptable Products:
 - 1) "Posi Clip" by Fire Trak Corporation.

- 2) "The System" by Metal-Lite, Inc.
5. Provide top track preassembled with connection devices spaced to fit stud spacing indicated on drawings; minimum track length of 12 feet.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 1. CertainTeed Corporation: www.certainteed.com.
 2. Lafarge North America Inc: www.lafargenorthamerica.com.
 3. National Gypsum Company: www.nationalgypsum.com.
 4. USG Corporation: www.usg.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 4. Paper-Faced Products:
 - a. CertainTeed Corporation; ProRoc Brand Gypsum Board.
 - b. Lafarge North America Inc; Regular Drywall and Firecheck Type X and Type C.
 - c. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
 - d. USG Corporation; Sheetrock Brand Gypsum Panels.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Backing Board for Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
 1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 4. Type: Regular and Type X, in locations indicated.
 5. Type X Thickness: 5/8 inch.
 6. Regular Board Thickness: 5/8 inch.
 7. Edges: Tapered.
 8. Products:
 - a. CertainTeed Corporation; ProRoc Brand Moisture Resistant Gypsum Board ("Greenboard").
 - b. Georgia-Pacific Gypsum; DensShield Tile Backer.
 - c. Lafarge North America Inc; Watercheck ("Greenboard").
 - d. National Gypsum Company; Gold Bond Brand XP Gypsum Board.
 - e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced.
 1. Owens Corning - Noise Barrier Batts
 2. Manville - Sound Control Batts
 3. Certainteed - Sound Control Batts
 4. Guardian Fiberglass, Inc. - Sound Control Batts
- B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board. Acoustical sealant shall be as manufactured by one of the following or approved equal:
 1. Ohio Sealants Inc. - Sound Sealant Rubber Base
 2. Pecora - Acoustical Sealant
 3. Tremco -Acoustical Sealant

- C. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- D. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
 - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 - 2. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Ready-mixed vinyl-based joint compound.
 - 4. Powder-type vinyl-based joint compound.
 - 5. Chemical hardening type compound for use in mold resistant systems.
- E. Screws for Attachment to Steel Members Less Than 0.03 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium-plated for exterior locations.
- F. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.
- G. Resilient Furring Channels: 1/2 inch deep Galvanized steel, Dietrich RC Deluxe.
- H. Security Barrier Mesh: 16 gauge, 3/4" Diamond; Clark-Dietrich or approved equal

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Studs: Space studs as permitted by standard.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.
 - 2. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- C. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- D. Standard Wall Furring: Install at concrete and masonry walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 - 1. Orientation: Vertical.
 - 2. Spacing: As indicated.
- E. Acoustic Furring: Install resilient channels at maximum 24 inches on center. Locate joints over framing members.
- F. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
 - 1. Level ceiling system to a tolerance of 1/360.
 - 2. Main runners shall be installed 48" on center, and be directly suspended by not less than 12 gage galvanized steel wire spaced 48" on center along the furring runners. Hanger wires shall be wrapped tightly with at least 3 full turns.
 - 3. Furring main runners shall be interconnected by furring cross tees 48" long spaced 16" on center and also 8" from the ends of each gypsum drywall panel. Cross tees shall also be installed adjacent to all recessed light fixtures on each side not supported by a furring runner. Pay special attention to the type of lay-in light fixture and direction in which they are installed.
 - 4. Wall track shall be installed wherever suspension components meet vertical surfaces, and the suspension component ends shall be butt cut to fit into the wall track.

5. Studs: Space studs at 16 inches (400 mm) on center.
 - a. Extend stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
 - b. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
 6. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- G. Blocking: Install blocking for support of plumbing fixtures, wall cabinets, toilet accessories, and hardware. Bolt or screw steel channels to studs.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 1. Place one bead continuously on substrate before installation of perimeter framing members.
 2. Place continuous bead at perimeter of each layer of gypsum board.
 3. In non-fire-rated construction, seal around all penetrations by conduit, pipe, ducts, and rough-in boxes.
 4. Bottom of Partitions: Apply a round bead of sealant at each side stud track before setting gypsum board. Set gypsum board into sealant to form complete contact with adjacent materials.
 5. Top and Sides of Partitions Abutting Existing Construction or Non-acoustical New Construction - After gypsum board is installed apply acoustical sealant to provide full contact with adjacent existing surfaces at each side of the partition.
 6. Cut Outs - Backs of electrical boxes, pipes, ducts, and other equipment penetrating the wall surface shall be buttered with sealant and perimeter edges of all items sealed with sealant.

3.04 BOARD INSTALLATION

- A. Comply with ASTM C 840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- E. Installation on Metal Framing: Use screws for attachment of all gypsum board except face layer of non-rated double-layer assemblies, which may be installed by means of adhesive lamination.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
 2. Partition, furring or column fireproofing abuts a structural element (except floor) or dissimilar wall or ceiling.
 3. Ceiling or soffit abuts a structural element, dissimilar wall or partition or other vertical penetration.
 4. Construction changes within the plane of partition or ceiling.

5. Ceiling dimensions exceed fifty feet in either direction with perimeter relief, thirty feet without relief.
 6. Where wings of "L", "U" and "T" shaped ceiling areas are joined.
 7. Where gypsum board systems abut dissimilar materials, gypsum board shall be isolated by installing a casing bead within a 1/4" of the dissimilar material and sealing the joint with either acoustical sealant as specified above for sound insulated partitions or caulking as specified under Section 07 90 05.
 8. Ceiling height door frames may be used as control joints. Less than ceiling height frames shall have control joints extending to the ceiling from both corners. Window openings shall be treated similar to doors with joint extending to the floor as well as the ceiling. Control joints in gypsum board to gypsum board configurations shall be formed using expansion joint formers as specified above. Joints shall be caulked with sound sealant or caulking as specified in Section 07 90 05 as appropriate to the condition.
 9. Control joints in fire rated construction shall be formed with double studs and expansion joint former and backed with safig insulation as specified under Section 07 84 00.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.06 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, bedded and finished with chemical hardening type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 2. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
- D. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

END OF SECTION

SECTION 09 51 00
SUSPENDED ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 RELATED REQUIREMENTS

1.03 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; 2013a.
- B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- C. 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; 2014.
- D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- E. UL (FRD) - Fire Resistance Directory; current edition.

1.04 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.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning.
- C. Product Data: Provide data on suspension system components and acoustical units.

1.06 QUALITY ASSURANCE

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

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels: Design intent is to match that of existing conditions.
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. Hunter Douglas Architectural; Techstyle Series: www.hunterdouglasarchitectural.com/#sle.
 - 4. USG: www.usg.com.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.

- B. Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
 - 1. Size: 24 by 48 inches.
 - 2. Thickness: 3/4 inches.
 - 3. Composition: Wet felted.
 - 4. Edge: Reveal edge.
 - 5. Surface Color: White.
 - 6. Surface Pattern: Fine textured.
 - 7. Substitutions: See Section 01 60 00 - Product Requirements.
 - 8. Suspension System: Exposed grid.
- C. SAT-1:
 - 1. USG Mars #86185HRC 2'x4'x3/4" SLT edge, white
 - 2. Class A Fire Rating
 - 3. 0.70 NRC
 - 4. 35 CAC min
 - 5. USG Donn Brand DX/DXL suspension system
 - 6. 15/16" grid profile – flat white 050
- D. SAT-2:
 - 1. USG Clean Room Acoustical Panels
 - 2. Class A Fire Rating
 - 3. 2'x4' SQ edge detail, white
 - 4. Class A Fire Rating
 - 5. 0.55 NRC;33 CAC min
 - 6. USG Donn Brand DX/DXL suspension system
 - 7. 15/16" grid profile – flat white 050

2.03 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 - 1. Same as for acoustical units.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. 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.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; intermediate-duty.
 - 1. Profile: Tee; 15/16 inch wide face.
 - 2. Construction: Double web.
 - 3. Finish: White painted.

2.04 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. 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. Furnish and install ceiling hold down clips for all lay-in ceilings that are installed in Vestibules or within twenty feet of an exterior door
- D. Ceiling holddown clips.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- C. 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.
- D. 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.
- E. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- F. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- G. Do not eccentrically load system or induce rotation of runners.
- H. 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.

3.03 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- G. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 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 SECTION INCLUDES

- A. VCT
- B. Resilient flooring.
- C. Resilient base.
- D. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2011.
- B. ASTM F970 - Standard Test Method for Static Load Limit; 2007 (Reapproved 2011).
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2004 (Reapproved 2014)e1.
- D. ASTM F1861 - Standard Specification for Resilient Wall Base; 2008 (Reapproved 2012)e1.
- E. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2004 (Reapproved 2014).
- F. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; Federal Specifications and Standards; Revision E, 1994.
- G. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute; October 2011.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, installation adhesives and accessories, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plan.
- D. Selection Samples: Submit manufacturer's complete set of color samples for Architect's initial selection.
- E. Verification from the flooring installer, in writing, on his letterhead, indicating that he has reviewed the concrete moisture content testing reports, or has conducted his own moisture content tests and accepts the moisture levels present within the concrete slab as acceptable for the installation of the products being furnished.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect roll materials from damage by storing on end.

1.06 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 VCT FLOORING

- A. VCT: Nora by Interface – Noraplan Environcare Tile
 - 1. Color: TBD
 - 2. Dimensions: 24" x 24" (610mm x 610mm)
 - 3. Thickness: 0.08" (2.0 mm)
 - 4. *Integral Cove base as noted at locations shown on drawings.
 - 5. Contact: Nora Lewandowski nora.lewandowski@interface.com

2.02 SHEET FLOORING

- A. SV: Nora by Interface – Noraplan Environcare Sheet
 - 1. Color: TBD
 - 2. Dimensions: 49.21' x 48" (15m x 1.22m)
 - 3. Overall Thickness: 0.08" (2.0 mm)
 - 4. *Integral Cove base as noted at locations shown on drawings.
 - 5. Contact: Nora Lewandowski nora.lewandowski@interface.com

2.03 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Height: 4 inch, or as noted.
 - 2. Thickness: 0.125 inch thick.
 - 3. Finish: Satin.
 - 4. Accessories: Premolded external corners and end stops.
 - 5. Manufacturers:
 - a. VB1 - VINYL BASE - 4" Cove Johnsonite
 - b. Substitutions: Not permitted.

2.04 ACCESSORIES

- A. Subfloor Filler: Cement based; type recommended by adhesive material manufacturer. No gypsum based fillers are allowed.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: Metal.
- D. Filler for Sheet Vinyl Coved Base: Plastic.
- E. Cap for Sheet Vinyl Coved Base: Vinyl

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive resilient flooring.
- C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- E. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.

- F. Verify that concrete sub-floor surfaces are ready for resilient flooring installation by reviewing testing report for moisture emission rate and alkalinity; obtain instructions if test results are not within the following limits:
 1. Moisture emission rate: Not greater than 3 lb per 1000 sq ft per 24 hours when tested using calcium chloride moisture test kit for 72 hours, as per ASTM F 1869-03.
 2. Alkalinity: pH range of 5-9.
 3. Installer shall verify in writing that he has reviewed the test results and is satisfied that the installation can proceed.
- G. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
 1. Sub-floor filler used on concrete slab on grade construction shall be cement based.
 2. No Gypsum based sub-floor fillers are allowed.
- D. Prohibit traffic until filler is fully cured.
- E. Clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions. Design intent is to match that of existing conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Spread only enough adhesive to permit installation of materials before initial set.
- D. Fit joints and butt seams tightly.
- E. Set flooring in place, press with heavy roller to attain full adhesion.
- F. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- G. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- H. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 FLOORING

- A. Install in accordance with manufacturer's instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Set flooring in place, press with heavy roller to attain full adhesion.
- D. 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 carefully at seams.
- E. Seal seams by heat welding where indicated.
- F. Double cut sheet at seams.
- G. Lay flooring with tightly butted seams, without any seam sealer unless otherwise indicated.
- H. Finish seams in sheet vinyl by heat welding.
- I. Double cut sheet; provide heat welded seams.
- J. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

- K. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Before installation of flooring, secure metal strips with stainless steel screws. Secure resilient strips by adhesive.
- L. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip and cap with a vinyl cap.
- M. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.05 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.
- C. Clean, seal, and wax resilient flooring products in accordance with manufacturer's instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. No thresholds in any floor areas. Coordinate with architect for further information.

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.
- B. Section 09 65 00 – Resilient Flooring: Coordinate flooring transitions referenced in accessories.

1.03 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2006 (Reapproved 2011).
- B. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2005.
- C. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2014c.
- D. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.
- E. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.
- F. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Carpet and Rug Institute; Current Edition.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; National Fire Protection Association; 2015.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate layout of joints.
- C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.07 EXTRA MATERIALS

- A. See Section 01 60 00 - Product Requirements, for additional provisions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tile Carpeting: Tufted, manufactured in one color dye lot.
 - 1. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - 2. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 - 3. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.

2.02 TILE CARPETING

- A. Schedule:
 - 1. CPT-1: Patcraft – Pivot Point
 - a. Color: TBD
 - b. 12" x 48" Carpet Tile
 - c. Loop
 - d. Solution Dyed
 - e. .221 Total Thickness
 - f. Primary Backing: Non-Woven Synthetic
 - g. Herringbone
 - h. Provide minimum 1 full carton attic stock
 - i. Contact: TBD
- B CPT 2: Patcraft – Pivot Point
 - a. Color: TBD
 - b. 12" x 48" Carpet Tile
 - c. Loop
 - d. Solution Dyed
 - e. .221 Total Thickness
 - f. Primary Backing: Non-Woven Synthetic
 - g. Herringbone
 - h. Provide minimum 1 full carton attic stock
 - i. Contact: TBD

2.03 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Transition strips, color as selected by Architect.
- C. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
 - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- C. Vacuum clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Fully adhere carpet tile to substrate.
- G. Trim carpet tile neatly at walls and around interruptions.
- H. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

SECTION 09 90 00
PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints and other coatings.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Ceramic and other tiles.
 - 7. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
 - 8. Exterior insulation and finish system (EIFS).
 - 9. Glass.
 - 10. Concealed pipes, ducts, and conduits.

1.02 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 D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials; 2007.
- C. GreenSeal GS-11 - Paints and Coatings; 2013.
- D. SSPC (PM1) - Good Painting Practice: SSPC Painting Manual, Vol. 1; Society for Protective Coatings; Fourth Edition.
- E. SSPC (PM2) - Steel Structures Painting Manual, Vol. 2, Systems and Specifications; Society for Protective Coatings; 1995, Seventh Edition.

1.03 DEFINITIONS

- A. Conform to ASTM D 16 for interpretation of terms used in this section.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Product Data: Provide data on all finishing products, including VOC content.
- E. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on gypsum board.

- F. Certification: By manufacturer that all paints and coatings comply with VOC limits specified.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Extra Paint and Coatings: 1 gallon of each color; store where directed.
 3. Label each container with color in addition to the manufacturer's label.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 10 years experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Minimum Application Temperature for Varnish Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
- F. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints: Provide Zero VOC latex paints for each manufacturer.
 1. Base Manufacturer: Sherwin Williams (SW) - ProMar 200 Zero - VOC Mixture.
 2. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
 3. Benjamin Moore & Co: www.benjaminmoore.com.
 4. Pittsburgh Paints
 5. Pratt & Lambert.
 6. Diamond Vogel
- C. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. 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. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Non-flat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - 4) Varnishes: 350 g/L, maximum.
 - c. Architectural coatings VOC limits of State in which the project is located.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Chemical Content: The following compounds are prohibited:
1. Aromatic Compounds: In excess of 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
 2. Acrolein, acrylonitrile, antimony, benzene, butyl benzyl phthalate, cadmium, di (2-ethylhexyl) phthalate, di-n-butyl phthalate, di-n-octyl phthalate, 1,2-dichlorobenzene, diethyl phthalate, dimethyl phthalate, ethylbenzene, formaldehyde, hexavalent chromium, isophorone, lead, mercury, methyl ethyl ketone, methyl isobutyl ketone, methylene chloride, naphthalene, toluene (methylbenzene), 1,1,1-trichloroethane, vinyl chloride.
- E. Flammability: Comply with applicable code for surface burning characteristics.
- F. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint WE-TR-S - Wood, Transparent, Sealer, Optional Stain:
1. Two coats of stain; SW Woodscapes Semi-Transparent or Solid Color as directed by Architect.
- B. Paint CE-OP-3L - Exterior Masonry, Opaque, Latex, 3 Coat:
1. One coat of Primer; SW Loxon Masonry Primer.
 2. Flat: Two coats of latex enamel; SW Loxon Acrylic Coating.
- Trash enclosure coating system shall be TUFF II manufactured by Styro Industries; P.O. Box 8098 Madison, WI 53708; www.styro.net; or equal.
- C. Paint ME-OP-2L - Exterior Ferrous Metals, Primed, Latex, 2 Coat:
1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 2. Eggshell: Two coats of latex enamel; SW DMT Acrylic Eggshell Coating.

2.04 PAINT SYSTEMS - INTERIOR

- A. Paint WI-OP-3L - Interior Wood, Opaque, Latex, 3 Coat:
1. One coat of latex primer sealer, SW PrepRite Classic Latex Primer.
 2. Flat: Two coats of latex enamel, SW Pro-Mar 200 Interior Latex Flat.

- B. Paint WI-TR-VS - Wood, Transparent, Varnish, Stain:
 - 1. Filler coat (for open grained wood only).
 - 2. One coat of stain; SW Wood Classics Oil Stain.
 - 3. One coat sealer; SW Wood Classics Sanding Sealer.
 - 4. Satin: Two coats of varnish; SW Wood Classics Polyurethane.
- C. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat, WALLS:
 - 1. One coat of block filler, SW PrepRite Block Filler (B25W25).
 - 2. Eggshell: Two coats of latex enamel, SW Sherscrub Eggshell.
- D. Paint MI-OP-2L - Ferrous Metals, Primed, Latex, 2 Coat.
 - 1. Touch-up with latex primer.
 - 2. Semi-gloss: Two coats of latex enamel; SW DMT Acrylic Eggshell Coating B66-2100.
- E. Paint MI-OP-2DF - Roof Deck, Primed, Dryfall, 2 Coat
 - 1. Touch-up with Alkyd primer
 - 2. Dryfall Paint: Two Coats Waterborne Acrylic Dryfall Paint (B42).
- F. Paint GI-OP-3L - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat, WALLS:
 - 1. One coat of Latex primer sealer, SW Interior Latex Primer.
 - 2. Eggshell: Two coats of latex enamel; SW Sherscrub Supreme Latex Eggshell.
- G. Paint GI-OP-3LA - Gypsum Board/Plaster, Latex-Acrylic, 3 Coat, CEILINGS:
 - 1. One coat of Latex primer sealer, SW Interior Latex Primer.
 - 2. Flat: Two coats of latex enamel-acrylic; SW Sherscrub.
- H. Paint GI-OP-3EP - Gypsum Board/Plaster, Epoxy, 3 Coat, WALLS & CEILINGS.
 - 1. One coat of SW Interior Latex Primer.
 - 2. Two coats of water based epoxy SW PRO Industrial Pre-Catolyzed Waterbased Epoxy.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
 - 4. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating 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. Surfaces: Correct defects and clean surfaces which affect work of this section. Remove or repair existing coatings that exhibit surface defects.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- H. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- J. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- K. Interior Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.
- L. Exterior Wood to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior calking compound after sealer has been applied. Prime concealed surfaces.
- M. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's instructions.
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance.
- D. Sand wood and metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

3.06 SCHEDULE - SURFACES TO BE FINISHED

- A. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically noted.
 - 2. Fire rating labels, equipment serial number and capacity labels.
- B. Paint the surfaces described below under Schedule - Paint Systems.
- C. Mechanical and Electrical: Use paint systems defined for the substrates to be finished.
 - 1. Paint all insulated and exposed pipes occurring in finished areas to match background surfaces, unless otherwise indicated.
 - 2. Paint shop-primed items occurring in finished areas.
 - 3. Paint interior surfaces of air ducts and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
 - 4. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

3.07 SCHEDULE - PAINT SYSTEMS

- A. Concrete, Concrete Block: Finish all surfaces exposed to view.
 - 1. Interior: CI-OP-3L, Walls, Eggshell.
 - 2. Interior: CI-OP-3E, Walls and Ceilings, Gloss Epoxy as noted on drawings.
- B. Gypsum Board: Finish all surfaces exposed to view.
 - 1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
 - 2. Interior Walls: GI-OP-3L, Eggshell.
 - 3. Interior Walls and Ceilings: GI-OP-3EP, epoxy as scheduled.
- C. Wood: Finish all surfaces exposed to view.
 - 1. Interior Paneling & Trim: WI-TR-VS, gloss.
- D. Steel Frames: Finish all surfaces exposed to view; MI-OP-2L, semi-gloss.
- E. Steel Fabrications: Finish all surfaces exposed to view.
 - 1. Interior: MI-OP-2L, semi-gloss.

3.08 SCHEDULE - COLORS

- A. Contractor shall allow for up to 10 colors to be used throughout the project. Colors not described below may be patch to match existing.
- B. Accent colors will be used on various wall surfaces, see finish plan for locations.
- C. The following colors have been pre-selected, other colors may be chosen at a later date:
 - 1. Semi-gloss for ferrous metals
 - 2. Eggshell for walls
 - 3. Flat for ceilings / soffits
 - 4. PNT-1: Color TBD
 - 5. PNT-2: Color TBD
 - 6. PNT-3: Color TBD

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Signage.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities; Final Rule; current edition; (ADA Standards for Accessible Design).
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Signage: Shall match the signage from the existing facilities.
 - 1. Text schedule shall be developed by the sign supplier and coordinated with the Owner/Architect.

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: All signs are required to comply with ADA Standards for Accessible Design and ANSI/ICC A 117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Interior Directional and Informational Signs.

2.03 PART 3 EXECUTION

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

B. Installation:

1. Install in accordance with manufacturer's instructions.
2. Install neatly, with horizontal edges level.
3. Locate signs where indicated:
 - a. If no location is indicated obtain Owner's instructions.
4. Protect from damage until Substantial Completion; repair or replace damage items.

END OF SECTION

**SECTION 10 26 01
WALL AND CORNER GUARDS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 Gypsum Board Assemblies: Substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards: Match that of existing conditions.
 1. Arden Architectural Specialties, Inc; Product CG-V: www.ardenarch.com.
 2. Construction Specialties, Inc; Product VA series: www.c-sgroup.com.
 3. InPro Corporation; Product Textured Tape On Corner Guards: www.inprocorp.com.
 4. Pawling Corporation; Product CG-13: www.pawling.com.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

- A. Corner Guard - Surface Mounted: Extruded one-piece unit, installed with tape.
 1. InPro Series 160 Surface Mount Corner Guards w/ Aluminum retainer
 2. Wing Size: 2"
 3. Height: 8'
 4. Color: standard colors, multiple colors may be used. Selected by Architect
 5. Contact: Todd Thoma; 612.578.5657

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only. Install at top of wall base.

3.02 SCHEDULE

- A. Install corner guards at all outside corners, or as shown and noted on the drawings.

END OF SECTION

SECTION 10 28 00
TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Accessories for toilet rooms, showers, and utility rooms.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 – Rough Carpentry: Related work.
- B. Section 06 41 00 – Architectural Wood Casework: Mop holder for casework, see drawings.

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2012.
- B. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2010.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- E. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium; 2011e1.
- F. ASTM C1036 - Standard Specification for Flat Glass; 2011e1.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2008.
- H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2004 (Reapproved 2010).
- I. GSA CID A-A-3002 - Mirrors, Glass; U.S. General Services Administration; 1996.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Products listed are made by Bobrick.
- B. Other Acceptable Manufacturers:
 - 1. A & J Washroom Accessories Inc: www.ajwashroom.com.
 - 2. American Specialties, Inc: www.americanspecialties.com.
 - 3. Bradley Corporation: www.bradleycorp.com.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
 - 1. Grind welded joints smooth.
 - 2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

- B. Keys: Provide 2 keys for each accessory to Owner; master key all lockable accessories.
- C. Stainless Steel Sheet: ASTM A666, Type 304.
- D. Stainless Steel Tubing: ASTM A269, Type 304 or 316.
- E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- F. Mirror Glass: Float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- G. Adhesive: Contact type, waterproof.
- H. Fasteners, Screws, and Bolts: Hot dip galvanized, tamper-proof, security type.
- I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

- A. Stainless Steel: No. 4 satin brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy baked enamel.
- D. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.
- E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.
- F. Back paint components where contact is made with building finishes to prevent electrolysis.

2.04 TOILET ROOM ACCESSORIES

- A. Paper Towel Dispenser: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.
 - 1. Capacity: 400-C Fold minimum.
 - 2. Product: B-262 manufactured by Bobrick.
- B. Soap Dispenser: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and horizontal stainless steel tank and working parts; push type soap valve, check valve, and window gage refill indicator, tumbler lock.
 - 1. Minimum Capacity: 40 ounces.
 - 2. Product: B-2111 manufactured by Bobrick.

2.06 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch (1.3 mm) thick stainless steel, Type 304, with 1/2 inch (12 mm) returned edges, 0.06 inch (1.6 mm) steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4 inch (6 mm) diameter.
 - 2. Hooks: 2, 0.06 inch (1.6 mm) stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: 3 spring-loaded rubber cam holders at shelf front.
 - 4. Length: 30 inches.
 - 5. Product: B-224 manufactured by Bobrick.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights and Locations: As required by accessibility regulations, as indicated on drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Accessories.

1.02 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2020.

1.03 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by Underwriters Laboratories Inc. for the purpose specified and indicated.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate cabinet physical dimensions.
- C. Product Data: Provide extinguisher operational features.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguisher Cabinets and Accessories:
 - 1. JL Industries, Inc; Product Cosmic 10E Extinguisher: www.jlindustries.com.
 - 2. Larsen's Manufacturing Co; Product MP10 Extinguisher: www.larsensmfg.com.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
- B. Dry Chemical Type Fire Extinguishers: Cast steel tank, with pressure gage.
 - 1. Class A B:C.
 - 2. Size 10.
 - 3. Finish: Baked enamel, Red color.

2.03 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers on wall brackets.

3.03 SCHEDULES

- A. F.E. = Fire Extinguisher with wall bracket.

END OF SECTION

SECTION 10 51 00

LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Locker units with hinged doors.
- B. Metal filler panels.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on locker types, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan.
- D. Samples: Submit two samples 3 x 6 inches (75 x 150 mm) in size, of each color scheduled; applied to specified base metal.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Lockers:
 - 1. Lyon Workspace Products; Product Standard Quiet Lockers: www.lyonworkspace.com.
 - 2. Penco Products, Inc; Product Guardian: www.pencoproducts.com.
 - 3. Republic Storage Systems Co; Product Quiet Lockers: www.republicstorage.com.
 - 4. List Industries, Inc.; Product Whisper Quiet Premier Locker.
 - 5. Art Metal Products; Product Artisan Silent Lockers.
 - 6. Hadrian; Product Emperor.
 - 7. Hallowell; Product Silent KD Lockers.
 - 8. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Sheet Steel: ASTM A653/A653M SS Grade 33/230, with G60/Z180 coating, stretcher leveled; to the following minimum thicknesses:
 - 1. Body and Shelf: 24 gage, 0.024 inch
 - 2. Door Outer Face: 16 gage
 - 3. Door Frame: 16 gage
 - 4. Hinges: 14 gage, 0.075 inch
 - 5. Base: 20 gage, 0.036 inch
 - 6. Trim: 20 gage, 0.036 inch
- B. Accessories for Each Locker: one double prong ceiling hook, three single prong wall hooks, and shelf.
- C. Locker Benches: Stationary type; bench top of laminated maple species wood, stained, sealed and varnished; pedestals of chrome steel, 18 inches high.

2.03 LOCKER UNITS

- A. Width: 12 inches
- B. Depth: 12 inches
- C. Height: 60 inches
- D. Configuration: two tier.

- E. Mounting: Surface mounted.
- F. Base: Metal base.
- G. Top: sloped metal with closures.
- H. Locking: Recessed Handle Equipped for padlock hasps.
- I. Ventilation Method: Door louvers.
- J. Class: Quiet.
- K. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
- L. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
- M. Locking device supplied by others.
- N. Number Plates: Provide oval shaped aluminum plates. Form numbers of block font style, in contrasting color.
- O. Provide ventilation openings at top and bottom of each locker.
- P. Form recess for operating handle and locking device.
- Q. Finish edges smooth without burrs.
- R. Fabricate metal tops and closure pieces.

2.04 FINISHING

- A. Clean, degrease, and neutralize metal; prime and finish with one coat of baked enamel.
- B. Paint locker units 1 color, as selected.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Place and secure on prepared base.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install end panels and filler panels.
- F. Install accessories.
- G. Replace components that do not operate smoothly.

3.02 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 10 56 13
METAL STORAGE SHELVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal storage shelving.
- B. Shelving units.
- C. Accessories.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers literature and technical specifications.
- C. Shop Drawings: Detailed drawings of assembly, including interfaces with supporting structure.
 - 1. Use a scale sufficiently large enough to show all pertinent features.
 - 2. Submit in the form of black line prints.
- D. Selection Samples: For each finish material specified submit material or color chips showing full range of manufacturers standard colors.

1.03 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard one year warranty from Date of Substantial Completion, covering all parts and including the cost of materials and labor for replacement of defective parts.

1.04 MAINTENANCE SERVICE

- A. Provide one-year maintenance service contract through office located within 200 miles from the project site, including maximum 4 hour turn-around time on all requests for service and factory trained and authorized service personnel.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Space Saver, 4 post shelving or as shown on drawings.
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that are the standard manufactured products of a single manufacturer, not a custom design.
- C. Provide products that are U.S. made or assembled.

2.02 MANUFACTURED UNITS

- A. Design:
 - 1. Wedge-lock type consisting of uprights, shelves, and shelf supports, designed to be assembled without fasteners or clips. Shelves shall not have any holes on exposed surfaces. Front and back flanges shall be flush with outside faces of posts. Design shall permit individual shelf adjustment and/or removal anywhere along the entire height of uprights.
 - a. Finishes: from standard line.
- B. Materials and Workmanship:
 - 1. Fabricate units from Class 1, cold-rolled steel sheet with all bends sharp and true and no exposed "knife" edges.
 - a. All units shall be free of burrs, sharp edges and projecting hardware with smooth, non-abrasive surfaces and edges.
 - b. After fabrication, shelving shall exhibit no dents, "oil canning", buckling or other surface irregularities.

- C. Uprights:
 1. Formed from steel sheet to a hollow “tee” shape for intermediate supports and formed angles for end supports. Uprights shall have keyhole slots on inner wall only. Provide with sheet steel panels full height and depth of end uprights. Provide intermediate “tee” uprights between adjacent units
- D. Shelves:
 1. Form from sheet steel with flanges on all sides and return hem on front and back flanges. Ends shall be formed to clear inside of upright offset panels. Shelves shall be independently adjustable. Provide all shelves with slots for file dividers.
- E. Canopy Tops:
 1. Same construction as shelf units.
- F. Shelf Supports:
 1. Form from heavy gauge steel sheet with four solid steel shoulder rivets, two per ear, that interlock with inner wall of uprights.
- G. Nominal Shelf Dimensions:
 1. Width: 12 inches (305MM) to 72 inches (1829MM) sections used to meet project requirements.
 2. Shelf Edge Vertical Profile: 3/4 inch (19MM) maximum.
 3. Vertical Adjustment Increment: 1-1/2 inches (38MM).
 4. Width Of Intermediate Uprights: 2 inches (51MM).
 5. Clearance Between Uprights: Nominal shelf section width minus 2 inches (51MM).
 6. Levelness of Completed Shelf Units: Maximum 1/8 inch (3.2MM) between bottom shelf and canopy top, measured along the edge of any upright in any direction.
 7. Number of Vertical Shelf Spaces: As indicated on the drawings.
 8. Vertical Shelf-To-Shelf Spacing: As indicated on the drawings.
- H. Load Carrying Capabilities:
 1. Provide shelf units capable of supporting 40 pounds per lineal foot (18kg/305MM) with maximum deflection of L/140. Shelves shall exhibit no permanent deflection under fully loaded conditions.
- I. Accessories:
 1. Center Stops: Provide manufacturer’s standard. For Files rm 112
 2. Laminate End Panel: Provide manufacturer’s standard. For rm 112 & rm 131
 3. End Panel Mounting Brackets: Provide manufacturer’s standard. For Files rm 112 & Evidence holding rm 131
 4. Bin Dividers for compartments: Provide manufacturer’s standard. For Equipment rm 130
 5. Hanging rods for uniform storage: Provide manufacturer's standard. For Equipment rm 130
 6. File Drawers: Files rm 112
 - a. Drawers shall be mounted to closed type 4-post uprights with mounting brackets and be adjustable on [1.5] inch increments vertically.
 - b. Compatible with closed 4-Post uprights only.
 - c. Drawer sizes:
 - 1) HEIGHT: Available in nominal heights of [12] inches
 - 2) WIDTH: Available in nominal widths of [48] inches (variable in 1-inch increments).
 - 3) DEPTH: Available in single-face or back-to-back closed 4-Post uprights in depths of [15] inches (variable in 1-inch increments).
 - d. Drawer construction shall be a minimum 16-gauge cold rolled steel for the drawer body 16-gauge cold rolled steel for the drawer front and reinforcement channels (as required).
 - e. Drawer shall include hardware to allow for hanging files storage.
 - f. Drawers shall have the ability to support a uniformly distributed load of 100 pounds without impeding the smooth operation of the drawer.

- g. Drawer slides shall provide full-extension and soft-close functionality and consist of ball bearing drawer slides with built-in detents.
- h. Drawer bodies shall be painted with non-off gassing powder coat paint.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine shelving units scheduled to receive accessories [with Installer present] for compliance with requirements for installation tolerances and other conditions affecting performance of specified accessory items.
- B. Verify that intended installation locations of sorter unit units will not interfere with or block established required exit paths or similar means of egress once units are installed.
- C. Proceed with accessory installation only after unsatisfactory conditions have been corrected.

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. General: Follow manufacturer's written instructions for installation of each type of accessory item specified.

3.04 PROTECTION

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

3.05 ADJUSTING

- A. Adjust all accessories to provide smoothly operating, visually acceptable installation.

3.06 DEMONSTRATION/TRAINING

- A. Schedule and conduct demonstration of installed accessory items and features with Owner's personnel.
- B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.04 PROTECTION

- A. Protect installed products until completion of project.

END OF SECTION

SECTION 10 56 26

MOBILE STORAGE SHELVING UNITS (MECHANICALLY ASSISTED BY SPACESAVOR)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mechanically assisted, carriage mounted high-density mobile storage units, support rails, fabrication, and installation including leveling of support rails.
- B. Shelving units.
- C. Accessories.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers literature and technical specifications.
- C. Shop Drawings: Detailed drawings of assembly, including interfaces with supporting structure.
 - 1. Use a scale sufficiently large enough to show all pertinent features.
 - 2. Submit in the form of black line prints.
- D. Selection Samples: For each finish material specified submit material or color chips showing full range of manufacturers standard colors.

1.03 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard one year warranty from Date of Substantial Completion, covering all parts and including the cost of materials and labor for replacement of defective parts.

1.04 MAINTENANCE SERVICE

- A. Provide one-year maintenance service contract through office located within 200 miles from the project site, including maximum 4 hour turn-around time on all requests for service and factory trained and authorized service personnel.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Space Saver, High Density – 2 units or as shown on drawings.
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that are the standard manufactured products of a single manufacturer, not a custom design.
- C. Provide products that are U.S. made or assembled.

2.02 MOBILE SHELVING

- A. General: The system consists of manufactured storage units mounted on manufacturer's track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until the desired aisle is opened. The carriage/rail system provides uniform carriage movement along the total length of travel, even with unbalanced loads.
- B. Carriage System Design and Features: The carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails [recessed][surface] mounted to the floor. Rails shall be types selected by the manufacturer to ensure smooth operation and self-centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by the manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

- C. Movement Controls: Triple or single arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 40 inches (1051MM) from the base of each unit to permit units to be moved to create a single aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.
- D. Drive System: The system shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.
 - 1. System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.
 - 2. A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.
 - 3. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
- E. Safety Features:
 - 1. Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.
 - 2. A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.
- F. Finishes:
 - 1. Fabricated Metal Components And Assemblies: Manufacturer's standard powder coat paint finish.
 - 2. End Panels, Accessible Ends: Manufacturer's standard powder coat paint finish.86

2.03 COMPONENTS

- A. Rails:
 - 1. Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer's selection.
 - 2. Capacity: 1,000 pounds per lineal foot (1385kg/M) of carriage.
 - 3. Minimum Contact Surface: 5/8 inch (16MM) wide.
 - 4. Provide rail sections in minimum 6 foot (1.83M) lengths.
 - 5. Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
 - 6. Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.
 - 7. [Anti-Tip Rail Form Covers: Manufacturer shall provide for protection if required [to prevent damage to rails during concrete back pours.] [when anti-tip devices are installed].
- B. Floor / Ramp:
 - 1. Floor/Ramp Sheathing: Minimum 3/4 inch (19MM), 5-ply underlayment grade plywood. Particle board sheathing materials are not permitted.
 - 2. Provide fire retardant treated floor/ramp materials when required by code.
 - 3. Finished flooring materials shall be provided by [the Owner] [others].
- C. Carriages:
 - 1. Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
 - 2. Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.

3. When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.
 4. Design carriages to allow the shelving uprights to recess and interlock into the carriages a minimum of 3/4 inch (19MM). Top mount carriages are unacceptable.
 5. Provide each carriage with two wheels per rail.
- D. Drive / Guide System:
1. Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
 - a. If line shafts are used, all wheels on one side of carriage shall drive.
 - b. If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.
 2. Shafts: Solid steel rod or tube.
 3. Shaft Connections: Secured couplings.
 4. Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.
- E. Wheels:
1. Capacity: Minimum load capacity per wheel: 3200 lbs (1455kg).
 2. Size: Minimum 5 inches (127MM), outside diameter drive wheels.
 3. Guides: Determined by manufacturer; minimum 2 locations.
- F. Face Panels:
1. Materials: Plastic laminate clad particle board with plastic edging on vertical edges.
 2. Finishes: [Selected from manufacturer's standard available colors and patterns.]
[(Optional) Selected by the [Architect] [Architect/Engineer] [Engineer] [Designer].
- G. Accessories:
1. Anti-Tip Devices: Provide manufacturer's standard fixtures.]
 2. Carriage Mount Locks: Provide manufacturer's standard.]
 3. Mechanical Sweep and Safety Stop (Non-Powered).]

Every potential aisle shall be protected with a 3" (76 mm) high extruded aluminum safety sweep, hinged from the carriage using spring steel leaf springs, with the base edge maximum 3/4" (19mm) from the floor. The carriage(s) shall stop when depressed at any location along the leading edge of the sweep surface. Activated safety sweep shall engage an impact- absorbing friction disk brake to protect occupants, stored media and the carriage system itself via a sheathed cable system comprised of aircraft-grade 3/64" (1.2mm) stainless steel core cables housed inside lined conduit. Safety sweep shall have bright, red and white safety identification tape applied full length marking its location. Safety sweep shall run the full length of both sides of each moveable carriage for full aisle coverage.

Mechanical safety sweep shall automatically reset to enable mobile system users to freely and safely back carriages away from aisle obstructions simply by reversing the direction of the rotating handle.

Safety sweep shall be operational when the carriages are not moving. Should a sweep be activated in an open aisle, the carriage with the activated sweep will not close on that aisle. Safety sweep shall automatically reset if activated and then released when the carriages are not moving.

Safety sweep shall require no electrical power or batteries to operate.
 4. [(Optional) Automatic Aisle Locks.]

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.

- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Examine floor surfaces with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of mobile storage units.
- D. Verify that building structural system is adequate for installing mobile storage units at locations indicated on approved shop drawings.
 - 1. [In new construction, ensure that recesses for rails in floors are at proper spacing and depths, with allowance for grouting.]
 - 2. [For installations on existing floors, ensure that rail spacings indicated on shop drawings are in proper locations so existing load-bearing structural members are not over stressed.]
- E. Verify that intended installation locations of mobile storage units will not interfere with nor block established required exit paths or similar means of egress once units are installed.
- F. Prepare written report, endorsed by Installer, listing conditions detrimental to proper performance of mobile storage units, once installed.
- G. Proceed with installation only after unsatisfactory conditions have been corrected.

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.
- B. Rails:
 - 1. Lay out rails using full length units to the maximum extent possible. Use cut lengths only at ends to attain total length required. Locate and position properly, following dimensions indicated on approved shop drawings. Verify thickness of finished floor materials to be installed (by others) and install level 1/16 inch (0.6MM) above finished floor surfaces.
 - 2. Verify level, allowing for a minimum 1/4 inch (6MM) of grout under high points. Position and support rails so that no movement occurs during grouting.
 - 3. Set rails in full grout bed, completely filling any voids entire length of all rails including rail connectors. Trim up sides flush with rails to ensure proper load transfer from rail to supporting floor. Using shims in lieu of full grouting is not permitted.
 - 4. Installation Tolerances: Do not exceed levelness of installed rails listed below:
 - a. Maximum Variation From True Level Within Any Module: 3/32 inch (2.4MM).
 - b. Maximum Variation Between Adjacent (Parallel) Rails: 1/16 inch (1.6MM), perpendicular to rail direction.
 - c. Maximum Variation In Height: 1/32 inch (.8MM), measured along any 10 foot (3.05M) rail length.
 - 5. Verify rail position and level; anchor to structural floor system with anchor type and spacings indicated on approved shop drawings.
- C. Floors/Ramps:
 - 1. General: Finished elevation shall be 1/16 inch (1.6MM) below top of rails.
 - 2. Place floors and ramps to the extent indicated on approved shop drawings. Extend ramps under all movable ranges. [Extend under stationary ranges if dual control access is required.] Provide ramp at both ends of mobile system. Do not extend ramps beyond the ends of carriages.
 - 3. Construct floors and ramps to prevent warping or deformation of floor panels in a normal operating environment. Support panels on levelers at maximum 16 inches on center.
 - 4. Ramp Slope: Do not exceed the following:
 - a. ADA Accessible Ramps: Maximum 1:12 slope (4.76 degrees).
 - b. Other Ramps: Maximum 9 degree slope (1.9:12).

- c. Vertical Transition, Ramp edge to floor: Maximum 1/8 inch (3MM).
- D. Shelving Units Installation:
 - 1. General: Follow layout and details shown on approved shop drawings and manufacturer's printed installation instructions. Position units level, plumb; at proper location relative to adjoining units and related work.
 - 2. Carriages:
 - a. Place movable carriages on rails. Ensure that all wheels track properly and centering wheels are properly seated on centering rails. Fasten multiple carriage units together to form single movable base where required.
 - b. Position fixed carriage units to align with movable units.
 - 3. Shelving Units:
 - a. Permanently fasten shelving units to fixed and movable carriages with vibration-proof fasteners.
 - b. Stabilize shelving units following manufacturer's written instructions. Reinforce shelving units to withstand the stress of movement where required and specified.

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 10 56 26.13

MOBILE STORAGE SHELVING UNITS (MECHANICALLY ASSISTED BY SPACESAVOR)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mechanically assisted, carriage mounted high-density mobile storage units, support rails, fabrication, and installation including leveling of support rails.
- B. Shelving units.
- C. Accessories.

1.02 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers literature and technical specifications.
- C. Shop Drawings: Detailed drawings of assembly, including interfaces with supporting structure.
 - 1. Use a scale sufficiently large enough to show all pertinent features.
 - 2. Submit in the form of black line prints.
- D. Selection Samples: For each finish material specified submit material or color chips showing full range of manufacturers standard colors.

1.03 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's standard one year warranty from Date of Substantial Completion, covering all parts and including the cost of materials and labor for replacement of defective parts.

1.04 MAINTENANCE SERVICE

- A. Provide one-year maintenance service contract through office located within 200 miles from the project site, including maximum 4 hour turn-around time on all requests for service and factory trained and authorized service personnel.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer: Space Saver, High Density – 2 units or as shown on drawings.
 - 1. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Provide products that are the standard manufactured products of a single manufacturer, not a custom design.
- C. Provide products that are U.S. made or assembled.

2.02 MOBILE SHELVING

- A. General: The system consists of manufactured storage units mounted on manufacturer's track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until the desired aisle is opened. The carriage/rail system provides uniform carriage movement along the total length of travel, even with unbalanced loads.
- B. Carriage System Design and Features: The carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails [recessed][surface] mounted to the floor. Rails shall be types selected by the manufacturer to ensure smooth operation and self-centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by the manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

- C. Movement Controls: Triple or single arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 40 inches (1051MM) from the base of each unit to permit units to be moved to create a single aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.
- D. Drive System: The system shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.
 - 1. System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.
 - 2. A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.
 - 3. All bearings used in the drive mechanism shall be permanently shielded and lubricated.
- E. Safety Features:
 - 1. Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.
 - 2. A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.
- F. Finishes:
 - 1. Fabricated Metal Components And Assemblies: Manufacturer's standard powder coat paint finish.
 - 2. End Panels, Accessible Ends: Manufacturer's standard powder coat paint finish.86

2.03 COMPONENTS

- A. Rails:
 - 1. Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer's selection.
 - 2. Capacity: 1,000 pounds per lineal foot (1385kg/M) of carriage.
 - 3. Minimum Contact Surface: 5/8 inch (16MM) wide.
 - 4. Provide rail sections in minimum 6 foot (1.83M) lengths.
 - 5. Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
 - 6. Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.
 - 7. [Anti-Tip Rail Form Covers: Manufacturer shall provide for protection if required [to prevent damage to rails during concrete back pours.] [when anti-tip devices are installed].
- B. Floor:
 - 1. Finished flooring materials shall be provided by [the Owner] [others].
- C. Carriages:
 - 1. Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
 - 2. Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.
 - 3. When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.
 - 4. Design carriages to allow the shelving uprights to recess and interlock into the carriages a minimum of 3/4 inch (19MM). Top mount carriages are unacceptable.

5. Provide each carriage with two wheels per rail.
 6. Files rm 112 to consist of:
 - + 3 mobile carriages at 48"L x 36"D
 - + 1 mobile carriages at 48"L x 30"D
 - + 1 fixed carriage at 96"L x 18"D
 - + 1 fixed carriage at 48"L x 18"D
 SEE FLOOR PLANS FOR DETAILS
 Evidence holding rm 131 to consist of:
 - + 3 mobile carriages at 11'L x 48"D
 - + 1 mobile carriage at 14'L x 48"D
 - + 1 mobile carriage at 14'L x 36"D
 - + 1 fixed carriage at 14'L x 24"D
 ALL CARRIAGES DEEPER THAN 36" MUST HAVE BACK-TO-BACK SHELVING. SEE FLOOR PLANS FOR DETAILS.
- D. Drive / Guide System:
1. Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
 - a. If line shafts are used, all wheels on one side of carriage shall drive.
 - b. If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.
 2. Shafts: Solid steel rod or tube.
 3. Shaft Connections: Secured couplings.
 4. Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.
- E. Wheels:
1. Capacity: Minimum load capacity per wheel: 3200 lbs (1455kg).
 2. Size: Minimum 5 inches (127MM), outside diameter drive wheels.
 3. Guides: Determined by manufacturer; minimum 2 locations.
- F. Face Panels:
1. Materials: Plastic laminate clad particle board with plastic edging on vertical edges.
 2. Finishes: Selected by Architect from manufacturer's standard available colors and patterns.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Examine floor surfaces with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of mobile storage units.
- D. Verify that building structural system is adequate for installing mobile storage units at locations indicated on approved shop drawings.
 1. [In new construction, ensure that recesses for rails in floors are at proper spacing and depths, with allowance for grouting.]
 2. [For installations on existing floors, ensure that rail spacings indicated on shop drawings are in proper locations so existing load-bearing structural members are not over stressed.]
- E. Verify that intended installation locations of mobile storage units will not interfere with nor block established required exit paths or similar means of egress once units are installed.
- F. Prepare written report, endorsed by Installer, listing conditions detrimental to proper performance of mobile storage units, once installed.

- G. Proceed with installation only after unsatisfactory conditions have been corrected.

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.
- B. Rails:
 - 1. Lay out rails using full length units to the maximum extent possible. Use cut lengths only at ends to attain total length required. Locate and position properly, following dimensions indicated on approved shop drawings. Verify thickness of finished floor materials to be installed (by others) and install level 1/16 inch (0.6MM) above finished floor surfaces.
 - 2. Verify level, allowing for a minimum 1/4 inch (6MM) of grout under high points. Position and support rails so that no movement occurs during grouting.
 - 3. Set rails in full grout bed, completely filling any voids entire length of all rails including rail connectors. Trim up sides flush with rails to ensure proper load transfer from rail to supporting floor. Using shims in lieu of full grouting is not permitted.
 - 4. Installation Tolerances: Do not exceed levelness of installed rails listed below:
 - a. Maximum Variation From True Level Within Any Module: 3/32 inch (2.4MM).
 - b. Maximum Variation Between Adjacent (Parallel) Rails: 1/16 inch (1.6MM), perpendicular to rail direction.
 - c. Maximum Variation In Height: 1/32 inch (.8MM), measured along any 10 foot (3.05M) rail length.
 - 5. Verify rail position and level; anchor to structural floor system with anchor type and spacings indicated on approved shop drawings.
- C. Shelving Units Installation:
 - 1. General: Follow layout and details shown on approved shop drawings and manufacturer's printed installation instructions. Position units level, plumb; at proper location relative to adjoining units and related work.
 - 2. Carriages:
 - a. Place movable carriages on rails. Ensure that all wheels track properly and centering wheels are properly seated on centering rails. Fasten multiple carriage units together to form single movable base where required.
 - b. Position fixed carriage units to align with movable units.
 - 3. Shelving Units:
 - a. Permanently fasten shelving units to fixed and movable carriages with vibration-proof fasteners.
 - b. Stabilize shelving units following manufacturer's written instructions. Reinforce shelving units to withstand the stress of movement where required and specified.

3.04 PROTECTION

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

3.05 ADJUSTING

- A. Adjust components and accessories to provide smoothly operating, visually acceptable installation.

3.06 DEMONSTRATION/TRAINING

- A. Schedule and conduct demonstration of installed equipment and features with Owner's personnel.

- B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

END OF SECTION

SECTION 210001 – FIRE SUPPRESSION CERTIFICATION

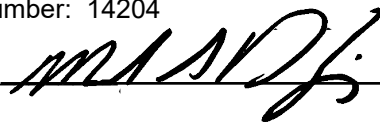
PART 1 - GENERAL

1.1 MECHANICAL ENGINEER'S CERTIFICATION

A. I hereby certify that Division 21 of this Specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota.

B. Name: Mike S. Dolejs, PE

C. License Number: 14204

D. Signature:  Date July 22, 2022

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 210001

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SECTION 211000 - WATER-BASED FIRE PROTECTION SYSTEMS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following fire protection piping inside the building
 - 1. Wet pipe fire sprinkler system
- B. Fire Protection System Design:
 - 1. The Contract Documents indicate sprinkler design criteria. Fire Protection Design/Build Contractor shall be responsible for laying out sprinkler heads and designing piping systems in accordance with current NFPA publications, governing codes and authorities having jurisdiction, and Owner's insurance underwriters.
 - 2. Design the wet sprinkler system based on requirements indicated in Contract Documents together with flow and pressure characteristics of the available municipal water system.
- C. Scope:
 - 1. The fire protection contractor's work begins at the existing fire protection service entrance and riser assembly.
 - 2. Provide backflow prevention assembly in accordance with NFPA, local plumbing codes and authorities having jurisdiction.
 - 3. Project includes modifications to existing wet pipe fire protection system to accommodate architectural changes. Refer to architectural plans.
 - 4. Project will be accomplished in phases with Owner maintaining partial occupancy throughout the construction process. Contractor shall include an accommodation for project phasing in preparing his/her bid for the Work.
 - 5. Existing fire sprinkler components are provided. The fire protection contractor is responsible for determining if the existing piping, valves, etc. are acceptable for re-use. If deemed feasible by the fire protection contractor and allowed by the Authority Having Jurisdiction, Engineer of Record, and Owner, existing fire sprinkler piping, valves, hangers, etc. may be re-used. New sprinklers shall be provided throughout the remodeled areas by the fire protection contractor as part of this project. If necessary, completely new fire sprinkler components shall be provided by the fire protection contractor as part of this project.
 - a. If any portion of the existing sprinkler system is deemed unusable by the fire protection contractor or is not allowed to be reused by the Authority Having Jurisdiction, Engineer of Record, or Owner, then it shall be the fire protection contractor's responsibility to completely disconnect and remove all components. These components include but are not limited to fire sprinklers, piping, valves, and hanger assemblies.

- D. Related Sections include the following:
 - 1. Division 26 Sections for power supply wiring including disconnects, motor starters, and required electrical devices.
 - 2. Division 26 Sections for fire alarm system connections to water flow indicators, pressure switches, supervisory switches, and alarm devices for fire protection systems.
- E. Protection Limits:
 - 1. Provide 100 percent coverage for all building areas and as indicated on plans.
 - 2. Sprinkler coverage shall be provided below obstructions as required.

1.3 SYSTEM DESCRIPTIONS

- A. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water that is connected to an automatic water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts the fusible link or destroys frangible device.
 - 1. From the valve assembly, a wet-pipe fire sprinkler system is provided for all affected areas of the facility.

1.4 PERFORMANCE REQUIREMENTS

- A. System design, installation and components shall be compliant with the South Dakota State Building Code, South Dakota State Fire Code, all applicable codes/standards referenced by those documents to the National Fire Protection Association (NFPA), and Sisseton, South Dakota requirements.
- B. Design and obtain approval from Authority Having Jurisdiction (AHJ) for fire protection systems specified. The AHJ includes but may not be restricted to the Sisseton, South Dakota Inspections Department and the Sisseton Fire Department.
- C. Obtain all required approvals and permits. Permits shall be obtained from the city, municipality and/or state in which the system will be installed. If permits are not issued by the city or municipality, a permit shall be obtained from the State Fire Marshal or State Building Codes and Standards department as applicable.
- D. Minimum Pipe Sizes: Pipes shall not be smaller than sizes allowed by NFPA for connection to water supply piping, standpipes, branch lines, etc. to sprinklers.
- E. Hydrant Flow Test:
 - 1. Pressure gauge on existing fire protection sprinkler system riser indicates a static pressure of approximately 75 PSI.
 - 2. Contractor shall verify with the AHJ the need for a hydrant flow test to address the limited scope of fire protection sprinkler system modifications indicated on the drawings for this project. Contractor shall conduct hydrant flow tests if required by the AHJ. Testing shall be conducted in accordance with NFPA and the AHJ. The results of all hydrant flow tests shall be submitted for review.
- F. Standard piping system component working pressure: listed for at least 175 psig.

- G. Fire sprinkler system design shall be approved by AHJ and the Engineer of Record.
1. Minimum cushion between water supply and demand: 10 percent or 5 psi, whichever is greater
 - a. Including losses through water service piping, valves, backflow preventer (where necessary), etc.
 - b. Calculate to the test fire hydrant, as indicated above.
 - c. Meet AHJ requirements.
 2. Sprinkler occupancy hazard classifications:
 - a. Refer to NFPA 13
 3. Minimum density for fire sprinkler design:
 - a. Refer to NFPA 13.
 4. Seismic design for fire sprinkler systems:
 - a. Refer to project Structural Plans and Specifications for seismic design category.
 - b. Seismic design shall be accomplished in accordance with NFPA 13.
 5. Meet all requirements of NFPA 13.

1.5 SYMBOLS AND ABBREVIATIONS

- A. Refer to symbols and abbreviations on drawings. Other symbols are in common usage, but if uncertainty exists regarding any plan symbols or abbreviations, it shall be brought to the attention of the Engineer, and he shall clarify same by addendum.
- B. Where the phrase "Provide ----" occurs; "provide" shall be construed to mean the same as "furnish and install ----."
- C. AHJ – Authority Having Jurisdiction.

1.6 SUBMITTALS

- A. This is a performance specification for design/build fire protection system(s). Confirmation of design via shop drawings, hydraulic calculations, product submittals, etc. is the sole responsibility of the fire protection design/build contractor. Fire protection shop drawings shall be prepared in accordance with all applicable NFPA standards. Submit three sets (each) to AHJ, Owner, Architect, and Engineer for review, comment, and approval. Include necessary hydraulic calculations.
 1. **Drawings and hydraulic calculations shall be signed by a registered Professional Engineer (PE)** indicating that the work was prepared by him/her or under his/her direct supervision. The engineer shall be proficient in fire protection systems design. Where permitted by state and local jurisdictions, fire protection drawings and hydraulic calculations may be prepared by a NICET Level III or IV-certified technician working under the direct supervision of the Professional Engineer,

- B. Working plans, drawn to scale showing all items in accordance with NFPA 13 that pertain to the design of the fire protection system.
- C. The results of all hydraulic sprinkler and standpipe system calculations.
- D. The results of all hydrant flow tests.
- E. Product data for the following:
 - 1. Piping materials, including sprinkler specialty fittings.
 - 2. Valves, including listed fire protection valves and specialty valves.
 - 3. Backflow prevention assemblies.
 - 4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
 - 5. Alarm devices, including electrical data.
- F. Field test reports and certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping." The "Contractor's Material and Test Certificate for Underground Piping" form should be acquired by the fire protection contractor from the underground contractor.
- G. Hydrostatic tests and field acceptance tests for automatic fire protection system.
- H. Operation & Maintenance (O&M) Manuals. Provide two copies of O&M Manuals. The O&M Manuals shall include a title page, a table of contents, inspection/testing/maintenance requirements from the South Dakota State Fire Code, an original complete copy of NFPA 25, product data/cut sheets, and emergency service guidance.
- I. Record Drawings. Maintain a set of record drawings at the project site. Provide two copies of record drawings to the Owner upon completion of construction.

1.7 QUALITY ASSURANCE

- A. Designer Qualifications:
 - 1. This is a performance specification for design/build fire protection system(s). Confirmation of design via shop drawings, hydraulic calculations, product submittals, etc. is the sole responsibility of the fire protection design/build contractor. **Fire protection design/build contractor shall serve as the Engineer of Record** for the fire sprinkler system and standpipe system.
- B. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing fire protection systems to assume design and installation responsibility.
- C. Welding: Qualify processes and operators according to NFPA and other necessary certifications.
- D. NFPA Standards: Fire protection system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems"
 2. NFPA 14, "Installation of Standpipe and Hose Systems"
 3. NFPA 25 "Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems"
 4. NFPA 72, "National Fire Alarm Code"
 5. NFPA 75, "Protection of Information Technology Equipment"
- E. Comply with requirements of NFPA for submittals, approvals, materials, installation, inspections, and testing.
- F. Comply with all design, installation and testing requirements of sprinkler, specialty valve, and backflow prevention assembly manufacturers.
- G. Warranty
1. Furnish one year manufacturer's warranty for basic fire suppression materials and methods and automatic sprinkler systems.

1.8 COORDINATION

- A. Coordinate design and installation of fire protection pipe, sprinklers, fire detection components, etc. with other construction that penetrates ceilings, including light fixtures, speakers, HVAC equipment, and partition assemblies. Coordinate work with all other trades.
- B. Obtain reproducible plan drawings from HVAC/Sheet-metal Contractor to initiate the coordination process.
- C. The Fire Protection Contractor shall forward the Drawings to the Piping Contractor, Plumbing Contractor, HVAC/sheet-metal Contractor and Electrical Contractor for inclusion of their systems work. The Fire Protection contractor shall be responsible for retrieving all drawings from necessary contractors and developing necessary drawings highlighting conflicting areas.
- D. Following the completion of these drawings, an onsite coordination meeting shall be convened, and attended by all the above contractors, and the Mechanical and Electrical design Engineers for the purpose of review and coordination. This meeting allows the opportunity for all contractors to resolve coordination issues prior to the fabrication and installation of material. Coordination meeting shall take place before any work is started. No additional cost to the project will be accepted for any coordination related items if this process is not adhered to.
- E. The fire protection contractor is responsible for coordinating with the Architect of Record in regards to various features of the fire protection design, as depicted throughout this specification. Examples include sprinkler types in various areas of the building, Fire Department Connection, hose connections, exterior alarm bell/horn-strobe, etc.
1. The fire protection contractor is responsible for coordinating the routing and installation of any exposed piping with the Architect of Record, prior to fabrication of such piping.
 2. In addition, sprinkler layouts for the building shall be submitted to the Architect of Record for review purposes, prior to fabrication of the fire protection components.

1.9 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. Fire Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers and sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench(es). Include separate or additional cabinets with sprinklers and wrench(es) for each type of sprinkler on project.
 - 2. For projects with concealed sprinklers, sprinkler cabinet shall include six sprinkler covers with custom colors. Provide six custom color ceiling covers for each color selection.

1.10 ALTERNATE PROPOSALS

- A. Refer to Division 01 Section "Alternates," for the Description of Alternates.

PART 2 - PRODUCTS

2.1 COMPLIANCE

- A. All materials and products shall comply with the requirements of NFPA.

2.2 STEEL PIPE AND FITTINGS

- A. All steel pipe and fittings shall comply with the requirements of NFPA.
- B. Plastic/CPVC piping is not allowed.
- C. **Dry pipe fire protection sprinkler piping shall be Schedule 40.**

2.3 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.
- B. All sprinkler specialty fittings shall comply with the requirements of NFPA.

2.4 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed, with 175-psig minimum pressure rating.
- B. All fire protection valves shall comply with NFPA, including control valves, indicating valves, butterfly valves, etc.

2.5 BACKFLOW PREVENTION ASSEMBLIES

- A. All backflow prevention assemblies shall comply with local plumbing codes, NFPA and authorities having jurisdiction.

- B. Water pressure drop associated with backflow prevention assemblies shall be included in hydraulic calculations.

2.6 SPRINKLERS

- A. Sprinklers shall be UL-listed, with 175-psig minimum pressure rating.
- B. All sprinklers shall comply with the requirements of NFPA.
- C. Sprinkler types, features, and options as follows:
 - 1. Quick-response, semi-recessed pendent sprinkler, including escutcheon.
 - a. Example (or similar): Tyco TY-FRB chrome-plated or white-painted head with chrome-plated or white-painted metal escutcheon, self-adjusting.
 - 2. Escutcheon colors shall match sprinklers.
- D. Special Coatings: Wax, lead, and corrosion-resistant paint—where necessary to protect sprinkler heads.
- E. Sprinkler escutcheons: Materials, types, and finishes for following sprinkler-mounting applications.
 - 1. Ceiling mounting: White-painted steel or chrome, 1-piece, flat, or recessed. Not more than 3-inch diameter and 1/4-inch deep.
 - 2. Sidewall mounting: White-painted steel or chrome, 1-piece, flat. Not more than 3-inch diameter and 1/4-inch deep.
 - 3. Escutcheons shall not extend beyond the plane of the wall or ceiling more than 1/4-inch. Two-piece telescoping escutcheons are not acceptable.
 - 4. Escutcheon color to match sprinkler.
- F. Sprinkler guards: Wire-cage type, including fastening device for attaching to exposed sprinklers in mechanical areas, storage areas and walk-in coolers.
- G. Sprinkler Cabinets: Finished steel cabinet and hinged cover.

2.7 SPRINKLER HEAD FLEXIBLE DROP FITTINGS

- A. Where acceptable to the AHJ, flexible drop fittings may be used at Contractor's option to locate sprinklers as required by final finished ceiling tiles and walls. Drop fittings shall consist of a braided type 304 stainless steel flexible tube, zinc plated steel threaded nipple or groove coupling for connection to branch-line piping and a zinc plated steel reducer with a female thread for connection to the sprinkler head. Union joints shall be provided for ease of installation. Flexible drop shall attach to the ceiling grid using a one-piece bracket. The bracket shall allow installation before the ceiling tile is in place.
- B. Flexible drop hose and ceiling bracket shall be furnished by the same manufacturer as a complete assembly. Sprinkler flexible drop fittings and bracket assemblies shall be UL listed and FM Approved with 175-psig minimum working-pressure rating and constructed of materials compatible with piping.

- C. Sprinkler flexible drop fittings shall comply with the requirements of NFPA.
- D. Flexible drop hoses shall be factory-pressure tested to 400 psi.
- E. Sprinkler flexible drop fittings and bracket assemblies shall be installed in accordance with the manufacturer's installation instructions.

2.8 HOSE CONNECTIONS

- A. Unless indicated otherwise by Authorities Having Jurisdiction, hose connections are not required for this building.

2.9 FIRE DEPARTMENT CONNECTIONS

- A. Unless indicated otherwise by Authorities Having Jurisdiction, existing fire department connection shall remain in service.

2.10 ALARM DEVICES

- A. Alarm devices shall be UL-listed.
- B. Alarm devices shall comply with the requirements of NFPA and the AHJ.
- C. Alarm-device types shall match piping and equipment connections.
- D. Electrically-operated alarm: An approved exterior horn-strobe device is required, at the discretion of the AHJ and Architect of Record.
- E. Water flow indicators: UL 346, electrical-supervision, paddle-operated-type, and water-flow detector with proper pressure rating and designed for horizontal or vertical installation. Include 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.
- F. Valve supervisory switches: UL 753, electrical, single-pole, double-throw, switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

2.11 PRESSURE GAGES

- A. Description: UL 393, 3-1/2- to 4-1/2-inch-diameter, dial pressure gauge with range of 0 to 250-psig minimum.
 - 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
 - 2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, protection, and other conditions where piping is to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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. The drawings do not necessarily indicate all the conditions, details, or work required. The Fire Protection Contractor shall examine the building to determine the actual conditions and extent of the work. Any details not clear to this Contractor shall be referred to the Architect/Engineer for clarification prior to bidding.
- C. Disconnect, demolish, and remove fire-suppression systems, equipment, and components indicated to be removed or made obsolete by new work.
 - 1. Piping indicated to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping indicated to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment indicated to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment indicated 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 indicated to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- D. Disposition of Removed Materials:
 - 1. Do not reuse removed materials unless explicitly permitted by Documents.
 - 2. Use of Owner's dumpsters for the disposition of any type of construction debris is not allowed.
- E. Equipment indicated to remain Owner's property: Place in storage location designated by Owner.
- F. If pipe 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.
- G. Where demolition work is to be performed adjacent to existing work that remains in an occupied area:
 - 1. Construct temporary dust partition to minimize the amount of contamination of the occupied space.

2. Provide temporary connections necessary to permit the Owner to occupy areas of the building to remain in use during construction.

H. Where pipe is removed and not reconnected to new work, cap end of existing services as if they were new work

3.3 PIPING APPLICATIONS, GENERAL

- A. Shop-weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than the systems pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Provide main drain and auxiliary drains as required by NFPA and AHJ. Coordinate with Owner and Engineer of Record.

3.4 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Wet pipe fire sprinkler system, 175-psig maximum working pressure: comply with the requirements of NFPA 13.
- B. Painting of exposed sprinkler pipe is not included in this project. Fire protection contractor is responsible for covering sprinklers during painting as work of other divisions, removing covers after painting, and replacing any painted sprinkler heads.

3.5 STANDPIPE SYSTEM PIPING APPLICATIONS

- A. Unless indicated otherwise by Authorities Having Jurisdiction, standpipe systems are not required for this building.

3.6 VALVE APPLICATIONS

- A. Listed fire protection valves: UL-listed for applications where required by NFPA 13.
 1. Shutoff duty: Use ball, butterfly, gate valves, and wall PIV.
- B. Unlisted general duty valves: For applications where NFPA 13 does not require UL-listed and approved valves.
 1. Shutoff duty: Use ball, butterfly, or gate valves.

3.7 JOINT CONSTRUCTION

- A. Joint construction shall comply with the requirements of NFPA.

3.8 PIPING INSTALLATION

- A. Locations and arrangements of piping installation shall comply with the requirements of NFPA.
- B. Piping in areas with ceilings shall be provided above ceilings. Piping in areas without ceilings shall be installed in an exposed condition. Piping in exposed conditions shall be installed with necessary clearances from building operations, utilities, etc. at the discretion of the Owner and Engineer of Record.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- E. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13—at the discretion of the AHJ.
- F. Install sprinkler piping with drains for complete system drainage.
 - 1. Coordinate drains with Owner, Engineer of Record, and plumbing contractor.
- G. Install ball drip valves to drain piping between Fire Department Connection and check valves. Drain to floor drain or outside building. Coordinate drains with Owner, Engineer of Record, and plumbing contractor.
- H. Install alarm devices in piping systems.
 - 1. All wiring of such devices is by others.
- I. Hangers and supports: Comply with NFPA 13 for hanger materials.
 - 1. Install sprinkler system piping according to NFPA 13.
- J. Install pressure gauges on riser or feed main, at each sprinkler test connection, and where required by NFPA and AHJ. Include pressure gauges with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gauge and valve. Install gauges to permit removal, and install where they will not be subject to freezing conditions.
- K. Clean and flush the fire protection piping system before filling.
- L. Fill wet pipe sprinkler system piping with water.
- M. The fire protection contractor shall acquire "Contractor's Material and Test Certificate for Underground Piping" form from the underground contractor.

3.9 VALVE INSTALLATION

- A. Install listed fire protection valves, unlisted general-duty valves (where allowed by NFPA 13), specialty valves and trim, controls, and specialties according to NFPA 13 and AHJ.

- B. Install listed fire protection shutoff valves supervised-open, located to control sources of water supply except from Fire Department Connection. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install backflow prevention assemblies in accordance with manufacturer's written instructions, NFPA, local plumbing codes and authorities having jurisdiction.
- D. Install required alarm devices for control valves including but not limited to flow switches and tamper switches for control valves, yard valves and post indicating valves. All wiring of such devices is work of other divisions.
- E. Provide permanent signage at valve assembly regarding areas/systems service, pertinent hydraulic data, etc.

3.10 SPRINKLER APPLICATIONS

- A. Use the following sprinkler types, unless sprinkler types are indicated on drawings:
 - 1. Rooms without ceilings: Upright sprinklers.
 - 2. Acoustical tile suspended ceilings: Semi-recessed sprinklers.
 - 3. Gypsum board ceilings: Semi-recessed sprinklers.
 - 4. Wall and/or soffit mounting: Semi-recessed sidewall sprinklers.
 - 5. Sprinkler Finishes:
 - a. Upright sprinklers in unfinished, non-public spaces: natural brass
 - b. Upright sprinklers in finished, non-public spaces (exposed to view): chrome plated
 - c. Upright sprinklers in finished, public spaces (exposed to view): chrome plated
 - d. Pendant sprinklers in finished, public spaces with ceilings: chrome plated
 - e. Pendant sprinklers in finished, non-public spaces with ceilings: chrome plated

3.11 SPRINKLER INSTALLATION

- A. Sprinkler zoning and coverage shall comply with the requirements of NFPA 13.
- B. Sprinklers shall be located in a regular pattern, perpendicular and parallel with building lines, in alignment with other ceiling components such as lights, air diffusers, grilles, and speakers.
 - 1. Acoustical ceiling tile: Sprinklers shall be located in the **center of tile**.
 - 2. Sprinklers shall be located no closer than 4 inches from any ceiling edge or from any other ceiling component in public areas.
 - 3. Sprinkler locations and types shall be reviewed and accepted by the Architect of Record before any piping is fabricated or installed.
 - 4. Provide additional sprinklers above and below ceilings as necessary per NFPA 13 and AHJ, including floating ceilings, wood ceilings, open ceiling grids, etc.
 - 5. Do not install pendant or sidewall, wet-type sprinklers in areas subject to freezing. Meet NFPA 13 requirements. The fire protection contractor is responsible for notifying the Architect and Engineer of Record of any additional areas that may require dry pendant sprinklers or dry-type sprinklers due to potential for freezing.
- C. Additional sprinklers (in excess of NFPA requirements) may be required for aesthetics.

3.12 HOSE-CONNECTION INSTALLATION

- A. Unless indicated otherwise by Authorities Having Jurisdiction, standpipe hose connection systems are not required for this building.

3.13 FIRE PROTECTION OF ELECTRICAL AND DATA ROOMS

- A. Provide a complete fire protection sprinkler system in electrical switchgear rooms, electrical panel rooms, data rooms and small electrical and communication rooms in accordance with NFPA 13.
- B. Do not install sprinkler piping directly above electrical equipment, motor control centers or data racks.
- C. Sprinkler piping serving electrical and data rooms shall serve those areas only. Sprinkler piping serving other areas shall not pass through electrical and data rooms.

3.14 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Unless indicated otherwise by Authorities Having Jurisdiction, existing fire department connection shall remain in service.

3.15 SPRINKLER ZONING AND CONNECTIONS

- A. Sprinkler zoning and coverage shall comply with the requirements of NFPA 13.
 - 1. One or more system/zones shall be provided for wet pipe sprinklers in affected areas of the building.
 - 2. One or more system/zones shall be provided for wet pipe standpipes in affected areas of the building.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Install ball drip valves at each check valve for Fire Department Connection. Drain to floor drain or outside building.
- D. Connect piping to specialty valves, specialties, Fire Department Connection, and accessories.
- E. Electrical Connections: Low voltage/fire alarm wiring is specified in Division 26 for monitoring of fire protection systems.

3.16 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13, NFPA 14 and in Division 23 Section "Identification for HVAC Piping and Equipment."

3.17 CONTINUITY OF SERVICES

- A. Continuity of services: The project shall be conducted in a phased manner as directed by the architect and the owner. The building is occupied and the service shall remain operable except for the prescribed activity as directed by the architect/owner. The Division 21 work shall be performed on a floor-by-floor and area-by-area basis. Division 21 contractor shall allow for phased construction in the bid.
- B. Fire protection that serves more than one floor or more than the construction area shall remain in service during building hours. The contractor shall provide fire protection watch and shall allow for phased and after hour activity in the bid.

3.18 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks in accordance with NFPA. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls, safeties and backflow prevention assemblies. Replace damaged and malfunctioning controls and equipment.
 - 3. Energize circuits to applicable electrical equipment and devices.
 - 4. Flush, test, and inspect sprinkler systems and standpipe systems according to NFPA 13 and NFPA 14.
 - 5. Coordinate with fire alarm tests. Operate as required.
 - 6. Verify that equipment hose threads are same as local Fire Department equipment.
- B. Report test results promptly and in writing to Owner, Engineer of Record, and AHJ.

3.19 FINISHES

- A. Finishes shall comply with the requirements of NFPA 13.
- B. Finishes shall comply with the requirements noted above in this specification.

3.20 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers and piping.
- B. Protect sprinklers from damage until Substantial Completion.

3.21 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and backflow prevention assemblies. Refer to Division 01 Sections for closeout procedures.

END OF SECTION 211000

SECTION 220001 - PLUMBING CERTIFICATION

PART 1 - GENERAL

1.1 MECHANICAL ENGINEER'S CERTIFICATION

A. I hereby certify that Division 22 of this Specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota.

B. Name: Mike S. Dolejs, PE

C. License Number: 14204

D. Signature:  Date July 22, 2022

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 22 0001

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SECTION 220010 - GENERAL PROVISIONS

PART 1 - SUMMARY

1.1 SUMMARY OF WORK

- A. In general the work consist of the following:
 - 1. Modifications to interior plumbing system.
- B. Location of Work: Sisseton, South Dakota

1.2 GENERAL

- A. The work shall consist of the furnishing of all labor, materials, services, and equipment necessary for, and incidental to the mechanical work called for on the drawings and specifications.
- B. The work shall also include the completion of details of mechanical work not mentioned or shown, which are necessary for the successful operation of the mechanical systems described on the drawings and as required by the specifications.
- C. The only mechanical work not included shall be those items explicitly indicated to be excluded.
- D. The contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the contract documents.
- E. The completed mechanical systems shall be complete and in all respects ready for use, tested as indicated and/or required with test reports, prior to the final site observation and/or the owner's acceptance. The work of these documents shall consist of furnishing all labor, materials, services, and equipments necessary for and incidental to the mechanical work called for on the drawings or specifications.
- F. The contractor is responsible for review of all drawings, including but not limited to architectural, electrical, fire protection, structural, civil and landscape for portions of their work to be included or coordinated. No extra credits will be allowed due to the contractor's failure to review and coordinate with all other disciplines.
- G. Contractor shall visit the site and become familiar with on site conditions before submitting their bid. Failure to visit the site will in no way relieve the contractor the necessity of performing work and any work required to complete the work intended by the drawings and specifications, which should be determined by the site visit.
- H. The drawings and specifications are intended to supplement each other, such that information contained in either shall be executed in the same manner.
- I. If a question exists regarding the exact intention of the documents, instructions shall be obtained from the architect/engineer before proceeding. If instructions cannot be obtained due to time or communication limitations, the greater quantity, superior quality, or condition most favorable to the owner shall be assumed.

- J. The drawings are in general diagrammatic and not intended to show exact locations. The drawings are not intended to be scaled for rough-in dimensions or exact locations. Architectural, electrical, structural, fire protection, landscape drawings, etc. shall be consulted for exact locations if required. Architectural and Structural Drawings shall take precedence over Mechanical Drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Only critical dimensions will be provided.
- K. Contractor, when installing his equipment, shall leave adequate room for the installation of equipment by other contractors where space is limited. Consideration has been given to such conditions of limited space in the preparation of the drawings, and the locations and dimensions of equipment have been selected accordingly. Contractor shall be cautioned that in certain instances, space may be limited to the extent that there may be only one arrangement of equipment or facilities that will allow installation of same.

1.3 CODES & STANDARDS

- A. All work shall comply with all current and applicable codes, specifications, ordinances, laws, regulations, industry standards, and utility company regulations
- B. The codes and standards are minimum requirements with respect to the installation as shown and specified, and are intended to comply with these requirements. Where conflicts exist, the greater quantity, superior quality or condition most favorable to the owner shall be assumed.

1.4 RELATED DOCUMENTS

- A. The General Conditions of the Contract for Construction, Supplementary Conditions and the General Requirements of Division 01 are hereby made a part of this division.
- B. The sections contained in Division 22 may conflict with the conditions of contract of the General Requirements. The statement requiring the greater quantity, superior quality, or condition most favorable to the owner shall take precedence.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- D. Division 22 work shall include all mechanical work unless explicitly indicated otherwise.

1.5 SPECIAL CHARGES

- A. All fees, permits, and licenses required for the mechanical work are to be included in the contract.
- B. If more than two final site inspections are required by the engineer, the contractor will be billed at an hourly rate for the time associated with the additional site visits.
- C. Sewer availability charges (SAC) are to be paid by the General Contractor. Water availability charges (WAC) are to be paid by the General Contractor.

1.6 SUBMITTALS

A. General

1. All requests for information, clarification, etc., shall be submitted in writing to the engineer with a copy to the owner/architect.
2. All shop drawings and operating manuals shall be submitted to the engineer with transmittal copies to the owner/architect.

B. Substitutions and Prior Approvals.

1. Comply with the requirements of Division 01 Section 3000, "Administrative Requirements".

C. Shop Drawings

1. Comply with the requirements of Division 01 Section 3000, "Administrative Requirements".
2. Shop drawings shall be submitted on Division 22 items as specified in individual sections.
3. Shop drawings shall be stamped approved by the contractor prior to submittal.
4. Shop drawings shall include detailed product information with catalog numbers, features, dimensions, wiring diagrams, and any other critical information clearly highlighted. The related specification sections may require additional information.
5. Shop drawings must be submitted in a format to allow easy identification of the exact item that is to be furnished, with all optional features or components clearly identified.
6. Shop drawings not properly submitted will be returned and not reviewed.

D. Operation and Maintenance Manuals

1. Comply with the requirements of Division 01 Section 7800, "Closeout Submittals".
2. Operating manuals shall include information on all equipment requiring shop drawings.

E. Record Drawings

1. Comply with the requirements of Division 01 Section 7800, "Closeout Submittals".

1.7 COORDINATION

A. Coordinate work with other trades in the installation of equipment, piping, conduit, and ductwork.

B. HVAC/Sheet-metal Contractor shall initiate the coordination process by providing reproducible plan drawings showing ductwork and equipment.

C. The HVAC/sheet metal Contractor shall forward the Drawings to the Piping Contractor, Fire Protection Contractor and Electrical Contractor for inclusion of their systems work. The HVAC/sheet metal contractor shall be responsible for retrieving all drawings from necessary contractor and developing necessary drawings highlighting conflicting area.

D. Following the completion of these drawings, an on site coordination meeting shall be convened, and attended by all the above contractors, and the Mechanical and Electrical design Engineers for the purpose of review and coordination. This meeting allows the opportunity for all contractors to resolve coordination issues prior to the fabrication and installation of material.

Coordination meeting shall take place before any work is started. No additional cost to the project will be accepted for any coordination related items if this process is not adhered to.

1.8 SYMBOLS AND ABBREVIATIONS

- A. Refer to symbols and abbreviations on drawings. Other symbols are in common usage, but if uncertainty exists regarding any plan symbols or abbreviations, it shall be brought to the attention of the Engineer, and the Engineer shall clarify same by addendum.
- B. Where the phrase "Provide ----" occurs; "provide" shall be construed to mean the same as "furnish and install ----."

1.9 UTILITY REBATE SCHEME

- A. It is the intention to apply the local utility energy efficient rebate scheme to this project. Contractor shall secure, on behalf of the Owner, the maximum rebate available. This shall include all submittals to the utility company, including substantiation where required, and making all necessary arrangements on behalf of the Owner. All rebates shall be made to the Owner at the time of Substantial Completion.

1.10 ALTERNATE PROPOSALS

- A. Refer to Division 01 Section 2300, "Alternates," for the Description of Alternates.

1.11 CAD DRAWING FILES

- A. All Division 22 electronic CAD drawing files provided by the Architect/Engineer for this project are for use solely with respect to this project. Contractor may request copies of the Division 22 CAD drawing files for the preparation of Shop Drawings. However, CAD drawing files shall not be used on other projects, for additions to this project, or for completion of this project by others. Any intentional or unintentional revisions, additions, or deletions to these Division 22 CAD drawing files shall be made at the full risk of the person(s) making such revisions, additions, or deletions, and such person(s) shall hold harmless and indemnify Architect/Engineer of any and all responsibilities and liabilities.
- B. CAD diskettes are not to be construed as updated As-Built Construction Documents. The drawing files reflect only bidding documentation of original Construction Drawings. Addenda or written changes occurring during the construction process will not be incorporated into the Division 22 CAD drawing files.
- C. Cost for Division 22 CAD drawing files, provided in AutoCAD format (other formats will be available only by special arrangement with Engineering design Initiative, Ltd), will be \$100 per drawing sheet, payable directly to Engineering Design Initiative, Ltd. CAD diskettes may be obtained on a COD basis at the office of Engineering Design Initiative, Ltd.
- D. Procedure for acquiring CAD files shall be as follows:
- E. Contractor shall make a request to Engineering Design Initiative, Ltd. in writing, including a list of the files desired.

1. Engineer will send the contractor an invoice and "Document Release and Indemnity Agreement."
2. Contractor shall sign this agreement and send a check for the amount to the Engineer.
3. Upon receipt of these items, Engineer will send the CAD files to contractor. Files can be sent on diskette, CD ROM, or e-mail as agreed between Contractor and Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. None

PART 3 - EXECUTION

3.1 GENERAL

- A. Lay-out and coordinate all work well enough in advance to avoid conflicts or interferences with other work in progress. Conflicts arising from lack of coordination shall be this contractor's responsibility.
- B. Perform all work in conformity with the construction called for by other trades and afford reasonable opportunity for the execution of their work. Properly coordinate all work with the work of other trades at such time, and in such a manner as not to delay or interfere with their work.
- C. Promptly report to the architect/engineer any delay or difficulties encountered which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of work of other trades as being fit and proper for the execution of this work.
- D. Plan all work so that it proceeds with a minimum of interference with other trades. Inform all parties concerned of openings required for equipment and provide all special frames, sleeves and anchor bolts as required.

3.2 WORKMANSHIP

- A. Only quality workmanship will be accepted. All parts of the mechanical systems such as pipes, ducts, grillage, etc., shall be square and true with the building or site geometry, and shall be neat and orderly in appearance.

3.3 SCHEDULE

- A. Schedule all work such that the progress of the mechanical work will conform to the progress of the other trades. Complete the entire installation as soon as the conditions of the project will permit. Any cost resulting from defective or ill-timed work performed under this section shall be borne by this contractor.
- B. Contractor shall prepare an accurate schedule for every construction meeting.

3.4 GUARANTEE

- A. Guarantee all materials and equipment installed under this subcontract against defects in workmanship and materials for a period of twelve (12) months after final acceptance of the work by the Owner. Repair and/or replace any materials or equipment developing such defects within that time promptly, upon due notice given by the Owner, at no additional expense to the Owner.
- B. All equipment bearing a manufacturer's guarantee shall be construed as an extended guarantee to the Owner by the Manufacturer. Any such equipment that proves to be defective in materials or workmanship within the guarantee period is to be replaced by the Subcontractor in accordance with the manufacturer's guarantee, at no additional expense to the Owner.

3.5 CUTTING AND PATCHING

- A. Each trade shall perform all cutting and patching necessary in order to perform the work, unless such work has been delegated to the General Contractor. All patching shall be performed in such manner as to leave no visible trace and to return the part affected to the condition of undisturbed work. Patching work shall be performed by persons experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted. All holes in masonry shall be drilled with rotary drills. Impact tools shall not be used.

3.6 HOLES THROUGH MASONRY AND CONCRETE

- A. Each trade shall provide all holes and openings required for his work, unless such holes and openings are shown to be provided on the Architectural or Structural Drawings. Pay particular attention to openings required in pre-cast, pre-stressed, or post-tensioned slabs.

3.7 CONCRETE BASES AND PADS

- A. Concrete bases or pads exterior to the building shall be provided by the trade requiring same.
- B. Concrete bases or pads within the building shall be provided by each trade requiring same.

3.8 PAINTING

- A. Refer to appropriate section of Division 22 for painting requirements.
- B. Pre-painted equipment delivered to the job site prime painted or finish painted shall be touched up as necessary and/or as directed. When available, spray cans of the paint shall be obtained from the equipment manufacturer.
- C. Uninsulated (or Bare) Metal Surfaces.
 - 1. In spaces being painted by the General Contractor, metal surfaces, such as bare pipe, angle iron, hanger rods, steel bases, etc., shall be the painting responsibility of the General Contractor.
 - 2. In mechanical spaces and all other spaces that are not being painted by the General Contractor, metal surfaces, such as bare pipe, angle iron, hanger rods, steel bases, etc., shall be the painting responsibility of the Mechanical Contractor.

- a. All metal surfaces to be painted shall be thoroughly cleaned, wire brushed, and then painted with a primer coat and two (2) coats of oil-based paint.

3.9 CLEANUP

- A. Each trade shall periodically clear away all debris, surplus materials, etc., resulting from his work or operations, leaving the job and the equipment furnished under any or all contracts in a clean condition.

3.10 TESTS

- A. Each trade shall test the equipment provided and/or installed under this Specification and shall demonstrate its proper operation to the Owner's operating engineer.
- B. No equipment shall be tested or operated for any purpose until it has been fully prepared, lubricated and properly connected and made ready for normal operation. Any damage to equipment occasioned by improper or ill-timed operation or testing shall be made good at the contractor's own expense, before final inspection and acceptance.

3.11 INSTRUCTION OF OPERATING PERSONNEL

- A. Each trade shall furnish, without additional expense to the Owner, the services of competent instructors, who will give full instruction in the care, adjustment, and operation and maintenance of all parts of the equipment to the Owner's permanent employees who are to have charge of the equipment. See individual sections for additional training requirements for specific systems.
- B. Each instructor shall be thoroughly familiar with all parts of the installation on which he is to give instructions and shall be trained in operating theory as well as in practical operation and maintenance work. Factory trained instructors shall be employed wherever they are available. Instruction shall be given during regular work week and at a time just prior to the time the equipment is accepted and turned over to the Owner for regular operation.
- C. All training and operating instructions shall be recorded by the contractor and the videotape(s) handed over to the Owner.
- D. Contractor shall submit to the Architect/Engineer, a letter, signed by the Owner, stating that the instruction of operating personnel has been completed and is accepted by the Owner.

END OF SECTION 220010

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Sleeves.
 - 5. Mechanical Sleeve Seals
 - 6. Escutcheons.
 - 7. Grout.
 - 8. Plumbing Demolition
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Supports and anchorages.

1.3 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 rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.
- G. Provide: Construed to mean the same as "furnish and install".

1.4 SUBMITTALS

- A. Welding certificates.

1.5 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. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 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.

1.7 ACCESS PANELS IN WALLS AND CEILING

- A. Provide 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."

1.8 COORDINATION

- A. Coordinate work with other trades in the installation of equipment, piping, conduit, and ductwork.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 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.

2.3 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. 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.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
 4. Aboveground Pressure Piping: Pipe fitting.
- 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.
1. Manufacturers:
 - a. Eslon Thermoplastics.
- 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.
1. Manufacturers:
 - a. Thompson Plastics, Inc.
- 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.
1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. 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.
1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 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: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. 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. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. 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: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.

- G. 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.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 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.

2.7 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM 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.

2.8 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 and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated and rough brass.
- 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.

2.9 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.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 02 Section "Selective 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: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping 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.

3.2 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 above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes and per slope per local code requirements.
- 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. 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, 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 Equipment Rooms: One-piece, cast-brass type.

- i. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
 - M. Sleeves are not required for core-drilled holes.
 - N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete footings and foundations, 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 all pipe sizes.
 - 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.
 - O. Underground, Pipe Penetrations Daylighting into interior spaces: 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.
 - P. 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.
 - Q. Verify final equipment locations for roughing-in.
 - R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.3 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. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 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.

3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Painting and Coatings."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 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.

3.8 ERECTION OF FIRE-RATED WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place fire-retardant wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing 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.

3.9 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 220500

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SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron, single-flange butterfly valves.
3. Bronze swing check valves.
4. Iron swing check valves.

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. Section 22 1116 "Domestic Water Piping" for valves applicable only to this piping.
4. Section 22 1319 "Sanitary Waste Piping Specialties" for valves applicable only to this piping.
5. Section 22 1423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. Characterized: Ball valve with V-shaped port for linear response throttling service.
- C. EPDM: Ethylene propylene copolymer rubber.
- D. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- E. NRS: Nonrising stem.
- F. OS&Y: Outside screw and yoke.
- G. PTFE: Teflon®. Polytetrafluoroethylene. Fluorocarbon based polymer.
- H. RS: Rising stem.
- I. SWP: Steam working pressure.

- J. TFE: Tetrafluoroethylene. Fluorocarbon based polymer.
- K. Viton®: 'FKM', Fluorocarbon based fluoroelastomer.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Handwheel: For valves other than quarter-turn types.
 - 2. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. 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.
 - 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. Valve Bypass and Drain Connections: MSS SP-45.
- H. All similar valves shall be of similar manufacturer.

2.2 BRONZE BALL VALVES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Hammond Valve.
 - d. Legend Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig.
 - c. CWP Rating: 600 psig.
 - d. WOG Rating: 600
 - e. Body Design: Two piece.
 - f. Body Material: Bronze.
 - g. Ends: Threaded, socket welding, solder joint, grooved and flared ends.
 - h. Seats: PTFE or TFE.
 - i. Stem: Bronze.
 - j. Ball: Chrome-plated brass.
 - k. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.; Apollo Valves.
 - b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DeZurik Water Controls.
 - f. Hammond Valve.
 - g. Kitz Corporation.
 - h. Legend Valve.
 - i. Milwaukee Valve Company.
 - j. NIBCO INC.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. 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.

2.4 BRONZE SWING CHECK VALVES

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

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.
 2. Throttling Service: Ball or butterfly valves.
 3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze nonmetallic disc.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. 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 Steel Piping, NPS 2 and Smaller: Threaded ends.
 3. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends or lug body except where threaded valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- TEMPERED- 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. Ball Valves: NSF Lead Free, Two piece, full port, bronze with bronze trim.
 3. Bronze Swing Check Valves: Class 125, bronze disc.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe positioning systems.
 - 7. 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.

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.

1.5 SUBMITTALS

- A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

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 D1.4, "Structural Welding Code--Reinforcing Steel."
4. 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. 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. Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.
4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco 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 METAL FRAMING SYSTEMS

- A. Description: MFMA-4, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 - 1. B-Line Systems, Inc.; a division of Cooper Industries.
 - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 - 3. GS Metals Corp.
 - 4. Power-Strut Div.; Tyco International, Ltd.
 - 5. Thomas & Betts Corporation.
 - 6. Tolco Inc.
 - 7. 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.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 - 1. Carpenter & Paterson, Inc.
 - 2. ERICO/Michigan Hanger Co.
 - 3. PHS Industries, Inc.
 - 4. Pipe Shields, Inc.
 - 5. Rilco Manufacturing Company, Inc.
 - 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- 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.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless 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. 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.

2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. Manufacturers:
 - 1. C & S Mfg. Corp.
 - 2. HOLDRITE Corp.; Hubbard Enterprises.
 - 3. Samco Stamping, Inc.

2.8 EQUIPMENT SUPPORTS

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

2.9 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 carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 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 two rods if longitudinal movement caused by expansion and contraction might occur.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is 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.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 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.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- L. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.
 - b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- M. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to 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.

- O. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- P. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- Q. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. 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.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and

larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. 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 3-1/2: 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.
 - 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 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:

1. Material and Thickness: Aluminum, 0.032-inch or anodized aluminum, 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: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel rivets.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

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.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

C. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

D. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

E. Fasteners: Stainless-steel rivets.

F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

G. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

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

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches high.

2.4 STENCILS

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

2.5 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch 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 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.

2.6 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

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

3.3 PIPE LABEL INSTALLATION

- A. 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 with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.5 WARNING-TAG INSTALLATION

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

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Sealants.
- 6. Factory-applied jackets.
- 7. Tapes.
- 8. Securements.
- 9. Corner angles.

- B. Section includes insulating the following plumbing piping services:

- 1. Domestic cold-water piping.
- 2. Domestic hot-water and tempered hot water piping.
- 3. Domestic recirculating hot-water piping.
- 4. Sanitary waste and vent piping.

- C. Related Sections include the following:

- 1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. 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.

PART 2 - PRODUCTS

2.1 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. 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. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber, Preformed Pipe Insulation:
 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
 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.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 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).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 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).
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.

- d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
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).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
- 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 - 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
- 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 - 4. Solids Content: 63 percent by volume and 73 percent by weight.
 - 5. Color: White.

2.5 SEALANTS

- A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. 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).

B. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. 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).

2.6 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.

2.7 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.

- d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - 2. Width: 3 inches.
 - 3. Thickness: 11.5 mils.
 - 4. Adhesion: 90 ounces force/inch in width.
 - 5. Elongation: 2 percent.
 - 6. Tensile Strength: 40 lbf/inch in width.
 - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
- 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 - 2. Width: 2 inches.
 - 3. Thickness: 6 mils.
 - 4. Adhesion: 64 ounces force/inch in width.
 - 5. Elongation: 500 percent.
 - 6. Tensile Strength: 18 lbf/inch in width.

2.8 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, per manufacturer's recommendations.
- 1. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
- 1. Provide per manufacturers recommendations:
 - a. Products: Subject to compliance with requirements, provide one of the following or approved equal:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.

2.9 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 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.

3.3 PENETRATIONS

- A. 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.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" for Firestopping and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 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.

3.5 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.

3.6 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.

3.7 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 three 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 locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 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. Underground piping.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Hot, Tempered Hot, and Recirculated Hot Water: Insulation shall be of the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I:
 - a. Pipe size up to 1-1/4 inches: 1 inch insulation thickness.
2. Pipe size 1-1/2 inches and larger: 1-1/2 inch insulation thickness.
3. Exception: Underfloor PEX Pipe Applications.
 - a. Flexible Elastomeric: 1/2 inch thick.

B. Domestic Cold Water (Potable): Insulation shall be the following:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thickness for pipe size 1-1/4 inches and less, 1 inch thickness for pipe size over 1-1/2 inches.
2. Flexible Elastomeric: 1 inch thick
3. Exception: Underfloor PEX Pipe Applications.
 - a. Flexible Elastomeric: 1/2 inch thick.

C. Sanitary Waste and Vent Piping located in air plenum spaces:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION 220700

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SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-slab domestic water building-service pipe, fittings, and appurtenances from inside the building to 5'-0" outside the building foundation wall.
2. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
3. Specialty valves.
4. Water meters purchased from utility company for installation by Contractor.
5. Escutcheons.
6. Sleeves.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.3 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

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

2.2 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
- b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- B. Hard Copper Tube: 6" and below pipe size 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. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 6. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Pro-Press & Pure-Flow System.
 - b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 7. Copper-Tube Extruded-Tee Connections:
 - a. 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.
- C. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal.

2.3 PEX TUBE AND FITTINGS

- A. PEX Distribution System: ASTM F 877, SDR 9 tubing.
1. Fittings for PEX Tube:
 - a. ASTM F 1807, metal-insert type with copper or stainless-steel crimp rings and matching PEX tube dimensions.
 - b. ASTM F1960, cold expansion fittings with PEX reinforcing rings.

2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877; with plastic or corrosion-resistant-metal valve for each outlet.
3. Manufactures:
 - a. Uponor "AQUAPEX"
 - b. Viega "PureFlow"

2.4 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. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 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.

2.6 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.
- C. Plastic-to-Metal Transition Fittings:
 1. Description: CPVC or 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.
- D. Plastic-to-Metal Transition Unions:
 1. Description: CPVC or PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.7 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. 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.
- C. 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.
- D. 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.
- E. 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.

2.8 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated or rough-brass finish with setscrews.
- C. Split Casting, Cast Brass: Polished, chrome-plated or rough-brass finish with concealed hinge and setscrew.
- D. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

- E. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.9 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.

2.10 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
 - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
 - 2. Housing: Ductile-iron casting with hub, waterstop, anchor ring, and locking devices. Include gland, bolts, and nuts.
 - 3. Housing-to-Sleeve Gasket: EPDM rubber.
 - 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
 - 5. Pipe Sleeve: AWWA C151, ductile-iron pipe or ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

2.11 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Sections.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install 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.
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level without pitch and plumb.
- E. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- G. 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.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- I. Install piping adjacent to equipment and specialties to allow service and maintenance.
- J. Install piping to permit valve servicing.
- K. 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.
- L. Install piping free of sags and bends.
- M. Install fittings for changes in direction and branch connections.
- N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- O. Install pressure gages on suction and discharge piping from each plumbing pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

- P. Install thermometers on outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: 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. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. 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.
- H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- 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. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D 2855.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 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.

3.5 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 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flange kits.
- D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 WATER METER INSTALLATION

- A. Rough-in domestic water piping, and install water meters according to utility company's requirements.
- B. Water meters shall be purchased by the Contractor from the Utility and installed by Division 22 Contractor.
- C. Install remote registration system according to standards of utility company and of authorities having jurisdiction.

3.8 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 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.
 - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. 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.
- E. Install supports for vertical copper tubing every 10 feet.
- F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS AND FLUSHING OF SERVICE SYSTEM

- 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. Use transition fitting to join dissimilar piping materials.
- D. Division 22 shall provide final flushing of water service system and water service flange. Provide testing, disinfection, and certifications as specified in 'Cleaning' elsewhere in this specification and as required by the authority having jurisdiction.
- E. Connect domestic water piping to water-service piping flange with shutoff valve; extend and connect to the following:
 - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 2. 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. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 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.
 5. Bare Piping in Equipment Rooms: One piece, cast brass.
 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.11 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. Seal space outside of sleeves in concrete slabs and walls with grout.
- I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- J. 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. 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: 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 with water stop.
 - 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.
- K. 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 "Fire-Resistive Joint Systems" for firestop materials and installations.

3.12 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.

3.13 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.

3.14 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 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.

3.15 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm 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. Prepare and submit reports of purging and disinfecting activities.
- C. 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. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8, shall be the following:
 - 1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.
- D. Under-building-slab and aboveground domestic water piping, shall be the following:
 - 1. PEX Tube, NPS 2 and smaller; fittings for PEX tube; and crimped joints.
- E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and soldered joints.
- F. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:
 - 1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and 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: Thermostatic circulation valves.
 - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Temperature-actuated, water mixing valves.
 - 4. Strainers.
 - 5. Drain valves.
 - 6. Water hammer arresters.
 - 7. Air vents.
- B. Related Sections include the following:
 - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
 - 2. Division 22 Section "Domestic Water Piping" for water meters.
 - 3. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
 - 4. Division 22 Section "Drinking Fountains and Water Coolers" for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 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. NSF Compliance:
 - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
 - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Chrome plated.

2.2 BACKFLOW PREVENTERS

- A. Hose-Connection Backflow Preventers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.
 - e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.

- h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1052.
 3. Body: Bronze, nonremovable, with manual drain.
 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 5. Finish: Chrome or nickel plated.
- B. Beverage-Dispensing-Coffee Maker Equipment Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Watts Industries, Inc.; Water Products Div.
 - c. Zurn Industries, LLC; Wilkins Div.
 2. Standard: ASSE 1022.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8.
 5. Body: Stainless steel.
 6. End Connections: Threaded.
- C. Reduced-Pressure-Principle Backflow Preventers:
1. Basis-of-Design Product: Subject to compliance with requirements, provide Watts Series 909 with a Watts Series 909AG air gap fitting or an approved equal by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1013.
 3. Operation: Continuous-pressure applications.
 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
 5. Size: Refer to Drawings.
 6. Body: Bronze for NPS 2 and smaller; steel with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
 7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 8. Configuration: Designed for horizontal, straight through flow.
 9. Accessories:
 - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
 - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
- D. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. FEBCO; SPX Valves & Controls.
 - c. Flomatic Corporation.
 - d. Watts Industries, Inc.; Water Products Div.
 - e. Zurn Plumbing Products Group; Wilkins Div.
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 TEMPERATURE ACTUATED WATER MIXING VALVES

A. Point-of-Use Thermostatic Mixing Valves **TMV-1**:

1. Subject to compliance with requirements, provide Lawler Model TMM-1070 Lead Free Unit No. 87500 or an approved equal by one of the following:
 - a. Leonard Valve Company
 - b. Apollo Valves; Conbraco Industries, Inc.
 - c. Watts; a Watts Water Technologies Company
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Connections: 3/8-inch.
5. Type: Point of use, 'T' type, thermostatic mechanical mixing valve with high temperature limit stop with automatic reset. The mixing valve shall have compression fittings and a means to adjust outlet temperature. Valve construction shall include a bronze body and integral back flow checks.
6. Material: Bronze body.
7. Valve Finish: Rough bronze.
8. Flow Capacity: 0.5 GPM at 5 PSIG pressure drop.
9. Tempered-Water Setting: 120 degree F supply water set to 110 degree F tempered water.

2.4 EMERGENCY EYEWASH / DELUGE SHOWER THERMOSTATIC MIXING VALVES

1. See specification section 22 4500.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Drain: Pipe plug.

2.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

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

2.8 AIR VENTS

A. Welded-Construction Automatic Air Vents:

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.

5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- C. Install thermostatic recirculation valves in locations where they can easily be serviced. Install shut-off valve upstream of each thermostatic recirculation valve.
- D. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- E. Install balancing valves in locations where they can easily be adjusted.
- F. Install Y-pattern strainers for water on supply side of each motorized control valve, and supply side of all domestic water pumps.
- G. Install water hammer arresters as close as possible to each quick acting device and in water piping according to PDI-WH 201.
- H. Install air vents at high points of water piping.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 1. Reduced-pressure-principle backflow preventers.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
 - 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Perform test of water piping specialties. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.

END OF SECTION 221119

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. PE: Polyethylene plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. TPE: Thermoplastic elastomer.

1.4 PERFORMANCE REQUIREMENTS

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

1.5 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

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

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Gaskets: ASTM C 564, rubber.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: CISPI 301.
- B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - 1. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - a. Manufacturers:
 - 1) ANACO.
 - 2) Fernco, Inc.
 - 3) Ideal Div.; Stant Corp.
 - 4) Mission Rubber Co.
 - 5) Tyler Pipe; Soil Pipe Div.
 - 6) Star

2.5 PVC PIPE AND FITTINGS

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

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

D. Solvent Cement: ASTM D 2564.

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

2.6 SPECIAL PIPE FITTINGS

A. Expansion Joints: Two or three-piece, ductile-iron assembly consisting of telescoping sleeve(s) with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:
 - a. EBAA Iron Sales, Inc.
 - b. Romac Industries, Inc.
 - c. Star Pipe Products; Star Fittings Div.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Comply with requirements in Division 31 Sections.

3.2 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 the following:

1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
2. Dissimilar Pipe-Material Couplings: 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 the following:

1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

D. Aboveground, vent piping NPS 4 and smaller shall be the following:

1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- E. Aboveground, vent piping NPS 5 and larger shall be the following:
1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.
- G. Underground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
 2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
 3. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: Shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.3 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- C. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.
- E. 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.
- F. 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.

- G. 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.
- H. 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; 2 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.
- I. Provide sleeves and link sleeve-seal penetration systems at underground wall penetrations. Provide grouted sleeves at underground slab penetrations. Sleeves are specified in specification section 22 0500.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing. Refer to sleeves specified in Section 22 11 16.
- K. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

3.4 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. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
- F. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.

3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.5 HANGER AND SUPPORT INSTALLATION

- A. 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.
 - 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.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Hangers shall not be placed on the coupling.
- 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. Support horizontal cast-iron and PVC soil piping at each horizontal branch connection.
- I. Brace for horizontal cast-iron soil piping not to exceed 40 foot intervals to prevent horizontal movement.
- J. Above Ground Horizontal PVC Piping: All sizes; install hangers for PVC piping every 4 feet; allow for expansion every 30 feet, then support each joint with the following minimum rod diameters:
 1. NPS 1-1/2 through NPS 4: 3/8-inch rod.
 2. NPS 5 through NPS 8: 1/2-inch rod.
 3. NPS 10 through NPS 12: 5/8-inch rod.
- K. Install supports for vertical PVC piping at base and each floor; provide mid-story guides; provide for expansion every 30 feet.

- L. Refer to the appropriate IAPMO Installation Standard for expansion and other special requirements.
- M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 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.

3.7 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.

3.8 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 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cleanouts.
 - 2. Roof flashing assemblies.
 - 3. Miscellaneous sanitary drainage piping specialties.
 - 4. Flashing materials.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 for concrete.
- B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Jay R. Smith Mfg. Co.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Industries, LLC.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Outlet Connection: No hub].
7. Closure: Brass plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
10. Top: Adjustable scoriated nickel-bronze.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Medium Duty.

B. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Jay R. Smith Mfg. Co.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Industries LLC.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated stainless-steel cover plate with screw.

2.2 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
- B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 1. Open-Top Vent Cap: Without cap.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

B. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

C. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.4 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
 1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
 2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
 3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION.

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

- E. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- F. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- G. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 22 1316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Section 07 6200 "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 IDENTIFICATION

- A. Identification materials and installation are specified in Section 31 2000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
 - 1. Use warning tapes or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system 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.

3.6 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protective shielding guards.
 - 2. Fixture supports.
 - 3. Faucets.
 - 4. Sinks.
- B. Related Sections include the following:
 - 1. Division 22 Section "Emergency Plumbing Fixtures."

1.3 DEFINITIONS

- A. Retain abbreviations and terms that remain after this Section has been edited.
- B. ABS: Acrylonitrile-butadiene-styrene plastic.
- C. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- D. FRP: Fiberglass-reinforced plastic.
- E. PMMA: Polymethyl methacrylate (acrylic) plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.5 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. 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.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. 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. Plastic Sinks: ANSI Z124.6.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 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.
- G. 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.
- H. Comply with the following applicable standards and other requirements specified for bathtub/shower 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.
- 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. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 8. Pipe Threads: ASME B1.20.1.
 9. Plastic Toilet Seats: ANSI Z124.5.
 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Plumberex Specialty Products Inc.
 - b. TRUEBRO, Inc.
 - c. Zurn Plumbing Products Group; 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.

2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Josam Company.
 2. MIFAB Manufacturing Inc.
 3. Smith, Jay R. Mfg. Co.
 4. Tyler Pipe; Wade Div.
 5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
 6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Lavatory Supports:
 1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
 2. Accessible-Fixture Support: Include rectangular steel uprights.

2.3 FAUCETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Chicago Faucets.
 2. Symmons Industries, Inc.
 3. Delta Faucet Company - Commercial.
 4. Zurn Plumbing Products Group; Commercial Brass Operation/

2.4 SINKS

- A. **SK-1**: ADA Compliant, counter-mounting, single bowl, stainless-steel fixture.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Model LRAD1919 or an approved equal by one of the following:
 - a. Eljer.
 - b. Kohler Co.
 - c. American Standard Companies, Inc.
 - d. Just Manufacturing Company.
 - e. Moen, Inc.
 - f. Franke
 2. Description: ADA compliant, single-bowl, counter-mounting, self-rimming, stainless-steel sink.
 - a. Overall Dimensions: 19-1/2" x 19". Depth 7-1/2".
 - b. Metal Thickness: 18 gauge stainless steel.

- c. Bowl:
 - 1) Drain: 3-1/2-inch.
 - a) Location: Off-centered in bowl.
- d. Faucet Hole Punching: Compatible with faucet.
- e. Sink Faucet: Chicago Faucet model 116.213.AB.1, dual beam infrared sensor, deck mounted, chrome plated brass, single hole with side valve faucet, 5-1/4-inch by 11-1/4-inch high gooseneck spout, single lever handle, and 1.5 gpm aerator. 6 Volt Lithium CRP2 battery.
- f. Scald Protection: Provide thermostatic mixing valve TMV-1. Refer to specification section 22 1119 for requirements.
- g. Supplies: NPS 1/2 chrome-plated copper with loose key stops.
- h. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch-thick tubular brass waste to wall; and wall escutcheon(s).
- i. Protective Shielding Guard(s): Yes.

B. **SK-2:** Counter-mounting, single bowl, stainless-steel fixture.

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Model LRAD1919 or an approved equal by one of the following:
 - a. Eljer.
 - b. Kohler Co.
 - c. American Standard Companies, Inc.
 - d. Just Manufacturing Company.
 - e. Moen, Inc.
 - f. Franke
- 2. Description: ADA compliant, single-bowl, counter-mounting, self-rimming, stainless-steel sink.
 - a. Overall Dimensions: 19-1/2" x 19". Depth 7-1/2".
 - b. Metal Thickness: 18 gauge stainless steel.
 - c. Bowl:
 - 1) Drain: 3-1/2-inch.
 - a) Location: Off-centered in bowl.
 - d. Faucet Hole Punching: Compatible with faucet.
 - e. Sink Faucet: Chicago Faucet model 1100-GN8AE3-317AB, deck mounted, chrome plated brass, center set faucet with gooseneck spout, wrist blade handles, and 1.5 gpm aerator.
 - f. Scald Protection: Provide thermostatic mixing valve TMV-1. Refer to specification section 22 1119 for requirements.
 - g. Supplies: NPS 1/2 chrome-plated copper with loose key stops.
 - h. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch-thick tubular brass waste to wall; and wall escutcheon(s).
 - i. Protective Shielding Guard(s): Yes.

C. **SK-3:** ADA Compliant, counter-mounting, double bowl, stainless-steel fixture.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay Lustertone Model LRAD372255 or an approved equal by one of the following:
 - a. Eljer.
 - b. Kohler Co.
 - c. American Standard Companies, Inc.
 - d. Just Manufacturing Company.
 - e. Moen, Inc.
 - f. Franke

2. Description: ADA compliant, double-bowl, counter-mounting, self-rimming, stainless-steel sink.
 - a. Overall Dimensions: 37" x 22". Depth 5-1/2".
 - b. Metal Thickness: 18 gauge stainless steel.
 - c. Bowl:
 - 1) Drain: 3-1/2-inch.
 - a) Location: Off-centered in bowl.
 - d. Faucet Hole Punching: Compatible with faucet.
 - e. Sink Faucet: Chicago Faucet model 1100-GN8AE3-369AB, deck mounted faucet with 8-inch spout and 2-3/8-inch hot and cold water metal lever handles, 2.2 gpm vandal proof aerator, polished chrome plated brass, 8-inch by 13.5-inch high gooseneck spout.
 - f. Scald Protection: Provide thermostatic mixing valve TMV-1. Refer to specification section 22 1119 for requirements.
 - g. Supplies: NPS 1/2 chrome-plated copper with loose key stops.
 - h. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 0.045-inch-thick tubular brass waste to wall; and wall escutcheon(s).
 - i. Protective Shielding Guard(s): Yes.

PART 3 - EXECUTION

3.1 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 walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PLUMBING FIXTURE INSTALLATION - COMMON REQUIREMENTS

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install plumbing fixture level and plumb according to roughing-in drawings.

- C. 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. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes unless otherwise indicated.
- E. Joint Sealing:
 - 1. Seal joints between plumbing fixture and walls, floors, cabinets, and counters using sanitary-type, one-part, mildew-resistant silicone sealant.
 - 2. Match sealant color to plumbing fixture.
 - 3. Comply with sealant requirements specified in Section "Joint Sealants."

3.3 LAVATORIES, SINKS, AND COMMERCIAL SINKS INSTALLATION

- A. Install supports, affixed to building substrate, for wall-mounted fixtures.
- B. Install counter-mounting fixtures in and attached to casework.
- C. Install accessible wall-mounted fixtures at handicapped/elderly mounting height for people with disabilities or the elderly, according to ANSI A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- F. Install faucet-spout 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.
- G. Install fresh batteries in battery-powered, electronic-sensor mechanisms.
- H. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220500 "Common Work Results for Plumbing."
- I. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories and sinks.

3.4 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.

3.5 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. Clean fixtures, remove stains and labels prior to acceptance.
- F. Install fresh batteries in sensor-operated mechanisms.

3.6 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 224000

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following emergency plumbing fixtures:
 - 1. Eyewash equipment.
 - 2. Water-tempering equipment.
- B. See Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- C. See Division 22 Section "Sanitary Waste Piping Specialties" for floor drains.

1.2 DEFINITIONS

- A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.
- C. Tepid: Moderately warm.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.
- B. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."
- B. 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.
- C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 - PRODUCTS

2.1 EYE-FACEWASH EQUIPMENT

A. Eye-facewash Equipment, **EEW-1**:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Speakman Model SE-572 Eyesaver or approved equal by one of the following:
 - a. Guardian Equipment Co.
 - b. Haws Corporation.
 - c. Stingray Systems.
2. Description: Plumbed, counter-mounting eyewash equipment with paddle handle activated valve.
 - a. Capacity: Deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.
 - b. Supply Piping: NPS 1/2.
 - c. Control-Valve Actuator: Stainless steel, push handle activated.
 - d. Spray Heads: Two, yellow ABS plastic spray outlets with flip-top dust caps, aerated.
 - e. Signage: Universal Emergency Sign.
 - f. Performance: 3.6 gpm @ 30 psi.

2.2 WATER-TEMPERING EQUIPMENT

A. Emergency Eyewash/Facewash Thermostatic Mixing Valves, **ETMV-1**:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Lawler Model 911 E/F or an approved equal by one of the following:
 - a. Encon Safety Products.
 - b. Haws Corporation.
 - c. Leonard Valve Company.
 - d. Powers, a Watts Industries Co.
 - e. Speakman Company.
2. Standard: ANSI Z358.1-1998
3. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.
 - a. Thermostatic Mixing Valve: Designed to provide 3 GPM of 85 deg F tepid, potable water at 10 psi pressure drop to emergency plumbing eye/face wash fixture. Shall maintain temperature at plus or minus 5 deg F. Thermostatic type with liquid filled thermal motor or dual element polyeutectic filled actuator. Sliding piston or shuttle mechanism. In the event of cold water interruption, the control mechanism shall close off the hot water port. In the event of hot water interruption, the control mechanism shall allow cold flow through both the fixed and variable bypass.
 - b. Dial thermometer outlet.
 - c. Temperature characteristics: inlet as indicated on drawings, 85 F outlet.

- d. Cabinet: Provide carbon steel recessed cabinet. Lock with two keys. Piano type hinge. 16 Ga. Steel. Baked enamel. Security screws (not vandal proof or tamper resistant) on external frame. Top out cabinet.
- e. Valve Finish: Rough bronze.
- f. Field provided accessories:
 - 1) Provide inlet check valves on hot and cold inlet. Installed 4 to 10 feet from the mixing valve inlets.
 - 2) Provide unions on inlets.

B. EEW-1, provide ETMV-1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.
- B. Install fixtures level and plumb.
- C. Fasten fixtures to substrate.
- D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
 - 1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.
 - 2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
- E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 22 Section "Common Work Results for Plumbing."
- F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Plumbing Piping."
- G. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.
- H. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping."
- I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- J. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

- K. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- L. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.
- M. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.
- N. Adjust or replace fixture flow regulators for proper flow.
- O. Adjust equipment temperature settings.

END OF SECTION 224500

SECTION 230001 - MECHANICAL CERTIFICATION

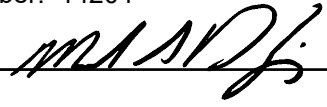
PART 1 - GENERAL

1.1 MECHANICAL ENGINEER'S CERTIFICATION

A. I hereby certify that Division 23 of this Specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota.

B. Name: Mike S. Dolejs, PE

C. License Number: 14204

D. Signature:  Date July 22, 2022

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230001

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SECTION 230010 - GENERAL PROVISIONS

PART 1 - SUMMARY

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 OF WORK

- A. In general the work consist of the following:
 - 1. Partial demolition of existing mechanical systems
 - 2. Water-to-air heat pumps and associated ductwork
 - 3. HEPA fan/filter units and associated ductwork
 - 4. Exhaust fan and associated ductwork
 - 5. Temperature control and building automation system
 - 6. Testing and balancing
 - 7. Commissioning
- B. Location of Work: Sisseton, SD

1.3 GENERAL

- A. The work shall consist of the furnishing of all labor, materials, services, and equipment necessary for, and incidental to the mechanical work called for on the drawings and specifications.
- B. The work shall also include the completion of details of mechanical work not mentioned or shown, which are necessary for the successful operation of the mechanical systems described on the drawings and as required by the specifications.
- C. The only mechanical work not included shall be those items explicitly indicated to be excluded.
- D. The contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the contract documents.
- E. The completed mechanical systems shall be complete and in all respects ready for use, tested as indicated and/or required with test reports, prior to the final site observation and/or the owner's acceptance. The work of these documents shall consist of furnishing all labor, materials, services, and equipments necessary for and incidental to the mechanical work called for on the drawings or specifications.
- F. The contractor is responsible for review of all drawings, including but not limited to architectural, electrical, fire protection, structural, civil and landscape for portions of their work to be included or coordinated. No extra credits will be allowed due to the contractor's failure to review and coordinate with all other disciplines.

- G. Contractor shall visit the site and become familiar with on site conditions before submitting their bid. Failure to visit the site will in no way relieve the contractor the necessity of performing work and any work required to complete the work intended by the drawings and specifications, which should be determined by the site visit.
- H. The drawings and specifications are intended to supplement each other, such that information contained in either shall be executed in the same manner.
- I. If a question exists regarding the exact intention of the documents, instructions shall be obtained from the architect/engineer before proceeding. If instructions cannot be obtained due to time or communication limitations, the greater quantity, superior quality, or condition most favorable to the owner shall be assumed.
- J. The drawings are in general diagrammatic and not intended to show exact locations. The drawings are not intended to be scaled for rough-in dimensions or exact locations. Architectural, electrical, structural, fire protection, landscape drawings, etc. shall be consulted for exact locations if required. Architectural and Structural Drawings shall take precedence over Mechanical Drawings. Because of the small scale of the Mechanical Drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Only critical dimensions will be provided.
- K. Contractor, when installing his/her equipment, shall leave adequate room for the installation of equipment by other contractors where space is limited. Consideration has been given to such conditions of limited space in the preparation of the drawings, and the locations and dimensions of equipment have been selected accordingly. Contractor shall be cautioned that in certain instances, space may be limited to the extent that there may be only one arrangement of equipment or facilities that will allow installation of same.

1.4 CODES & STANDARDS

- A. All work shall comply with all current and applicable codes, specifications, ordinances, laws, regulations, industry standards, and utility company regulations
- B. The codes and standards are minimum requirements with respect to the installation as shown and specified, and are intended to comply with these requirements. Where conflicts exist, the greater quantity, superior quality or condition most favorable to the owner shall be assumed.

1.5 RELATED DOCUMENTS

- A. The General Conditions of the Contract for Construction, Supplementary Conditions and the General Requirements of Division 01 are hereby made a part of this division.
- B. The sections contained in Division 23 may conflict with the conditions of contract of the General Requirements. The statement requiring the greater quantity, superior quality, or condition most favorable to the owner shall take precedence.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- D. Division 23 work shall include all mechanical work unless explicitly indicated otherwise.

1.6 SPECIAL CHARGES

- A. All fees, permits, and licenses required for the mechanical work are to be included in the contract.
- B. If more than two final site inspections are required by the engineer, the contractor will be billed at an hourly rate for the time associated with the additional site visits.

1.7 SUBMITTALS

- A. General
- B. All requests for information, clarification, etc., shall be submitted in writing to the engineer with a copy to the owner/architect.
- C. All shop drawings and operating manuals shall be submitted to the engineer with transmittal copies to the owner/architect.
- D. Substitutions and Prior Approvals.
 - 1. Comply with the requirements of Division 01 Section "Administrative Requirements".
- E. Shop Drawings
 - 1. Comply with the requirements of Division 01 Section "Submittals".
 - 2. Shop drawings shall be submitted on Division 23 items as specified in individual sections.
 - 3. Shop drawings shall be stamped approved by the contractor prior to submittal.
 - 4. Shop drawings shall include detailed product information with catalog numbers, features, dimensions, wiring diagrams, and any other critical information clearly highlighted. The related specification sections may require additional information.
 - 5. Shop drawings must be submitted in a format to allow easy identification of the exact item that is to be furnished, with all optional features or components clearly identified.
 - 6. Shop drawings not properly submitted will be returned and not reviewed.
- F. Operation and Maintenance Manuals
 - 1. Comply with the requirements of Division 01 Section "Closeout Requirements."
 - 2. Operating manuals shall include information on all equipment requiring shop drawings.
- G. Record Drawings
 - 1. Comply with the requirements of Division 01 Section "Closeout Requirements".

1.8 COORDINATION

- A. Coordinate work with other trades in the installation of equipment, piping, conduit, and ductwork.
- B. HVAC/Sheet-metal Contractor shall initiate the coordination process by providing reproducible plan drawings showing ductwork and equipment.

- C. The HVAC/sheet metal Contractor shall forward the Drawings to the Piping Contractor, Fire Protection Contractor and Electrical Contractor for inclusion of their systems work. The HVAC/sheet metal contractor shall be responsible for retrieving all drawings from necessary contractor and developing necessary drawings highlighting conflicting areas.
- D. Following the completion of these drawings, an on site coordination meeting shall be convened, and attended by all the above contractors, and the Mechanical and Electrical design Engineers for the purpose of review and coordination. This meeting allows the opportunity for all contractors to resolve coordination issues prior to the fabrication and installation of material. Coordination meeting shall take place before any work is started. No additional cost to the project will be accepted for any coordination related items if this process is not adhered to.

1.9 SYMBOLS AND ABBREVIATIONS

- A. Refer to symbols and abbreviations on drawings. Other symbols are in common usage, but if uncertainty exists regarding any plan symbols or abbreviations, it shall be brought to the attention of the Engineer, and the Engineer shall clarify same by addendum.
- B. Where the phrase "Provide ----" occurs; "provide" shall be construed to mean the same as "furnish, deliver and install ----."

1.10 UTILITY REBATE SCHEME

- A. It is the intention to apply the local utility energy efficient rebate scheme to this project. Contractor shall secure, on behalf of the Owner, the maximum rebate available. This shall include all submittals to the utility company, including substantiation where required, and making all necessary arrangements on behalf of the Owner. All rebates shall be made to the Owner at the time of Substantial Completion.

1.11 ALTERNATE PROPOSALS

- A. Refer to Division 01 Section "Alternates," for the Description of Alternates.

1.12 CAD DRAWING FILES

- A. All Division 23 electronic CAD drawing files provided by the Architect/Engineer for this project are for use solely with respect to this project. Contractor may request copies of the Division 23 CAD drawing files for the preparation of Shop Drawings. However, CAD drawing files shall not be used on other projects, for additions to this project, or for completion of this project by others. Any intentional or unintentional revisions, additions, or deletions to these Division 23 CAD drawing files shall be made at the full risk of the person(s) making such revisions, additions, or deletions, and such person(s) shall hold harmless and indemnify Architect/Engineer of any and all responsibilities and liabilities.
- B. CAD files are not to be construed as updated As-Built Construction Documents. The drawing files reflect only bidding documentation of original Construction Drawings. Addenda or written changes occurring during the construction process will not be incorporated into the Division 23 CAD drawing files.

- C. Cost for Division 23 CAD drawing files, provided in electronic format will be \$100 per drawing sheet, payable directly to Engineering Design Initiative. CAD files may be obtained on a COD basis at the office of Engineering Design Initiative.
- D. Procedure for acquiring CAD files shall be as follows:
- E. Contractor shall make a request to Engineering Design Initiative. in writing, including a list of the files desired.
 - 1. Engineer will send the contractor an invoice and "Document Release and Indemnity Agreement."
 - 2. Contractor shall sign this agreement and send a check for the amount to the Engineer.
 - 3. Upon receipt of these items, Engineer will send the CAD files to contractor. Files can be sent on flash drive, e-mail or other means as agreed between Contractor and Engineer.

PART 2 - PRODUCTS

2.1 GENERAL

- A. None

PART 3 - EXECUTION

3.1 GENERAL

- A. Lay-out and coordinate all work well enough in advance to avoid conflicts or interferences with other work in progress. Conflicts arising from lack of coordination shall be this contractor's responsibility.
- B. Perform all work in conformity with the construction called for by other trades and afford reasonable opportunity for the execution of their work. Properly coordinate all work with the work of other trades at such time, and in such a manner as not to delay or interfere with their work.
- C. Promptly report to the architect/engineer any delay or difficulties encountered which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of work of other trades as being fit and proper for the execution of this work.
- D. Plan all work so that it proceeds with a minimum of interference with other trades. Inform all parties concerned of openings required for equipment and provide all special frames, sleeves and anchor bolts as required.

3.2 WORKMANSHIP

- A. Only quality workmanship will be accepted. All parts of the mechanical systems such as pipes, ducts, grillage, etc., shall be square and true with the building or site geometry, and shall be neat and orderly in appearance.

3.3 SCHEDULE

- A. Schedule all work such that the progress of the mechanical work will conform to the progress of the other trades. Complete the entire installation as soon as the conditions of the project will permit. Any cost resulting from defective or ill-timed work performed under this section shall be borne by this contractor.
- B. Contractor shall prepare an accurate schedule for every construction meeting.

3.4 GUARANTEE/WARRANTY

- A. Guarantee all materials and equipment installed under this subcontract against defects in workmanship and materials for a period of twelve (12) months after final acceptance of the work by the Owner. Repair and/or replace any materials or equipment developing such defects within that time promptly, upon due notice given by the Owner, at no additional expense to the Owner.
- B. All equipment bearing a manufacturer's guarantee shall be construed as an extended guarantee to the Owner by the Manufacturer. Any such equipment that proves to be defective in materials or workmanship within the guarantee period is to be replaced by the Subcontractor in accordance with the manufacturer's guarantee, at no additional expense to the Owner.

3.5 CUTTING AND PATCHING

- A. Each trade shall perform all cutting and patching necessary in order to perform the work, unless such work has been delegated to the General Contractor/another trade. All patching shall be performed in such manner as to leave no visible trace and to return the part affected to the condition of undisturbed work. Patching work shall be performed by persons experienced, skilled, and licensed for the particular type of work involved. Inferior work will not be accepted. All holes in masonry shall be drilled with rotary drills. Impact tools shall not be used.

3.6 HOLES THROUGH MASONRY AND CONCRETE

- A. Each trade shall provide all holes and openings required for his work, unless such holes and openings are shown to be provided on the Architectural or Structural Drawings. Pay particular attention to openings required in pre-cast, pre-stressed, or post-tensioned slabs.

3.7 CONCRETE BASES AND PADS

- A. Concrete bases or pads exterior to the building shall be provided by the trade requiring same.
- B. Concrete bases or pads within the building shall be provided by each trade requiring same.

3.8 PAINTING

- A. Refer to appropriate section of Division 23 for painting requirements.
- B. Pre-painted equipment delivered to the job site prime painted or finish painted shall be touched up as necessary and/or as directed. When available, spray cans of the paint shall be obtained from the equipment manufacturer.

C. Uninsulated (or Bare) Metal Surfaces.

1. In spaces being painted by the General Contractor, metal surfaces, such as bare pipe, angle iron, hanger rods, steel bases, etc., shall be the painting responsibility of the General Contractor.
2. In mechanical spaces and all other spaces that are not being painted by the General Contractor, metal surfaces, such as bare pipe, angle iron, hanger rods, steel bases, etc., shall be the painting responsibility of the Mechanical Contractor.
 - a. All metal surfaces to be painted shall be thoroughly cleaned, wire brushed, and then painted with a primer coat and two (2) coats of oil-based paint.

3.9 CLEANUP

- A. Each trade shall periodically clear away all debris, surplus materials, etc., resulting from his work or operations, leaving the job and the equipment furnished under any or all contracts in a clean condition.

3.10 TESTS

- A. Each trade shall test the equipment provided and/or installed under this Specification and shall demonstrate its proper operation to the Owner's operating engineer.
- B. No equipment shall be tested or operated for any purpose until it has been fully prepared, lubricated and properly connected and made ready for normal operation. Any damage to equipment occasioned by improper or ill-timed operation or testing shall be made good at the contractor's own expense, before final inspection and acceptance.

3.11 INSTRUCTION OF OPERATING PERSONNEL

- A. Each trade shall furnish, without additional expense to the Owner, the services of competent instructors, who will give full instruction in the care, adjustment, and operation and maintenance of all parts of the equipment to the Owner's permanent employees who are to have charge of the equipment. Refer to individual sections for additional training requirements for specific systems.
- B. Each instructor shall be thoroughly familiar with all parts of the installation on which he is to give instructions and shall be trained in operating theory as well as in practical operation and maintenance work. Factory trained instructors shall be employed wherever they are available. Instruction shall be given during regular work week and at a time just prior to the time the equipment is accepted and turned over to the Owner for regular operation.
- C. All training and operating instructions shall be recorded by the contractor and the videotape(s) handed over to the Owner. Coordinate training schedule with Owner. Provide a minimum of three working days advance notice for each training session.
- D. Contractor shall submit to the Architect/Engineer, a letter, signed by the Owner, stating that the instruction of operating personnel has been completed and is accepted by the Owner.

END OF SECTION 230010

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SECTION 230130 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING

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 cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

1.3 DEFINITIONS

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.

1.4 SUBMITTALS

- A. Cleanliness verification report.

1.5 QUALITY ASSURANCE

- A. ASCS Qualifications: A certified member of NADCA .
- B. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Use existing duct-mounted accessories, as required, for physical and mechanical entry and for inspection. Provide new access panels according to Division 23 Section "Duct Accessories" where required. New access panels shall be gasketted.
- C. Remove and reinstall ceiling components to gain access for duct cleaning. Clean ceiling components after they have been removed and replaced.

- D. Systems and Components to Be Cleaned:
 - 1. Air devices for supply and return air.
 - 2. Ductwork:
 - a. Extractors and other devices inside ductwork.
- E. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- F. Particulate Collection:
 - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
 - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- G. Control odors and mist vapors during the cleaning and restoration process.
- H. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.
- I. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- J. Clean all air-distribution devices, registers, grilles, and diffusers.
- K. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
- L. Duct Systems:
 - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
 - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (refer to NADCA ACR 2006).
- M. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- N. Mechanical Cleaning Methodology:
 - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
 - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
 - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to

safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.

2. Cleaning Mineral-Fiber Insulation Components:

- a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
- b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- c. Fibrous materials that become wet shall be discarded and replaced.

O. Antimicrobial Agents and Coatings:

1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

P. Reconnect diffusers or boots to low-pressure ducts.

3.2 CLEANLINESS VERIFICATION

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify cleanliness after mechanical cleaning and before application of treatment, including biocidal agents and protective coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Schedule duct cleanliness inspection meeting with Owner at project site. Provide 48 hours advanced notice.
- E. Prepare a written cleanliness verification report. At a minimum, include the following:
 1. Written documentation of the success of the cleaning.
 2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
 3. Surface comparison test results if required.
 4. Plan view as-built documentation of locations of access panels
 5. System areas found to be damaged.

- F. Photographic Documentation: Provide photo documentation before and after air distribution cleaning at representative ducts and grilles.

3.3 RESTORATION

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Section 23 3113 "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Section "Metal Ducts."
- D. Replace damaged insulation according to Section "HVAC Insulation."
- E. Ensure that closures do not hinder or alter airflow.
- F. Remove air bags and inflatable plugs and devices used in the cleaning process.
- G. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.

END OF SECTION 230130

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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. Rooftop Piping Supports.
 - 6. Sleeves.
 - 7. Escutcheons.
 - 8. Grout.
 - 9. Equipment installation requirements common to equipment sections.
 - 10. Painting and finishing.
 - 11. Concrete bases.
 - 12. Supports and anchorages.
 - 13. HVAC Demolition.

1.3 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.

1.4 SUBMITTALS

A. Welding certificates.

1.5 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.

1.6 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.

1.7 ACCESS PANELS IN WALLS AND CEILING

- A. Provide access panels and doors for HVAC items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 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.

2.3 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. 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. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.4 TRANSITION FITTINGS

- A. 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.
 - 1. Manufacturers:

- a. Eslon Thermoplastics.
- B. 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.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- C. 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.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.

2.5 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: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
 - 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. 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. Manufacturers:

- a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
- 2. 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: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
 - 1. Manufacturers:
 - a. Calpico, Inc.
 - b. Lochinvar Corp.
- G. 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.
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Thunderline Co.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.
- B. Provide water-stop sleeve as part of sleeve-seal system. Provide pipe penetration water-stop sleeve in wall or other penetration assembly prior to installation of the sleeve-seal system.
 - 1. Model: Thunderline Co. model 'CS Century-line' sleeve as basis of design.
 - 2. Description: Manufactured HDPE plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic water-stop collar.
 - 3. Size the sleeve a minimum four inches larger than the outside diameter of the link sleeve itself and allowing ½" movement between (wall) forms to resist pour forces.

4. Each water-stop sleeve shall have end caps manufactured of the same material as the water stop and installed at each end of sleeve to prevent deformation during the initial concrete pour, and to facilitate attaching the sleeve to the wall forms. End caps shall remain in place to protect the opening from residual debris and animal entry prior to pipe insertion and link installation.

2.7 ROOFTOP PIPE SUPPORTS

- A. Polycarbonate or rubber UV resistant sleeper support with galvanized steel pipe clamps.

2.8 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.

2.9 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 and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With 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.

2.10 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.

PART 3 - EXECUTION

3.1 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.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - 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. Salvage heat pumps and return to Owner. Deliver to 3800 Bryant Ave South between 7:00 am and 1:00 pm Monday – Friday. Coordinate delivery with Owner. Unload and place in shop through overhead door (no loading dock or forklift available on site).
- 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.

3.2 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 above accessible ceilings to allow sufficient space for ceiling panel removal.
- 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. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - 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, cast-brass type with rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, 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 all pipe sizes unless noted below.
 - 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.
 - 1) Seal space outside of sleeve fittings with grout.
- 4. Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and joint sealant.
 - 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.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 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.

3.4 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.

3.5 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.

3.6 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Painting and Coatings".
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 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 5000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete" and "Concrete Reinforcing."

3.8 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.

3.9 ERECTION OF FIRE-RATED WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place fire-retardant 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 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with 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.

2.2 MOTOR CHARACTERISTICS

- A. Motors 3/4 HP and Larger: Three phase.
- B. Motors Smaller Than 3/4 HP: Single phase.
- C. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

- D. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with adjustable speed controllers:
 - 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 controlled by adjustable speed controllers shall be provided with a shaft grounding kit as manufactured by Aegis, Model SGR.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

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SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Bronze ball valves.
- 2. Iron, single-flange butterfly valves.
- 3. Bronze swing check valves.
- 4. Iron swing check valves.
- 5. Bronze gate valves.
- 6. Iron gate valves.
- 7. Bronze globe valves.
- 8. Iron globe valves.
- 9. 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.

1.3 SUBMITTALS

- A. Product Data: For each type of valve indicated.

1.4 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to HVAC valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 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. 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. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.
- G. All similar valves shall be of similar manufacturer.

2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements,:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - 2. 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: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full.

2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

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

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DeZurik Water Controls.
- f. Hammond Valve.
- g. Kitz Corporation.
- h. Legend Valve.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

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

- a. Conbraco Industries, Inc.; Apollo Valves.
- b. Cooper Cameron Valves; a division of Cooper Cameron Corp.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. DeZurik Water Controls.
- f. Hammond Valve.
- g. Kitz Corporation.

- h. Legend Valve.
- i. Milwaukee Valve Company.
- j. NIBCO INC.
- k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Aluminum bronze.

2.4 BRONZE SWING CHECK VALVES

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

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

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Milwaukee Valve Company.
- g. NIBCO INC.
- h. Powell Valves.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

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

2.5 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

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

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.

- d. Hammond Valve.
- e. Kitz Corporation.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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.

2.6 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

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

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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: Bronze.
- f. Disc: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

B. Class 125, RS Bronze Gate Valves:

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

- a. American Valve, Inc.
- b. Crane Co.; Crane Valve Group; Crane Valves.
- c. Crane Co.; Crane Valve Group; Jenkins Valves.
- d. Crane Co.; Crane Valve Group; Stockham Division.
- e. Hammond Valve.
- f. Kitz Corporation.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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: Solid wedge; bronze.
- g. Packing: Asbestos free.
- h. Handwheel: Malleable iron.

2.7 IRON GATE VALVES

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

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

- a. Crane Co.; Crane Valve Group; Crane Valves.
- b. Crane Co.; Crane Valve Group; Jenkins Valves.
- c. Crane Co.; Crane Valve Group; Stockham Division.
- d. Hammond Valve.
- e. Kitz Corporation.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Powell Valves.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-70, Type I.
- b. NPS 2-1/2 to NPS 12, CWP Rating: 200 psig.
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

2.8 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.
 - d. Kitz Corporation.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Powell Valves.
 - h. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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.

2.9 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. 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.

2.10 CHAINWHEELS

- A. Manufacturers: Subject to compliance with requirements, :
 - 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 butterfly 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

3.1 EXAMINATION

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

3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for butterfly, gate and globe valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

- F. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.3 ADJUSTING

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

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.
2. Throttling Service: Globe, ball, or butterfly valves.
3. Pump-Discharge Check Valves:
 - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 and Larger: Iron swing check valves with lever and weight or with spring.

- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

- C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE (Includes source side geothermal piping)

- A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with bronze trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.

- B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves, NPS 2-1/2 to NPS 12: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Gate Valves: Class 125, OS&Y.

5. Iron Globe Valves, NPS 2-1/2 to NPS 12: Class 125.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. 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. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. 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 "Vibration for HVAC Piping and Equipment" for vibration isolation devices.
4. Division 23 Section(s) "Metal 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.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.
- 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 D1.3, "Structural Welding Code--Sheet Steel."
 - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
 - 4. 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. 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. Manufacturers:
 - 1. AAA Technology & Specialties Co., Inc.
 - 2. Bergen-Power Pipe Supports.
 - 3. B-Line Systems, Inc.; a division of Cooper Industries.
 - 4. Carpenter & Paterson, Inc.
 - 5. Empire Industries, Inc.
 - 6. ERICO/Michigan Hanger Co.
 - 7. Globe Pipe Hanger Products, Inc.
 - 8. Grinnell Corp.
 - 9. GS Metals Corp.
 - 10. National Pipe Hanger Corporation.
 - 11. PHD Manufacturing, Inc.
 - 12. PHS Industries, Inc.
 - 13. Piping Technology & Products, Inc.
 - 14. Tolco 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 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:
 1. B-Line Systems, Inc.; a division of Cooper Industries.
 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
 3. GS Metals Corp.
 4. Power-Strut Div.; Tyco International, Ltd.
 5. Thomas & Betts Corporation.
 6. Tolco Inc.
 7. 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.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Manufacturers:
 1. Carpenter & Paterson, Inc.
 2. ERICO/Michigan Hanger Co.
 3. PHS Industries, Inc.
 4. Pipe Shields, Inc.
 5. Rilco Manufacturing Company, Inc.
 6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

- 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.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type stainless 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. 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.

2.7 EQUIPMENT SUPPORTS

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

2.8 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.
- 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-joint 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. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

- E. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- M. 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.
 2. Refer to Division 09 painting Sections.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

SECTION 230548 - VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Housed restrained-spring isolators.
 - 3. Spring hangers with vertical-limit stops.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
- B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ace Mountings Co., Inc.
 2. Amber/Booth Company, Inc.
 3. California Dynamics Corporation.
 4. Isolation Technology, Inc.
 5. Kinetics Noise Control.
 6. Mason Industries.
 7. Vibration Eliminator Co., Inc.
 8. Vibration Isolation.
 9. Vibration Mountings & Controls, Inc.
- B. Isolation 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.
1. Resilient Material: Oil- and water-resistant neoprene.
- C. Housed Restrained Spring Isolators
1. Freestanding, steel, open-spring isolators with vertical-limit stop restraint in two-part telescoping housing.
 2. Two-part telescoping housing steel top and bottom frame separated by an elastomeric material and enclosing the spring isolators. Housings shall be equipped with snubbers to limit vertical movement.
 - a. Drilled base housing for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
 - b. Threaded top housing with adjustment bolt and cap screw to fasten and level equipment.
 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.
- D. Spring Hangers with Vertical-Limit Stop: 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation 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.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- 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.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

- A. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- 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.

3.4 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.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring hangers.
- C. Adjust active height of spring isolators.

3.6 HVAC VIBRATION-CONTROL SCHEDULE

- A. Equipment on indoor housekeeping pads:
 1. Isolator Type: Pads.
- B. Supported or Suspended Equipment:
 1. Isolator Type: Spring Hangers with Vertical-Limit Stop.

END OF SECTION 230548

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.
 - 4. Duct labels.
 - 5. Stencils.
 - 6. Valve tags.
 - 7. Warning tags.
 - 8. Ceiling tacks.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. 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: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include equipment's Drawing designation or unique equipment number, drawing numbers where equipment is indicated (plans, details, and schedules).

2.2 HEAT PUMP CEILING 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: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Adhesive.
- H. Label Content: Heat pump equipment schedule number and Delta building automation system address identifier.

2.3 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: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or self-tapping screws.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.4 PIPE LABELS

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

2.5 DUCT LABELS

- A. Self-adhesive duct labels with permanent adhesive.
- B. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- C. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- D. 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.

2.6 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.
 2. Stencil Paint: Exterior, gloss, acrylic enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
 3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1 unless otherwise indicated.

2.7 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.

2.8 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 minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Color: Yellow background with black lettering.

2.9 CEILING TACKS

- A. Manufacture:
 1. W.H. Brady Co.

- B. No. 23250 Series, steel with 7/8 inch diameter color-coded head.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 CEILING TACKS

- A. Provide ceiling tacks to locate HVAC equipment, valves or dampers above accessible suspended ceilings. Locate tacks in corner of panel closest to equipment.

3.3 EQUIPMENT LABEL INSTALLATION

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

3.4 PIPE LABEL INSTALLATION

- A. 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 with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings.

3.5 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of self-adhesive duct labels, at Installer's option.
- C. Locate labels at blower coil supply and return connections.
- D. Locate labels at energy recovery unit supply, return, exhaust and outdoor air intake connections.
- E. 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.

3.6 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.7 WARNING-TAG INSTALLATION

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

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Constant-volume air systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Constant-flow hydronic systems.
 - b. Variable-flow hydronic systems.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

- A. Qualification Data: Within 10 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. Certified TAB reports.
- C. Sample report forms.
- D. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.

2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB. NEBB TAB must be independently owned and operated.
 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.
- B. TAB Conference: Meet with Engineer 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 Engineer.
- E. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - Not Applicable

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine ceiling plenums 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" 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.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. 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.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section "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.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. 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."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure total airflow.
 - a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
 - 2. Measure fan static pressures as follows to determine actual static pressure:
 - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Report the cleanliness status of filters and the time static pressures are measured.
 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
 6. Obtain approval Engineer 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.

3.6 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.

3.7 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 Engineer 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 pre-settings.
- 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.

3.8 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.

3.9 PROCEDURES FOR PRIMARY-SECONDARY HYDRONIC SYSTEMS

- A. Balance the primary circuit flow first and then balance the secondary circuits.

3.10 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.

3.11 PROCEDURES FOR HEAT PUMPS

- A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. Measure and record the following data with each heat pump operating at design conditions:
1. Evaporator/condenser water entering and leaving temperatures, pressure drop, and water flow.
 2. Evaporator/condenser refrigerant temperatures and pressures, using instruments furnished by manufacturer.
 3. Power factor if factory-installed instrumentation is furnished for measuring kilowatts.
 4. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatts.
 5. Capacity: Calculate in tons of cooling.

3.12 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 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.

3.13 TOLERANCES

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 2. Air Outlets and Inlets: Plus or minus 10 percent.
 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.14 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. Fan drive settings including settings and percentage of maximum pitch diameter.
 - e. Settings for supply-air, static-pressure controller.
 - f. 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 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: (Water-To-Air Heat Pumps):

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, where provided.
 - i. Center-to-center dimensions of sheave, and amount of adjustments in inches, where provided.
 - j. Number, make, and size of belts, where provided.
 - 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, where provided.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches, where provided.

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. Cooling-coil static-pressure differential in inches wg.
 - g. Heating-coil static-pressure differential in inches wg.
 - h. Outdoor airflow in cfm.
 - i. Return airflow in cfm.
 - j. Outdoor-air damper position.
 - k. Return-air damper position.
 - l. Water flow rate in gpm.
 - m. Water pressure differential in feet of head or psig across automatic balancing valve.
 - n. Water pressure differential in feet of head or psig across heat pump water-to-refrigerant coil.

F. 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.
- G. Round, Flat-Oval, and Rectangular Duct Traverse Reports:
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.
- H. 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.

I. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.15 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - 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 Engineer.
- 2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Engineer.

3. Engineer 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.

3.16 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 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Insulation Materials:
 - a. Flexible elastomeric.
 - b. Mineral fiber.
- 2. Fire-rated insulation systems.
- 3. Insulating cements.
- 4. Adhesives.
- 5. Mastics.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied jackets.
- 9. Tapes.
- 10. Securements.
- 11. Corner angles.

- B. Related Sections:

- 1. Division 22 Section "Plumbing Insulation."
- 2. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. 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.

PART 2 - PRODUCTS

2.1 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. 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. Products: Subject to compliance with requirements, provide the following:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Armacell LLC; AP Armaflex.
 - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied FRK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap.
 - e. Owens Corning; All-Service Duct Wrap.
- H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 1. Products: Subject to compliance with requirements, provide one of the following:

- a. CertainTeed Corp.; Commercial Board.
- b. Fibrex Insulations Inc.; FBX.
- c. Johns Manville; 800 Series Spin-Glas.
- d. Knauf Insulation; Insulation Board.
- e. Manson Insulation Inc.; AK Board.
- f. Owens Corning; Fiberglas 700 Series.

I. Mineral-Fiber, Preformed Pipe Insulation:

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Fibrex Insulations Inc.; Coreplus 1200.
 - b. Johns Manville; Micro-Lok.
 - c. Knauf Insulation; 1000 Pipe Insulation.
 - d. Manson Insulation Inc.; Alley-K.
 - e. Owens Corning; Fiberglas Pipe Insulation.
- 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. Thermal conductivity (k-value) at 100 deg F is 0.24 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

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. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Aeroflex USA Inc.; Aero seal.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
 - d. RBX Corporation; Rubatex Contact Adhesive.
 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).
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 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).
- D. ASJ Adhesive and FRK Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-82.
 - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
 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).

2.4 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 LEED mandated VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.

- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
 5. Color: White.
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-10.
 - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
 - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
 - d. Marathon Industries, Inc.; 550.
 - e. Mon-Eco Industries, Inc.; 55-50.
 - f. Vimasco Corporation; WC-1/WC-5.
 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 200 deg F.
 4. Solids Content: 63 percent by volume and 73 percent by weight.
 5. Color: White.

2.5 SEALANTS

A. FRK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. 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).

B. ASJ Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. 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).

2.6 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. FRK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 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. 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.

2.8 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 2. Width: 3 inches.
 3. Thickness: 11.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FRK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
 - b. Compac Corp.; 130.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
 - d. Venture Tape; 1506 CW NS.
 2. Width: 2 inches.
 3. Thickness: 6 mils.
 4. Adhesion: 64 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

- A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with.
 1. Products: Subject to compliance with requirements, provide the following:
 - a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
- B. Insulation Pins and Hangers:
 1. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
 - 2) GEMCO; Perforated Base.
 - 3) Midwest Fasteners, Inc.; Spindle.
 - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
 2. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide the following:
 - 1) GEMCO; Nylon Hangers.
 - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

- b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
 - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
 - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
3. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 - c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
4. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
5. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide the following:
 - 1) GEMCO.
 - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

2.10 CORNER ANGLES

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 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.

3.3 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 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.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: 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.
- E. 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.

3.4 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. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal corners and body to form a vapor barrier.

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt

- each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, 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.

3.6 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.

3.7 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.

3.8 FINISHES

- A. Comply with the requirements of Division 09 painting Sections.
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Repair and replace all defective or unprofessional insulation, heat trace, and insulation systems.
- C. Work shall be neat and professional in appearance.

3.10 DUCT INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated:
 1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 2. Factory-insulated flexible ducts.
 3. Factory-insulated plenums and casings.
 4. Flexible connectors.
 5. Vibration-control devices.
 6. Factory-insulated access panels and doors.

3.11 INDOOR DUCT INSULATION SCHEDULE:

- A. Concealed, Supply-Air Duct and Plenum Insulation: Mineral-fiber blanket, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density.
- B. Concealed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.
- C. Concealed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber blanket, 2 inches thick and 1.5-lb/cu. ft. nominal density.

- D. Exposed, Supply-Air Duct and Plenum Insulation: Mineral-fiber board, 1-1/2 inches thick and 3-lb/cu. ft. nominal density. **Exception:** Exposed spiral round ductwork.
- E. Exposed, Outdoor-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 3-lb/cu. ft. nominal density.
- F. Exposed, Exhaust-Air Duct and Plenum Insulation: Mineral-fiber board, 2 inches thick and 3-lb/cu. ft. nominal density.
- G. Combustion Air Duct Insulation for Equipment: Mineral-fiber blanket, 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density (Note: Includes plumbing equipment, i.e. water heater).

3.12 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.

3.13 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.

3.14 INDOOR PIPING INSULATION SCHEDULE

- A. Heat Pump Core Loop Supply and Return: Insulation shall be the following:
 - 1. Preformed Mineral Fiber: 1 inch thick.
- B. Condensate and Equipment Drain Water. Exception: Vertical drops to floor drains:
 - 1. All Pipe Sizes: Insulation shall be the following:
 - a. Preformed Mineral Fiber: 1/2 inch thick.

END OF SECTION 230700

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SECTION 230800 - HVAC COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. The commissioning activities have been developed to support delivery of project performance in accordance with the Owner's requirements for the project and the Commercial Energy Code requirements for system commissioning.
 - 1. Commissioning activities and documentation for Section C408 of the Commercial Energy Code.
- B. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- C. Related Sections:
 - 1. Section 23 0593 "Testing, Adjusting and Balancing for HVAC".
- D. Project will be accomplished in phases with Owner maintaining occupancy throughout the construction process. Contractor shall include an accommodation for project phasing in preparing his/her bid for the Work.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. TAB: Test and Balance.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING INTENT

- A. Intent of HVAC&R system commissioning is to assure delivery to the Owner of HVAC&R systems which are fully functioning in accordance with all specifications and which the Owner's personnel are fully trained and equipped to operate, maintain and troubleshoot.

1.5 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend commissioning coordination meetings.
- C. Provide information requested by the CxA for final commissioning documentation.
- D. Provide measuring instruments and logging devices to record test data.
- E. Provide Owner training for HVAC&R system equipment and controls.
- F. HVAC Temperature Control Contractor:
 - 1. With the CxA and design professional, review control designs for compliance with the Contract Documents, controllability with respect to actual equipment to be installed, and recommend adjustments to control designs and sequence of operation descriptions.
 - 2. Where allowed by Owner's policies, provide Commissioning Authority with web based remote access to building automation system for review of setpoints and trending.
 - 3. Perform functional performance testing at the direction of the CxA.
- G. TAB Contractor:
 - 1. Contract Documents Review: With the CxA, review the Contract Documents before developing TAB procedures.
 - a. Verify the following:
 - 1) Accessibility of equipment and components required for TAB Work.
 - 2) Adequate number and placement of duct balancing dampers to allow proper balancing while minimizing sound levels in occupied spaces.
 - 3) Adequate number and placement of balancing valves to allow proper balancing and recording of water flow.
 - 4) Adequate number and placement of test ports and test instrumentation to allow reading and compilation of system and equipment performance data needed to conduct both TAB and commissioning testing.
 - 5) Air and water flow rates have been specified and compared to central equipment output capacities.
 - b. Identify discontinuities and omissions in the Contract Documents.
- H. Electrical and Mechanical Contractors
 - 1. The Electrical and Mechanical Contractors shall coordinate installations and connections between and among electrical and HVAC systems, subsystems, and equipment.
 - 2. Participate in warranty review.

1.6 OWNER'S RESPONSIBILITIES

- A. Assign Owner and facilities maintenance personnel to participate in meetings, training sessions and functional testing sessions.

1.7 CxA'S RESPONSIBILITIES

- A. Provide Project-specific commissioning process functional test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning functional testing.
- C. Verify testing, adjusting, and balancing Work.
- D. Prepare final commissioning report.

1.8 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's pre-start and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
 - 4. Test and inspection reports and certificates.
 - 5. Corrective action documents.
 - 6. Verification of testing, adjusting, and balancing reports.

1.9 COMMISSIONING MEETINGS

- A. Attend HVAC&R commissioning meetings including, but not restricted to the following:
 - 1. HVAC&R Controls Review.
 - 2. Equipment Start-up.
 - 3. Testing and Balancing Coordination.
 - 4. System Functional Testing.
 - 5. Warranty Review.

1.10 CONTRACTOR TESTING

- A. Subcontractors shall forward, through the GC, a schedule of specified contractor tests for piping leak tightness, glycol solution concentration testing and building automation calibration and adjusting.
- B. The schedule shall allow at least 1 week's testing notice to the CxA. The CxA reserves the right to witness and document all specified tests.

- C. Submit contractors test reports to the appropriate design professionals, as specified, and concurrently to the CxA upon successful completion of each test.
- D. The Contractor responsible for the system or component being tested shall be responsible to provide all test equipment necessary to fulfill the testing requirements of this Division

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

3.1 TESTING AND BALANCING VERIFICATION

- A. Notify the CxA at least 10 days in advance of testing and balancing Work and provide access for the CxA to witness testing and balancing Work.
- B. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

3.2 FUNCTIONAL PERFORMANCE TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment through distribution systems to each zone.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

- D. Tests will be performed using design conditions whenever possible.
- E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- F. The CxA may direct that setpoints be altered when simulating conditions is not practical.
- G. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- H. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.3 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. HVAC&R System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of HVAC&R systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item to be tested.

3.4 SYSTEMS TO BE COMMISSIONED

- A. HVAC&R systems, assemblies, and equipment.

END OF SECTION 230800

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SECTION 230993 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Divisions 00 and 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes BAS equipment for the monitoring and control of the new heat pumps.
- B. The scope of work includes modifications, integration and expansion as necessary to the existing Johnson Control system to perform the sequence of operation as described herein.
- C. The system shall be Johnson Controls. No exceptions or substitutions allowed. Approved Contractors are:
 - 1. Johnson Controls of Sioux Falls, SD.
- D. The Contractor shall provide all unit controllers, sensors, valves, actuators and wiring necessary to perform the sequence of operations for the systems described herein.
- E. Contractor shall provide all necessary wiring to the head end and workstation as related to the points list.
- F. Field devices shall be latest version of Delta Controls consistent with existing similar field devices.
- G. All setpoints and reset schedules shall be adjustable.

1.3 GENERAL REQUIREMENTS

- A. All setpoints and reset schedules shall be adjustable.
- B. Provide low voltage wiring, power wiring, installation, and termination of all remote panels, sensors, and control devices furnished as specified in mechanical Division 23 Sections for field installation. Provide labor and materials for complete and operating control systems.
- C. Provide an ALARM indication in the event that a fan and/or pump output command does not match status.
- D. Provide an ALARM indication in the event that the temperature in any space falls below 40F.
- E. Update graphical interface generation to include new heat pumps. Coordinate graphical design with Owner.

- F. Provide additional field hardware points and devices as necessary to accomplish the sequences of operation. Control Contractor is responsible for field verifying and providing the required points needed to accomplish the sequences of operation whether all points were specified or not.
- G. Control Contractor is responsible for contacting equipment manufacturer for any field verification necessary to determine details of control connections required to the equipment.

1.4 DEFINITIONS

- A. ASC: Adjustable Speed Controller (Variable frequency drive or VFD).
- B. ASUC: Application Specific Unit Controller
- C. BAS: Building Automation System.
- D. CFM: Cubic Feet per Minute.
- E. CO2: Carbon Dioxide
- F. CTR: Current Transmitter Relay
- G. DDC: Direct digital control.
- H. DP: Differential Pressure.
- I. DPS: Differential Pressure Sensor.
- J. DPT: Differential Pressure Transmitter/Transducer.
- K. ERU: Energy Recovery Unit
- L. MFR: Manufacturer.
- M. OA: Outdoor Air.
- N. TAB: Test and Balance
- O. TCC: Temperature Control Contractor.
- P. TCC: Temperature Control Contractor.
- Q. VFD: Variable Frequency Drive

1.5 WATER SOURCE HEAT PUMPS (HP-14)

- A. The system consists of multiple water-to-air heat pumps that provide thermal comfort at the zone level. Heat pumps with cooling capacities 2 tons and higher have two-stage compressors for capacity control. Outdoor air is provided by an energy recovery unit to the return air plenum of selected heat pumps. The heat pumps are furnished with an electronic interface for BAS

control. Each heat pump shall have a 2-position motorized 2-port or 3-port isolation valve. Heat pumps shall be provided with field-installed electric duct heaters.

- B. The TCC shall provide space temperature/humidity sensors and BAS control inputs and outputs for each heat pump. Space temperature/humidity sensors shall have local user adjustable temperature setpoints for heating and cooling. Space temperature/humidity sensors shall also have local override switches to place unoccupied heat pumps into occupied mode. Local temperature setpoint adjustment range and unoccupied override time period shall be determined at the BAS operator interface station.
- C. Control Sequence
1. The heat pump system shall be scheduled by following an occupancy time schedule that is adjustable at the BAS operator interface station.
 2. Temperature sensors in the supply air discharge duct and in the return water piping shall monitor heat pump discharge air temperature and leaving water temperature.
 3. Occupied Operation:
 - a. In the occupied mode the circulation fan shall run continuously at a constant air supply volume.
 - b. The space temperature/humidity sensor shall provide an input to the BAS for control of the heat pump heating and cooling modes. Upon a call for heat pump heating or cooling the 2-position motorized valve shall open. After a suitable time delay for valve opening, the heat pump compressor shall be energized.
 - c. The space temperature/humidity sensor shall provide an input to the BAS for control of the heat pump heating/cooling stages and active dehumidification modes. Upon a call for dehumidification the hot gas reheat coil shall be activated until space humidity setpoint is achieved.
 4. Unoccupied Control:
 - a. In the unoccupied mode the circulation fan shall cycle with heat pump compressor operation.
 - b. The heat pump shall be controlled using an unoccupied heating setpoint initially set to 65 F and an unoccupied cooling setpoint initially set to 85 F, both adjustable. The heat pump may be reset to the Occupied Mode for a predetermined time period upon a signal from the BAS or manually at the room temperature sensor.
 - c. The space temperature/humidity sensor shall provide an input to the BAS for control of the heat pump heating/cooling stages and active dehumidification modes. Upon a call for unoccupied dehumidification the hot gas reheat coil shall be activated until space humidity setpoint is achieved.
 5. Provide a condensate drain pan high level sensor for each heat pump that shall disable the heat pump compressor and issue an alarm in the event of a condensate high level condition. Heat pumps installed in locations where the condensate cannot be drained by gravity will be equipped with condensate pumps. The condensate pumps will be furnished with high level sensors. The condensate pump high level sensors shall also disable the heat pump compressor and issue an alarm in the event of a condensate high level condition.
 6. Provide available heat pump faults and alarms at BAS operator workstation graphics.
 7. Upon detection of space temperature 5 F above or below setpoint the BAS shall initiate an alarm.

D. Points List

Item	Monitor	Control	Function	Type	Indication
1	X		Space temperature sensor	AI	DEG. F
2		X	Fan control	DO	ON/OFF
3		X	Compressor enable	DO	ON/OFF
4		X	Heating/cooling mode (reversing valve)	DO	POSITION
5	X		Compressor status	DI	ON/OFF
6	X		Heat pump status and fault (multiple points)	DI	ALARM
7	X		Discharge air temperature	AI	DEG. F
8	X		Leaving water temperature	AI	DEG. F
9	X		Heat pump condensate pan high level alarm	DI	ALARM
10	X		Condensate pump basin high level alarm	DI	ALARM

1.6 FAN FILTER UNITS

A. The system consists of a fan and HEPA filter module.

B. Control Sequence:

1. BAS shall schedule occupied and unoccupied operation following the occupancy schedule established for the heat pumps serving the fan filter units.
2. The BAS shall provide an output enable the fan. Fan speed shall be set by the test-and-balance contractor.
3. The BAS shall monitor fan status.

C. Points list.

Item	Monitor	Control	Function	Type	Indication
1	X		Fan Status	DI	ON/OFF
2		X	Fan Control	DO	

1.7 ELECTRIC DUCT HEATER

A. The system consists of an electric duct coil.

B. Control Sequence:

1. In the event that the accompanying heat pump cannot maintain space temperature setpoint (compressor failure, etc.) the BAS shall stage the electric heating element(s) to maintain space temperature setpoint.
2. Electric duct coil shall be furnished with internal controls for airflow verification and high temperature cutout.

C. Points list.

Item	Monitor	Control	Function	Type	Indication
1	X		Space temperature sensor	AI	DEG. F

2		X	Electric element stage(s) control	AO	STATUS
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1.8 TRANSFER FAN (TF-1)

A. The system consists of an inline fan with EC motor.

B. Control Sequence:

1. The transfer fan shall be scheduled by following an occupancy time schedule that is adjustable at the BAS operator interface station (typically same schedule as HP-14).
2. The transfer fan shall operate at a constant air volume to maintain the space pressure relationships between the compounding room, ante room and pharmacy space.
3. Occupied Operation:
 - a. In the occupied mode the transfer fan shall run continuously at a constant air volume to maintain the space pressure relationships between the compounding room, ante room and pharmacy space.
4. Unoccupied Control:
 - a. In the unoccupied mode the transfer fan shall cycle with heat pump fan operation.

C. Points list.

Item	Monitor	Control	Function	Type	Indication
1	X		Transfer fan status	DI	STATUS
2		X	Transfer fan control	DO	ON/OFF

1.9 EXHAUST FAN EF-14

A. The system consists of a fan and gravity damper.

B. Control Sequence:

1. BAS shall schedule occupied and unoccupied operation.
2. The BAS shall provide an output to energize the fan.
3. The BAS shall monitor fan status.

C. Points list.

Item	Monitor	Control	Function	Type	Indication
1	X		Exhaust Fan Status	DI	ON/OFF
2		X	Exhaust Fan and Damper Control	DO	

1.10 COMPOUNDING ROOM AND ANTE ROOM MONITORING

A. The system consists of a zone pressure, temperature and humidity monitor.

B. Control Sequence:

1. Monitoring system shall continuously monitor the temperature and humidity in the compounding room. Monitoring system shall continuously monitor the space pressure relationships between the compounding room, ante room and general pharmacy area. A minimum differential positive pressure of 0.02 to 0.05 inch water column shall be maintained between the compounding room and the ante room.
2. The BAS shall interface with the compounding room monitoring system to monitor and trend zone temperature, humidity and pressures at the operator interface workstation graphics.
3. The BAS shall interface with the compounding room monitoring system to display temperature, humidity and space pressure alarms at the operator interface workstation graphics.

C. Points list.

Item	Monitor	Control	Function	Type	Indication
1	X		Monitoring System Status (Multiple Points)	AI	STATUS
2	X		Monitoring System Alarms	DI	ALARM

1.11 MEDICAL RECEIVING ROOM MONITORING

A. The system consists of a zone pressure, temperature and humidity monitor.

B. Control Sequence:

1. Monitoring system shall continuously monitor the temperature and humidity in the medical receiving room. Monitoring system shall continuously monitor the space pressure relationship between the medical receiving room and general pharmacy area. A minimum differential negative pressure of 0.02 to 0.05 inch water column shall be maintained between the medical receiving room and the general pharmacy area.
2. The BAS shall interface with the compounding room monitoring system to monitor and trend zone temperature, humidity and pressures at the operator interface workstation graphics.
3. The BAS shall interface with the medical receiving room monitoring system to display temperature, humidity and space pressure alarms at the operator interface workstation graphics.

C. Points list.

Item	Monitor	Control	Function	Type	Indication
1	X		Monitoring System Status (Multiple Points)	AI	STATUS
2	X		Monitoring System Alarms	DI	ALARM

PART 2 - PRODUCTS

2.1 BUILDING AUTOMATION SYSTEM

A. The scope of work includes modifications and expansion as necessary to the existing Delta Control system to perform the heat pump sequence of operation.

- B. The system shall be Johnson Controls. No exceptions or substitutions allowed. Approved Contractors are:
 - 1. Johnson Controls of Sioux Falls, SD.
- C. The Contractor shall provide all unit controllers, sensors, valves, actuators and wiring necessary to perform the sequence of operations for the systems described herein.
- D. Contractor shall provide all necessary wiring to the existing workstation as related to the points list.
- E. Field devices shall be latest version of Delta Controls consistent with existing similar field devices.

2.2 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 scheduling with real-time clock. 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.

2.3 ROOM PRESSURE MONITOR AND CONTROLLER

- A. Air-Pressure Differential Indicating Transmitter, Switch, and Controller:
 - 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. Critical Room Control.
 - b. TSI Incorporated.
 - c. Setra Systems, Inc
 - 2. General Description of Requirements:
 - a. The room pressure monitor shall be capable of monitoring the differential pressure between a minimum of three individual spaces (compounding room, anteroom, pharmacy relationships) at all specified locations on the drawings. Each monitor shall have an internal differential pressure sensor with the ability to send an analog output of 4 to 20 mA, 0 to 5 VDC, or 0 to 10 VDC to a system controller, as well as

the option to bring in a secondary differential pressure sensor through an analog input on the device. The device shall have a display resolution of 0.0001" WC.

- b. Each monitor shall have a 7" dimmable, full color touch-screen display with a minimum 480 x 272 resolution. The touch screen shall display the current differential pressure, the room status (green – ok, red – in alarm, yellow - warning) as well integral room condition banner" in one device.
 - c. Monitors shall utilize a direct pressure sensing device for differential pressure measurement. The monitor shall have an internal pressure sensor as well as the capability to use an external (remote) pressure sensor input. Each monitor shall be provided with a NIST traceable calibration certificate for the internal differential pressure transducer.
 - d. Each monitor shall have the ability to communicate through the BACnet protocol as installed or have the ability to be field upgradable to BACnet without being sent back to the manufacturer.
 - e. Field configurable for pressure, velocity, and volumetric flow applications through user interface.
 - f. Select instrument range based on application. Range shall be approximately 2 times set point.
 - g. The display shall have customizable text for "Room ID" and "Room Condition" panels to allow for unique site nomenclature.
 - h. Each Monitor shall have two levels of password protection; user and supervisory. Room type and alarm set points shall only be changed using the supervisory security level. Each monitor shall have 1 touch room status to "Occupied" or "Unoccupied" under the user security level. Key switches are not acceptable.
3. Performance:
- a. Accuracy RSS = +/- 0.5%
 - b. Non-Linearity (BFSL) = +/- 0.49%
 - c. Hysteresis = +/- 0.05%
 - d. Stability: Within 1 percent per year.
 - e. Response Time: 250 ms.
 - f. Overpressure: 5 psig for instrument ranges less than 50 in wg and 9 psig for 100 in. wg range.
 - g. Temperature Limits: 32 to 140 deg F.
 - h. Thermal Effects: 0.020 percent per degree F.
 - i. Warm-up Period: One hour.
4. Controller Programming through Menu Keys to Access Five Menus:
- a. Security level.
 - b. Pressure, velocity, or flow application.
 - c. Engineering units.
 - d. K-factor for use with flow application.
 - e. Set-point control only; set-point and alarm operation; and alarm operation as high, low, or high/low with manual or automatic reset and delay.
 - f. View high and low readings.
 - g. Digital dampening for smoothing erratic applications.
 - h. Scaling of analog output to fit range and field calibration.
 - i. Ability to change deadband and timings to reduce nuisance alarms.
5. Display:
- a. Digital display with backlight, with 0.4-inch-high alphanumeric characters.

- b. Four indicators; two for set point and two for alarm status.
 - c. The touch screen shall display the current differential pressure, the room status (green – ok, red – in alarm, yellow - warning) as well integral “Room Condition Banner” in one device.
6. Operator Interface:
- a. Set-point adjustment through keypad on face of instrument.
 - b. Zero and span adjustments accessible through menu.
 - c. Programming through keypad.
7. Analog Output Signal:
- a. Two-wire, 4- to 20-mA dc current source.
 - b. Signal capable of operating into a 900-ohm load.
8. Digital Output Signal:
- a. Two SPDT relays.
 - b. Each rated for one amp at 30-V ac or dc.
9. Construction:
- a. Die cast-aluminum casing and bezel.
 - b. Threaded, NPS 1/8 connections on side and back.
 - c. Vertical plane mounting.
 - d. NEMA 250, Type 1.
 - e. Nominal 4-inch-diameter face.
 - f. Mounting Bracket: Appropriate for installation (flush or wall mounted. Refer to architectural set).

2.4 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Temperature Sensors and Transmitters:
1. Temperature Sensors for DDC temperature sensing shall have an accuracy of +/- 0.36 degrees F @ 70 degrees F or better.
 - a. Provide sensors with a range of –30 to 220 F or wider to prevent unreliable temperature readings and the control problems that result when the temperature exceeds the range of the sensor. During commissioning, any sensor that has an error of more than 3 deg F must be replaced by the control contractor, rather than be calibrated.
 2. Pipe / tank temperature sensing.
 - a. Furnish well-mounted temperature sensors complete with a stainless steel or brass well for installation by the piping contractor. Wells shall be filled with thermal conductive grease before installation of temperature sensor.

- b. Control Contractor to coordinate with the piping contractor for proper installation and placement of wells to ensure wells are installed per manufacturer recommendations and that the well is installed directly in the water flow of the pipe.
 - c. Hot water supply and return temperature monitoring, RTD temperature sensors must be used.
- 3. Mixed air and discharge air duct temperature sensing.
 - a. Provide a *continuous* averaging sensor that averages temperatures over the *entire* length and have an element length of a 10 foot or longer.
 - b. Averaging (10 feet or longer) sensors are required for all mixed and discharge air sensing applications.
 - c. If there is not access available to install the averaging duct sensor, the contractor will wind the element around a piece of conduit or rigid copper tubing and drill a hole in the bottom of the duct and install the sensor to traverse the duct diagonally.
- 4. A duct probe type sensor shall be used for measuring return air temperature.
- 5. For outside air temperature sensing.
 - a. Provide an outside air sensor with weatherproof shield to protect sensing elements. Sensor shall be located so that it accurately senses the outside air temperature and is unaffected by the sun.
 - b. The conduit for the outside air sensor shall be caulked with sealant to prevent building air from infiltrating to the outside air temperature sensor.
- 6. Room Sensors: Refer to the hydronics drawings for locations and types:
 - a. Staff spaces: Lockable cover, LED display, slide switch and override button.
 - b. Public spaces: Flat-plate sensors with stainless steel or bronze cover.
- 7. Encapsulated Thermistor and RTD Sensor:
 - a. Manufactures:
 - 1) Kele Model ST-R*R
 - b. Applications – Embed in concrete at the following:
 - 1) Indoor radiant concrete slab.
- C. Room sensor accessories include the following:
 - 1. Insulating Bases: For sensors located on exterior walls.
 - 2. Adjusting Key: As required for calibration and cover screws.
- D. Humidity Sensors: Thin film polymer capacitive design.
 - 1. Manufacturers:
 - a. Vaisala – HMW40/50 Series.
 - b. Honeywell
 - 2. Accuracy: 3 percent full range with linear output.
 - 3. Room Sensor Range: 0 to 90 percent relative humidity.

4. Room Sensor Cover Construction: Manufacturer's standard locking covers.
- E. Pressure Transmitters/Transducers:
1. Manufacturers:
 - a. Setra
 - b. Modus
 - c. Veris Industries.
 - d. Dwyer
 2. 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 or 0-10vdc.
 - c. Building Static-Pressure Range: bi-directional, -0.25 to 0.25 inch wg.
 - 1) When referencing "outside air", install surge dampeners, model SD-030, manufactured by Modus.
 - d. Duct Static-Pressure Range: 0 to 5 inch wg.
 - 1) For low side sensing tube runs greater than 100 feet use 3/8" tubing for duct static sensing.
 - 2) Provide tees with plugs in the sensing lines next to the transducer for calibration purposes
 3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA or 0-10vdc.
 - a. The sensor shall be rated for full system pressure without damage
 4. 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 or 0-10vdc.
 - a. The sensor MUST be provided with a three valve manifold and piping to allow the sensor to be isolated from the system for calibration an service.
 5. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.
 - a. The sensor shall be rated for full system pressure without damage
 6. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA or 0-10vdc.
- F. Water Sensor/Switch
1. Manufacturers:
 - a. Kele, Model LD1-24

2. Electronic control relay for detecting a rising water level.
3. All components shall be safely encapsulated against moisture ingress.
4. Power supply: 24 VAC
5. Power input: 1W

2.5 RELAYS AND CONTACTORS

A. Manufacturers

1. Functional Devices
2. Idec
3. Omron

B. Relays:

1. All Energy Management System relays will have a LED status indicator. Provide relays or contactors with appropriate current ratings and number of poles based on the required application. If interfacing to existing pumps and fans, the control contractor shall verify and perform any and all modifications necessary so that the EMS can start/stop the fans or pumps (i.e. momentary pushbuttons, no magnetic starter, no hand-off-auto switch, etc.).

2.6 ELECTRONIC DAMPER ACTUATORS

A. Manufacturers:

1. Belimo Aircontrols (USA), Inc.
2. Control system manufacturer as listed in Paragraph 2.2.

B. Dampers: Size for running torque calculated as follows:

1. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
2. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
3. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
4. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
5. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
6. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.

C. Electronic actuators, less than 600 in-lb. of rated torque, shall have ISO 9001 quality certification and be cULus listed under standard 60730-1 or UL listed under standard 873, CSA C22.2 No. 24 and have CE certification.

D. Electronic actuators used on dampers shall be designed to directly couple and mount to a stem, shaft or ISO style-mounting pad. Actuator mounting clamps shall be a V-bolt with a toothed V-clamp creating a cold weld, positive grip effect. Single point, bolt, or single screw actuator type fastening techniques or direct-coupled actuators requiring field assembly of the universal clamp is not acceptable.

- E. Actuators shall be fully modulating/proportional, pulse width, floating/tri-state, or two position as required and be factory or field selectable. Actuators shall have visual position indicators and shall operate in sequence with other devices if required.
- F. Optional auxiliary switches shall be available.
- G. Actuators shall have an operating range of -22° to 122° F.
- H. Proportional actuators shall accept a 0-10 VDC or 0-20 mA input signal and provide a 2-10 VDC or 4-20 mA (with a 500 W load resistor) operating range.
- I. Actuators shall be capable of operating on 24, 120 or 230VAC, or 24VDC and Class 2 wiring as dictated by the application. Power consumption shall not exceed 10 VA for AC, including 120VAC actuators, and 8 watts per actuator for DC applications.
- J. NEMA 2 rated actuators shall be provided with a three foot (minimum), pre-wired, electrical cable. Actuators requiring removal of the actuator cover for access to wiring terminals, exposing electronic, printed circuit boards to damage, are unacceptable.
- K. Actuators shall have electronic overload protection or digital rotation sensing circuitry to prevent actuator damage throughout the entire rotation. End switches to deactivate the actuator at the end rotation or magnetic clutches are not acceptable.
- L. For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Spring return actuators shall be capable of CW or CCW mounting orientation. Spring return models > 60 in-lbs. and non-spring return models > 90 in-lbs. will be capable of mounting on shafts up to 1.05" in diameter. Spring return actuators with more than 60 in-lb. of torque shall have a metal, manual override crank.
- M. Actuators using "on-board" chemical storage systems, capacitors, or other "on-board" non-mechanical forms of fail-safe operation are unacceptable.
- N. Upon loss of control signal, a proportional actuator shall fail open or closed based on the minimum control signal. Upon loss of power, a non-spring return actuator shall maintain the last position.
- O. Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required. Valves and dampers requiring greater torque or higher close off may be assembled with multiple low torque actuators.
- P. Dual mounted actuators using additional anti-rotation strap mechanical linkages, or special factory wiring to function are not acceptable. Actuators in a tandem pair must be "off the shelf," standard actuators ready for field wiring.
- Q. Damper and valve actuators will not produce more than 62 dB (A) when furnished with a mechanical fail-safe spring. Non-spring return actuators shall conform to a maximum noise rating of 45 dB(A) with power on or in the running or driving mode.
- R. Proportional actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload, mechanical travel and mechanical load limit. The actuators shall also provide actuator service data, at minimum, number of hours powered and number of hours in motion.

- S. Proportional actuators shall be capable of digital communication, as built.

2.7 ELECTRONIC VALVE ACTUATORS

A. Manufacturers:

1. Belimo Aircontrols (USA), Inc.
2. Control system mfg.

- B. Electronic actuators, less than 600 in-lb. of rated torque, shall have ISO 9001 quality certification and be cULus listed under standard 60730-1 or UL listed under standard 873, CSA C22.2 No. 24 and have CE certification.
- C. Electronic actuators used on valves shall be designed to directly couple and mount to a stem, shaft or ISO style-mounting pad.
- D. Actuators shall be fully modulating/proportional, floating/tri-state, or two position as required and be factory or field selectable.
- E. Optional auxiliary switches shall be available.
- F. Actuators shall have an operating range of -22° to 122° F.
- G. Proportional actuators shall accept a 0-10 VDC or 0-20 mA input signal and provide a 2-10 VDC or 4-20 mA (with a load resistor) operating range.
- H. Actuators shall be capable of operating on 24VAC, 120VAC or 230VAC, or 24VDC and Class 2 wiring as dictated by the application. Power consumption shall not exceed 10 VA for AC, including 120VAC actuators, and 8 watts per actuator for DC applications.
- I. NEMA 2 rated actuators shall be provided with either a covered terminal strip, or a three, six, or ten foot pre-wired, electrical cable.
- J. For power-failure/safety applications, an internal mechanical spring return mechanism shall be built into the actuator housing. Spring return actuators shall be capable of CW or CCW mounting orientation. Spring return actuators with more than 60 in-lb. of torque shall have a metal, manual override crank.
- K. Actuators using "on-board" chemical storage systems, capacitors, or other "on-board" non-mechanical forms of fail-safe operation are unacceptable.
- L. Upon loss of control signal, a proportional actuator shall fail open or closed based on the minimum control signal. Upon loss of power, a non-spring return actuator shall maintain the last position.
- M. Actuators utilizing brushless DC technology shall be capable of being mechanically and electrically paralleled to increase torque if required. Valves requiring greater torque or higher close off may be assembled with two low torque actuators.
- N. Dual mounted actuators using additional anti-rotation strap mechanical linkages, or special factory wiring to function are not acceptable. Actuators in a tandem pair must be "off the shelf," standard actuators ready for field wiring.

- O. Valve actuators will not produce more than 62 dB (A) when furnished with a mechanical fail-safe spring. Non-spring return actuators shall conform to a maximum noise rating of 45 dB(A) with power on or in the running or driving mode.
- P. Proportional actuators shall be fully programmable. Control input, position feedback and running time shall be factory or field programmable. Diagnostic feedback shall provide indications of hunting or oscillation, mechanical overload, mechanical travel and mechanical load limit. The actuators shall also provide actuator service data, at minimum, number of hours powered and number of hours in motion.
- Q. Proportional actuators shall be capable of digital communication, as built.

2.8 ELECTRONIC CONTROL VALVES

A. Manufacturers:

1. Belimo Aircontrols (USA), Inc.
2. Control system mfg.

B. General

1. The manufacturer shall be capable of providing individual valve identification tagging on each printed valve label. Valve tag identification shall be documented on the approved, submitted valve schedule.
2. Valves shall be designed and provided with the proper actuators to provide the rated valve close-off.
3. Valves: Size for torque required for valve close off at maximum pump differential pressure.
4. Sizing: Sizing: 4 psig maximum pressure drop at design flow rate or the following:
 - a. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.

C. Characterized Control Valves - Three Port Applications and Two-Position Valves

1. Control valves shall be of the Characterized Control Valve type provided by Belimo.
2. Characterized Control Valves shall be used for all water applications requiring equal percentage characteristics.
3. A flow-characterizing disc shall be installed in the inlet of Two-way characterized control valves and in the control port of Three-way valves. The valve trim shall utilize a stainless steel ball and stem for all water or glycol solutions up to 60%. For water applications, an optional chrome plated brass ball and brass stem may be used for sizes 3/4" and smaller.
4. Valve bodies shall be nickel-plated, forged brass with female NPT threads. Bodies to 1-1/4" shall be rated at 600 psi and sizes 1-1/2" to 3" at 400 psi.
5. Characterized Control Valves shall have a self-aligning, blowout proof, brass stem with a dual EPDM O-ring packing design. Fiberglass reinforced Teflon seats shall be used.
6. The valves shall have a four bolt mounting flange to provide a 4 position, field changeable, electronic actuator mounting arrangement.
7. A non-metallic coupling, constructed of high temperature, continual use material shall provide a direct, mechanical connection between the valve body and actuator. The coupling shall be designed to provide thermal isolation and eliminate lateral and rotational stem forces. Vent hole shall be provided to reduce condensation build-up.

2.9 CONTROL DAMPERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Ruskin Model CDTI50 or approved equal product by one of the following:
- B. Manufacturers:
 - 1. Air Balance Inc.
 - 2. TAMCO (T. A. Morrison & Co. Inc.).
- C. Description:
 - 1. Furnish, at locations shown on plans, or in accordance with schedules, insulated control dampers manufactured by an ISO 9001 accredited manufacturer that meet the following minimum construction requirements. Frames shall be 5" x 1" x .125" (minimum thickness) (127 x 25 x 3.2) 6063T5 extruded aluminum hat channel with hat shaped mounting flanges on both sides of the frame. Each corner shall be reinforced with two die formed internal braces and machine staked for maximum rigidity.
 - 2. Damper blades shall be airfoil type extruded aluminum for superior pressure drop and low noise generation. Each blade shall be maximum 6" (152) depth with integral structural reinforcing tube running full length. Minimum thickness of blade shall be .070 (1.78).
 - 3. Blade edge seals shall be flexible and suitable for -72°F (-60°C) to +275°F (+135°C) mechanically locked in extruded blade slots yet easily replaceable in field. Jamb seals shall be flexible stainless steel, compression type to prevent leakage between the end of the blade and the damper frame. Use of blade end to overlap the frame for jamb seal is not acceptable. Adhesive or clip-on type blade or jamb seals are not acceptable.
 - 4. Bearings shall be non-corrosive molded synthetic. Axles shall be ½" (13) plated steel hexagonal shaped and to provide positive locking connection to blade (round axles are not acceptable). Linkage shall be concealed out of airstream, within frame to reduce pressure drop, noise and maintenance.
 - 5. Submittal must include leakage, maximum airflow and maximum pressure ratings based on AMCA Publication 500. Damper shall be tested and licensed in accordance with AMCA 511 for Air Performance and Air Leakage. Damper shall meet the leakage requirements of the International Energy Conservation Code by leaking less than 3 cfm/sq. ft. at 1" of static pressure and shall be AMCA licensed as Class 1A.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that power supply is available to control units and operator workstation.
- B. Verify that duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

- A. TCC project manager shall attend regular project update meetings and report on the status of the controls installation.

- B. Prior to starting the work, the TCC shall submit a project plan for the execution of the work. This plan shall include at a minimum, the starting date and duration of the: engineering, installation, programming, and check-out along with any necessary milestones. The controls contractor may use Suretrak, Microsoft Project, Timeline or any other project planning software to develop the plan.
- C. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- D. Connect and configure equipment and software to achieve sequence of operation specified.
- E. Control Contractor to provide 4 hours of onsite training to owner's personnel /representative on how to use the system for the project. Training will be scheduled in advance with owner's personnel. Training shall be performed during normal working hours by a person who is familiar with the project.
- F. The DDC Control Systems Contractor selected agrees to provide a one (1) year warranty as described in this section and other related warranty and maintenance specification sections within this specification. Warranty shall begin at the completion of controls system commissioning and when all punch list items have been resolved to the satisfaction of the Owner.
- G. Verify location of thermostats, humidistats, and other exposed control sensors with drawings and room details before installation. Install devices 48 inches or 60 inches above the floor (verify actual height before installation of device).
 - 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- H. Install guards on thermostats in the following locations:
 - 1. Where indicated.
- I. Furnish control valves and instrument sensors for installation as work of other Division 23 Sections.
- J. Install labels and nameplates to identify control components according to Division 23 Section "Identification for HVAC Piping and Equipment."
- K. Install electronic and fiber-optic cables according to Division 27 Section "Communications Horizontal Cabling."

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. Install raceways, boxes, and cabinets according to Division 26 Sections.
- B. Install building wire and cable according to Division 26 Sections.
- C. Install signal and communication cable according to Division 26 Sections.
 - 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 control wiring for field installed sensors and other devices furnished by mechanical equipment manufacturers.
- E. Connect manual-reset limit controls independent of manual-control switch positions.
- F. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 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. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 5. Test each point through its full operating range to verify that safety and operating control set points are as required.
 6. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 7. Test each system for compliance with sequence of operation.
 8. 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 flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 5. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 6. Check temperature instruments and material and length of sensing elements.
 7. Check control valves. Verify that they are in correct direction.
 8. 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.

3.5 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 their normal operating ranges.
 - b. Check analog outputs such that the controlled device operates properly at 0, 25, 50, 75 and 100 percent output.
 - c. Check digital inputs by causing a change of state in the field device.
 - d. Check digital outputs, ensuring the controlled device energizes and de-energizes upon command of the digital output.
 - e. Check resistance temperature inputs at the normal operating range, calibrating for line resistance.
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. Provide diagnostic and test instruments for calibration and adjustment of system.
9. 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. Verify all binary output devices (relays, solenoid valves, two-position actuators and control valves, magnetic starters, etc.) operate properly (including motors starting / stopping) and that the normal positions are correct.
- D. Verify that all analog output devices (I/Ps, actuators, etc.) are functional / valves and dampers open and close, that start and stop span are correct, and that direction and normal positions are correct.
- E. Verify that the system operation adheres to the sequences of operation. Simulate and observe all modes of operation by overriding and varying inputs and schedules.
- F. Tune all DDC control loops individually as a part of the DDC program check-out process to provide stable and accurate control. PID loops should be tuned with Proportional and Integral values only. Derivative should only be used on loops that can't be tuned with PI only.
- G. Alarms and Interlocks:
 - 1. A high and low limit alarm shall be provided for each monitored analog sensor. All alarm setpoints to be adjustable by a system operator without program modification.
 - 2. Each binary point shall be individually alarmed for status. All alarm set points to be adjustable by a system operator without program modification.
 - 3. Interlocks shall be tripped using field contacts to check the logic, as well as to ensure that the fail-safe condition for all actuators is in the proper direction.
 - 4. The programmer for the DDC system shall also meet with Owner before programming the alarm limits to decide on alarm limits the Owner would like in the system.
 - 5. All set points that are automatically reset off of another variable shall have their alarm limits automatically set at set point (+/- 5 Deg F - Adjustable).
 - 6. Alarms shall be automatically disabled when the unit is commanded off. Re-enable 30 minutes (adjustable) after startup.
- H. Interlock actions shall be tested by simulating alarm conditions to check the initiating value of the variable and interlock action.
- I. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls.

END OF SECTION 230993

SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Heat pump loop water piping.
 - 2. Condensate-drain piping.
 - 3. Air-vent piping.
 - 4. Safety-valve-inlet and -outlet piping.
 - 5. Chemical Treatment.
 - 6. Hydronic specialties.

1.3 SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 - 2. Air control devices.
 - 3. Chemical treatment.
 - 4. Hydronic specialties.
- B. Welding certificates.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.
- F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.
- G. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable style or series number.

1.4 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.
- 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.
- E. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L and Type M; application as indicated in Part 3 "Piping Applications."
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type K; application as indicated in Part 3 "Piping Applications."
- C. Wrought-Copper Fittings: ASME B16.22.
- D. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. T-DRILL Industries Inc.
 - 2. Brazed joints: ASTM F2014-00, ASME B31.9 – 2004.
- E. Wrought-Copper Unions: ASME B16.22.

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications."
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications."
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications."
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications."
- 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."
- F. Wrought-Steel Fittings: ASTM A 234/A 234M, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company of America.
 - 2. Joint Fittings, NPS 2-1/2 Through NPS 24: ASTM A536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB forged steel fittings with grooves or shoulders constructed to accept Victaulic standard and AGS "W" series grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Couplings, NPS 2-1/2 through NPS 12: Ductile-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.
 - a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9. Victaulic Style 07 (Zero-Flex®).
 - b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77.
 - 4. Flange Adapters, NPS 2-1/2 through NPS 12: ASTM A536, Grade 65-45-12, ductile iron housing, flat faced, for incorporating flanges with ANSI Class 125, 150 and 300 bolt-hole patterns to a grooved piping system. Victaulic Style 741 or 743.
 - 5. Couplings, NPS 14 through NPS 24: Two ASTM A536 ductile-iron housing segments cast with a wide key profile, lead-in chamfer and flat bolt pads for metal to metal contact.

Gaskets shall be wide-width, pressure-responsive synthetic rubber (Grade EPDM for chilled, condenser, and heating hot water systems to 230°F), and plated bolts and nuts.

- a. Rigid Type: Victaulic Style W07, provides system rigidity and support and hanging in accordance with ASME B31.1 and B31.9.
 - b. Flexible Type: Victaulic Style W77, allows for linear and angular movement, vibration attenuation and stress relief.
- I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 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/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- F. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. Hart Industries International, Inc.

- d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - e. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Capitol Manufacturing Company.
 - b. Central Plastics Company.
 - c. 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. Central Plastics Company.
 - d. 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. 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. 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.

- e. Anvil International.
- 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.

2.5 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. Diaphragm-Operated Safety Valves:
 - 1. 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.
 - g. Kunkle Co.
 - h. Anvil International.
 - 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.

2.6 BALANCE VALVES:

- A. CBV, Calibrated-Orifice, Balancing Valves, Bronze:
 - 1. Manufacturers: Subject to compliance with requirements, provide Bell & Gossett model "Circuit Setter Plus", or approved equal products by one of the following:
 - a. Armstrong Pumps, Inc.
 - b. Flow Design Inc.
 - c. Gerand Engineering Co.
 - d. Griswold Controls.
 - e. Taco.

f. Tour & Andersson.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

2.7 AIR CONTROL DEVICES

A. 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. Patterson Pumps.
5. Taco.
6. Watts.
7. Legend Co. (Coin Key operated air vents only).

B. Type and location:

1. Install air control devices as indicated on plans and of type indicated in Part 2 of this specification section.
2. See Part 3 of this specification section for requirements and application of specific types of air vents. Provide as indicated in Part 3.

C. Manual Air Vents: Type MAV-1

1. Basis of Design Product: Subject to compliance with requirements, provide screwdriver operated manual air vents.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Manual shutoff valve, screwdriver operated.
5. Inlet Connection: NPS ¼".
6. CWP Rating: 1000 psig.
7. Maximum Operating Temperature: 350 deg F.

D. Manual Air Vents: Type MAV-2

1. Basis of Design Product: Subject to compliance with requirements, provide Watts model HAV or an approved equal.
2. Body: Chrome plated bronze.
3. Internal Parts: Replaceable cartridge, stainless steel check valve.
4. Operator: Knob or thumbscrew handwheel.
5. Inlet Connection: NPT 1/8 or ¼".
6. Manual shutoff valve (automatic air vent with manual shutoff).

7. CWP Rating: 125 psig water, 10 psig steam.
8. Maximum Operating Temperature: 240 deg F.

E. Manual Air Vents: Type MAV-3

1. Basis of Design Product: Subject to compliance with requirements, provide Coin Key Air Vent, Legend Company model T-77.
2. Body: Chrome-plated brass body.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or key.
5. Inlet Connection: NPS 1/8".
6. Inlet tubing and Connection: Provide 1/4" copper tubing from booster coil or terminal device, fitting for Coin Key Air Vent, and Coin Key MAV-3 air vent. Extend to just above accessible ceiling or in accessible location below terminal device.

F. Manual Air Vents: Type MAV-4

1. Basis of design Product: Subject to compliance with requirements, provide Bell & Gossett Model 4V or an approved equal.
2. Body: Chrome plated brass
3. Internal Parts: Nonferrous.
4. Operator: Coin operated.
5. Inlet Connection: NPTM 1/8".
6. Manual shut-off.
7. Rating: 150 psig.
8. Maximum operating Temperature: 250 deg. F.

G. Automatic Air Vents: Type AAV-1

1. Basis of Design Product: Subject to compliance with requirements, provide Bell and Gossett model 87, Watts model FV4-M1 or an approved equal.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: NPS 1/2.
6. Discharge Connection: NPS 1/4 or 1/8".
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

H. Automatic Air Vents: Type AAV-2

1. Basis of Design Product: Subject to compliance with requirements, provide Bell and Gossett model 107A or an approved equal.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: High capacity noncorrosive metal float.
5. Inlet Connection: NPTF 3/4".
6. Discharge Connection: NPT 3/8".
7. CWP Rating: 150 psig.
8. Maximum Operating Temperature: 250 deg F.

I. Automatic Air Vents: Type AAV-3

1. Basis of Design Product: Subject to compliance with requirements, provide Bell and Gossett model 97, Watts Duo-vent, or an approved equal.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Manual shut-off valve.
6. Inlet Connection: NPTF 1/8".
7. Discharge Connection: NPT 3/8".
8. CWP Rating: 150 psig.
9. Maximum Operating Temperature: 250 deg F.

2.8 CHEMICAL TREATMENT

A. Fluid:

1. **Chemical shall be same as used in the existing heat pump core loop.**
2. Scope of work includes all fluid required for the interior building load side of the heat pump system.
3. The circulating fluid shall consist of premixed food grade, non-toxic propylene glycol with corrosion inhibitors in deionized water.
4. Premixed to percent of glycol calculated by volume.

2.9 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. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

C. Grooved End Strainers:

1. Y-Pattern, NPS 2 through NPS 12, ASTM A 536, Grade 65-45-12 ductile iron body, Type 304 stainless steel metal removable basket with 1/16" or 1/8" diameter perforations, blowdown port fitted with pipe plug, 300 psig CWP rating. Victaulic Style 732.
2. T-Pattern, NPS 2 through NPS 12, ASTM A 536, Grade 65-45-12 ductile-iron body, Type 304 stainless steel basket with 57 percent free area; removable access coupling and end cap for strainer maintenance, up to 750 psig CWP rating. Victaulic Series 730.

3. T-Pattern, NPS 14 through NPS 24, ASTM B 53, Grade B, carbon steel body, Type 304 stainless steel frame and mesh removable basket, No. 6 or No. 4 mesh, carbon steel T-bolt hinged closure/cap for strainer maintenance. Victaulic Series W730.

D. 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.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Piping - (heating hot water, chilled water and indoor heat pump core loop), aboveground, shall be any of the following:
1. NPS 3 and smaller: Type L, drawn-temper copper tubing, wrought-copper fittings, and 95-5 soldered joints.
 2. NPS 2 and smaller: Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; flanged or threaded joints.
- B. Piping - (heating hot water, chilled water and indoor heat pump core loop), aboveground, NPS 2-1/2 and larger, shall be any of the following:
1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings; welded or flanged joints. Flanged fittings at equipment and valves.
 2. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints (230 deg F maximum temperature). **Mechanical Room Locations Only.**
- C. Piping - (heating), underground, shall be any of the following:
1. NPS 1 and smaller: PEX tubing with PEX to copper fittings.
- D. Makeup-water piping installed aboveground shall be the following:
1. Type L, drawn-temper copper tubing, wrought-copper fittings, and 95-5 soldered joints.
- E. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and 95-5 soldered joints.
- F. Air-Vent Piping:
1. Inlet: Same as service where installed.
 2. Outlet: Type K, annealed-temper copper tubing with 95-5 soldered or flared joints.

- G. 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

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply and return connection to each piece of equipment.
- B. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- C. Install safety valves at heat pumps (both source and loads sides) and elsewhere as required by ASME Boiler and Pressure Vessel Code.
- D. Install drains at low points as specified elsewhere in Part 3 of this specification.
- E. Install air vents at high points as specified elsewhere in Part 3 of this specification.

3.3 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 or Victaulic couplings 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 blow-off connection for strainers smaller than NPS 2.
- T. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- U. Install air vents at high points in piping systems.
- V. Connect to condensate drain pans using copper tubing. Extend to nearest equipment or floor drain. Construct deep trap at connection to drain pan and install cleanouts at changes in direction.
- W. Install condensate drain piping system.
- X. Connect piping to all hydronic coils and heat pumps. Install shutoff valve and union or flange at each coil supply connection. Install balancing valve and union or flange at each coil return connection.
- Y. Install piping adjacent to equipment to allow service and maintenance.
- Z. Install hydronic instrument wells, control valves and other accessories furnished by the Temperature Control Contractor.
- AA. Seal penetrations through fire and smoke barriers.

3.4 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. Install the following pipe attachments:
 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.

2. Spring hangers to support vertical runs.
3. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. 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.

D. 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.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.5 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 or groove 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/D10.12M, 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. Grooved Joints: **Mechanical rooms only.** Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll groove ends of pipe based on pipe and coupling manufacturer's (Victaulic) written instructions for pipe wall thickness. Use grooved-end fittings and rigid or flexible, grooved-end-pipe couplings. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be supplied by Victaulic. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A Victaulic factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.
 - 1. Install the Victaulic AGS piping system in accordance with the latest Victaulic installation instructions. Use Victaulic grooving tools with AGS roll sets to groove the pipe. Follow Victaulic guidelines for tool selection and operation. Coupling installation shall be complete when visual metal-to-metal contact is reached. AGS products shall not be installed with standard grooved end pipe or components. Installing AGS products in combination with standard grooved end products could result in joint separation and/or leakage.
- J. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

3.6 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.
 - 1. Hydronic manifolds in high points in piping at or exceeding 30 psig operating pressure, in-floor radiation manifolds: Type MAV-1.
 - 2. High points in piping in occupied spaces: Type MAV-2.
 - 3. Booster coils, VAV reheat coils, and terminals located above ceilings, with tubing and coin-key vent routed to accessible location above ceiling or below ductwork: Type MAV-3.
 - 4. Radiation and hydronic radiators exposed in occupied spaces: Type MAV-4.
- B. Install float-type automatic air vents as indicated:

1. Air separators of connection size 2" and less: Type AAV-1
2. Air separators of connection size above 2": Type AAV-2

C. Install automatic air vents in mechanical equipment room piping as indicated:

1. High points of piping located in mechanical rooms: Type AAV-3
2. Air Handler coils, hydronic equipment and terminals in Mechanical Rooms: Type AAV-3

3.7 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 ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 CHEMICAL TREATMENT

- A. Fill systems indicated to have glycol solutions with the following concentrations:
 1. Heat Pump Core Loop Piping System: Match existing fluid.

3.9 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 to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113

SECTION 233113 - 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 ducts and fittings.
4. Double-wall round 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 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

- A. 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.

B. Coordination Drawings: Refer to Section 230010 "Coordination".

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

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."

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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. McGill AirFlow LLC.
 - 2. Sheet Metal Connectors, Inc.
- B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. 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."
- E. 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."
- F. Interstitial Insulation: Refer to "DUCT LINER".
- G. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch- diameter perforations, with overall open area of 23 percent solid sheet steel.
- H. 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."
- I. 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 DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lindab Inc.
 - b. McGill AirFlow LLC.

- c. SEMCO Incorporated.
 - d. Sheet Metal Connectors, Inc.
 - e. Spiral Manufacturing Co., Inc.
- B. 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."
- C. 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."
- D. 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 DUCTS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Lindab Inc.
 - 2. McGill AirFlow LLC.
 - 3. SEMCO Incorporated.
 - 4. Sheet Metal Connectors, Inc.
- 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.
- D. Interstitial Insulation: Refer to "DUCT LINER".

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/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.
- D. Reinforcement Shapes and Plates: ASTM A 36/A 36M, 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.
- E. 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. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
 - 1. Manufacturers:
 - a. CertainTeed Corp.; Insulation Group. (ToughGard2)
 - b. Johns Manville International, Inc.
 - c. Knauf Fiber Glass GmbH.
 - d. Owens Corning.
 - 2. Materials: ASTM C 1071.

- a. Thickness: 1 inch.
 - b. Thermal Resistance (R-Value): 4.0.
 - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
 - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstreams.
 - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
- B. Insulation Pins and Washers:
- 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
- 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. UL 181 compliant.
- 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. Sealant: Modified styrene acrylic.
 3. Water resistant.
 4. Mold and mildew resistant.
 5. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 6. Service: Indoor and outdoor.
 7. Service Temperature: Minus 40 to plus 200 deg F.
 8. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 9. 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. 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).
- E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- F. Round and Oval Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated 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 Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

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 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. Seal penetrations through fire and smoke barriers.
- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
- N. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 2. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 - 3. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 - 4. Conditioned Space, Exhaust Ducts: Seal Class B.
 - 5. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Verify attachment selection and spacing in first two paragraphs below with structural engineer.
 - 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 intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 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.

3.6 PAINTING

- A. Comply with the requirements of Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- C. Duct system will be considered defective if it does not pass inspections.

3.8 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:
- B. Combustion air ducts for gas-fired equipment: Galvanized sheet steel.
- C. Supply Ducts:
 - 1. Ducts Connected to Air Handling Units:
 - a. Pressure Class: Positive 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
- D. Return Ducts:
 - 1. Ducts Connected to Air Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 - 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
- E. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
- F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Air Handling Units:
 - a. Pressure Class: Positive or negative 3-inch wg.
 - b. Minimum SMACNA Seal Class: B.
 2. Ducts Connected to Equipment Not Listed Above:
 - a. Pressure Class: Positive or negative 2-inch wg.
 - b. Minimum SMACNA Seal Class: B.
- G. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
- H. Liner: Single wall duct construction.
1. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.
 2. Return Ducts: Insulate where indicated on the drawings (dashed internal duct) with Fibrous glass, Type I, 1 inch thick.
 3. Exhaust ducts 15 feet upstream of roof penetration with Fibrous glass, Type I, 1 inch thick.
 4. Refer to Section 23 0700 for ductwork designated to be wrapped with insulation blanket/board.
- I. Liner: Double wall duct construction.
1. Heat Pump Supply and Return Ducts: Fibrous glass, Type I, 1 inch thick with perforated galvanized steel liner with 10 feet of heat pump.
 2. Refer to Section 23 0700 for ductwork designated to be wrapped with insulation blanket/board.
- J. 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 and Oval 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.

K. 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 1500 fpm or Lower: Conical tap with volume damper.
 - b. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Backdraft dampers.
2. Manual volume dampers.
3. Turning vanes.
4. Duct-mounted access doors.
5. Flexible connectors.
6. Flexible ducts.
7. Duct accessory hardware.

- B. Related Sections:

1. Division 26 Section "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 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. 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.

- C. Source quality-control reports.

- D. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 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.

1.5 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.

PART 2 - PRODUCTS

2.1 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/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish to match equipment 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.

2.2 BACKDRAFT DAMPERS

- A. 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. Duro Dyne Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Nailor Industries Inc.
 - 6. Pottorff; a division of PCI Industries, Inc.
 - 7. Ruskin Company.
 - 8. SEMCO Incorporated.
- B. Description: Gravity balanced.

- C. Maximum Air Velocity: 2500 fpm.
- D. System Pressure For Leakage Rating: 1-inch wg.
- E. Leakage Rating at 4 inch w.g. Back Pressure: 15 cfm/sq-ft.
- F. Frame: 0.125-inch- thick extruded aluminum, with galvanized steel braces at the corners.
- G. Blades: Multiple single-piece blades, maximum 6-inch width, 0.070-inch- thick, extruded aluminum with sealed edges.
- H. Blade Action: Parallel.
- I. Blade Seals: Extruded vinyl, mechanically locked.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Synthetic pivot bushings.

2.3 MANUAL VOLUME DAMPERS

- A. Manufacturers:
 1. Air Balance, Inc.
 2. Flexmaster U.S.A., Inc.
 3. METALAIRE, Inc.
 4. Nailor Industries Inc.
 5. Penn Ventilation Company, Inc.
 6. Ruskin Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

2.4 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. METALAIRE, Inc.

4. SEMCO Incorporated.
 5. Ward Industries, Inc.; 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. 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."
- D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.5 DUCT-MOUNTED ACCESS DOORS

- A. 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. Pottorff; a division of PCI Industries, Inc.
 9. Ventfabrics, Inc.
 10. 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. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. 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.

2.6 DUCT ACCESS PANEL ASSEMBLIES

- A. 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 steel.
- D. Fasteners: Carbon 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.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Duro Dyne Inc.
 - 3. 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.

2.8 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. McGill AirFlow LLC.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 4. Thermaflex
- B. Insulated-Duct Connectors: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; 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 20 to plus 210 deg F.
 4. Insulation R-Value: 4.2
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.

2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers where shown on plans 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 control dampers furnished (by TCC) as work of other Division 23 Sections.

- G. Install test holes at fan inlets and outlets and elsewhere as indicated.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On both sides of duct coils, including reheat coils associated with the VAV terminal units.
 - 2. At outdoor-air intakes and mixed-air plenums.
 - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 4. Control devices requiring inspection.
 - 5. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Access door schedule:
 - 1. Reheat/booster coils: two hand unless duct is less than 8" in which case one hand door.
 - 2. Elsewhere as indicated on the drawings.
- L. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door. Label access to Fire Damper and Combination Fire/Smoke Dampers with permanent printed label.
- M. Install flexible connectors to connect ducts to equipment.
- N. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Install duct test holes where required for testing and balancing purposes.
- Q. Connect ducts to duct silencers rigidly.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Inspect turning vanes for proper and secure installation.
4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. In-line centrifugal fans.
 - 2. Laboratory exhaust fans.
 - 3. Roof Curbs.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Fan speed controllers.
 - 6. Roof curbs.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.4 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Sections.

PART 2 - PRODUCTS

2.1 IN-LINE CENTRIFUGAL FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck.
 - 2. Carnes Company.
 - 3. Loren Cook Company.
- B. Housing: Minimum 18 gauge galvanized steel housing with bolted construction and integral duct collars. Provide access doors for two sides.
- C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.
- D. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.
- E. Fan Motor: Permanently lubricated electronically commutated rated for continuous duty with speed controller. Minimum efficiency: 85%.
- F. Accessories:
 - 1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent down to 20 percent.
 - 2. Companion Flanges: For inlet and outlet duct connections.
 - 3. Fan Guards: 1/2- by 1/2-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

2.2 LABORATORY EXHAUST FANS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Greenheck.
 - 2. Loren Cook Company.
- B. Description: Belt-driven upblast centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, discharge cone and accessories.
- C. Housing: Minimum 12 gauge steel construction with adjustable motor plate, integral housing drain and bolted, gasketed access door. Fans shall incorporate a high velocity conical discharge nozzle supplied by the fan manufacturer. Steel components shall be coated with a 5 mil electrostatically applied baked epoxy powder coating with ultraviolet protective topcoat.
- D. Fan Wheels: Backward inclined non-overloading steel centrifugal with blades continuously welded to the backplate. Fan impeller hub shall be keyed to a stainless steel drive shaft. Fan wheels shall be coated with a 5 mil electrostatically applied baked epoxy powder coating. Fan impeller shall be statically and dynamically balanced in accordance with AMCA Standard 204-96.
- E. Motors and Drives: Motor shall be premium efficiency, NEMA frame, totally enclosed fan cooled (TEFC) with 1.15 service factor. Fan bearings shall be heavy duty re-greaseable ball or roller type in cast iron pillow block housings selected for minimum L50 life of not less than 200,000 hours. Bearings shall have extended stainless steel lube lines with Zerk fittings. Fan belts shall be oil and heat resistant, non-static type. Drives shall be selected for minimum 1.5 service factor utilizing precision machined cast iron sheaves keyed to the wheel and motor shafts.
- F. Accessories:
 - 1. Fan isolation box with gravity isolation damper. Isolation box shall be coated with a 5 mil electrostatically applied baked epoxy powder coating with ultraviolet protective topcoat. Isolation damper shall have extruded aluminum frame, damper blades and linkage.
- G. Capacities and Characteristics: Refer to the schedule on the drawings.

2.3 ROOF CURBS

- A. Roof Curbs: Heavy duty steel with mitered and welded corners. Roof curbs shall be coated with a 5 mil electrostatically applied baked epoxy powder coating with ultraviolet protective topcoat. Roof curb shall be capable of supporting exhaust fan and discharge nozzle without the use of guy wires. Size as required to suit roof opening and fan base.
 - 1. Configuration: Self-flashing without a cant strip, with mounting flange.
 - 2. Overall Height: 12 inches.

2.4 MOTORS

- A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.5 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb.
- B. Inline Fans: Suspend units from structure.
- C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.
- D. Install units with clearances for service and maintenance.
- E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- G. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system.
 5. Verify lubrication for bearings and other moving parts.
 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 8. Shut unit down and reconnect automatic temperature-control operators.
 9. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- B. Adjust potentiometer as required to achieve design airflow.
- C. Adjust belt tension and align drive belt assemblies.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power ventilators.
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.

END OF SECTION 233423

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes ceiling and wall mounted diffusers, registers, and grilles.
- B. Refer to grilles, registers and diffusers schedule on the drawings for base design type, model, material, finish and accessories.
- C. 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.

1.3 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. Manufacturer's standard color charts.
- 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. 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.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
 - 1. Anemostat.
 - 2. Carnes.
 - 3. Price Industries.
 - 4. J & J.
 - 5. Krueger Mfg. Co.
 - 6. Metal Aire.
 - 7. Nailor.
 - 8. Titus Products Div., Phillips Industries Inc.
 - 9. Tuttle & Bailey.

2.2 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

3.1 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.

3.2 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. 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.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 233713

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SECTION 234133 - HIGH-EFFICIENCY PARTICULATE FILTRATION

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. HEPA rigid-cell box filters.
 - 2. HEPA filter fan modules.
 - 3. Front- and rear-access filter frames.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include dimensions; operating characteristics; required clearances and access; rated flow capacity, including initial and final pressure drop at rated airflow; efficiency and test method; fire classification; furnished specialties; and accessories for each model indicated.
- B. Shop Drawings: For air filters. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Show filter rack assembly, dimensions, materials, and methods of assembly of components.
 - 2. Include setting drawings, templates, and requirements for installing anchor bolts and anchorages.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of filter and rack to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide one complete set of filters for each filter bank.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. ASHRAE Compliance:
 1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- B. Comply with IEST-RP-CC001.5.
- C. Comply with UL 586.
- D. Comply with IEST-RP-CC007.2.
- E. Comply with NFPA 90A and NFPA 90B.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended use.

2.2 HEPA RIGID-CELL BOX FILTERS

- A. Description: Factory-fabricated, disposable, packaged air filters with media perpendicular to airflow and with holding frames.
 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. AAF International.
 - b. Camfil Farr.
 - c. Flanders Corporation.
- B. Filter Unit Class: UL 900, Class 1.
- C. Media: Fibrous material, constructed so individual pleats are maintained under rated-airflow conditions.
 1. Internal Separators: None.
 2. Gasket Material: None.
 3. Faceguard Material: Aluminum or Stainless steel.
 4. Faceguard Location: Upstream and Downstream.
- D. Filter-Media Frames:
 1. HEPA Filter to be located in Fan Filter Unit casing as well as Exhaust Fan Housing. Frames are included in those assemblies.
- E. Mounting Frames: Welded galvanized steel with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.3 HEPA FILTER FAN MODULES (FFU ON PLANS)

- A. Description: Factory-fabricated, HEPA filter ceiling module with fan.
 - 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. Camfil Farr.
- B. Casing:
 - 1. Configuration: Ducted inlet Plenum inlet with prefilter.
 - 2. Module Material: Extruded aluminum, 16 gage with mill finish.
 - 3. Suspension: Independent.
- C. Media: Camfil Farr 53 MM Megalam Filter Class ISO 45 E (00.005 at MPPS). Fibrous glass, constructed of continuous sheets with closely spaced pleats with vinyl-coated aluminum separators.
 - 1. Frame Material: Stainless steel or Aluminum.
 - 2. Media to Frame Side Bond: Polyurethane foam or Silicone.
 - 3. Face Gasket: Silicone.
 - 4. Faceguard: Plastic or Stainless steel.
- D. Accessories: Filter test port.
- E. Control: Variable speed via FC-100 handheld control device. FC-100 will be utilized for balancing purposes and adjustments for the future if necessary.
- F. Motor:
 - 1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 0513 "Common Motor Requirements for HVAC Equipment."
 - 2. Type: Electronically commutated motor.
 - 3. Fan-Motor Assembly Isolation: Rubber isolators.
 - 4. Enclosure: Open dripproof or totally enclosed fan cooled.
 - 5. Enclosure Materials: Cast iron.
 - 6. Unusual Service Conditions:
 - a. Room/Cell side access.
 - 7. Efficiency: Premium efficient.
 - 8. Motor Speed: Multispeed.
 - a. Speed Control: Infinitely adjustable with pneumatic-electric and electronic controls.
 - 9. Electrical Characteristics:
 - a. Refer to electrical plans for electrical characteristics.

2.4 FRONT- AND REAR-ACCESS FILTER FRAMES

- A. Framing System: Aluminum framing members with access for either upstream (front) or downstream (rear) filter servicing, cut to size and prepunched for assembly into modules. Vertically support filters to prevent deflection of horizontal members without interfering with either filter installation or operation.
 - 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. Camfil Farr.
- B. Prefilters: Incorporate a separate track, removable from front or back.
- C. Sealing: Factory-installed, positive-sealing device for each row of filters to ensure seal between gasketed filter elements to prevent bypass of unfiltered air.

2.5 CAPACITIES AND CHARACTERISTICS

- A. Refer to plans for capacities and characteristics.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment Mounting:
 - 1. Comply with requirements for vibration isolation devices specified in Section 23 0548.13 "Vibration Controls for HVAC."
- B. Position each filter unit with clearance for normal service and maintenance. Anchor filter holding frames to substrate.
- C. Install filters in position to prevent passage of unfiltered air.
- D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters that were used during construction and testing with new, clean filters.
- E. Coordinate filter installations with duct and air-handling unit installations.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Test for leakage of unfiltered air while system is operating.

2. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg or to designed operating pressure, whichever is higher; test housing joints, door seals, and sealing edges of filter with soapy water to check for air leaks.
3. HEPA Filters: Pressurize housing to a minimum of 3.0-inch wg or to designed operating pressure, whichever is higher; and test housing joints, door seals, and sealing edges of filter for air leaks according to pressure-decay method in ASME N510.

D. Air filter will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 CLEANING

- A. After completing system installation and testing, adjusting, and balancing air-handling and air-distribution systems, clean filter housings and install new filter media.

3.4 PROTECTION

- A. Protect installed products and accessories from damage during construction.

END OF SECTION 234133

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SECTION 238146 - WATER-SOURCE UNITARY HEAT PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following types of water-source heat pumps and accessories:
 - 1. Water-to-air heat pumps.
 - 2. Hose kits.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.
- 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. Heat Pumps
 - 2. Hose kits.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For water-source heat pumps, hose kits, pump packages and thermostats. Provide written schedule of all preventive maintenance procedures recommended by the heat pump manufacturer. Indicate in red type any maintenance procedures required for maintaining the heat pump warranty.
- E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
 - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

- 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. ASHRAE Compliance:
 - 1. ASHRAE 15.
 - 2. Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- E. Comply with NFPA 70.
- F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.
- G. Comply with safety requirements in UL 1995 for duct-system connections.

1.5 COORDINATION

- A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water-source heat pumps that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, compressor.
 - 2. Warranty Period: Five years from date of Substantial Completion.

1.7 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. One set of filters for each water-to-air heat pump unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide SmartSource heat pumps as manufactured by Daikin Applied or an approved equal product by one of the following manufacturers.
1. ClimateMaster, Inc.
 2. FHP-Bosch Manufacturing Inc.
 3. Trane Company.
 4. WaterFurnace International, Inc.

2.2 WATER-SOURCE WATER-TO-AIR HEAT PUMPS

A. General:

1. Furnish and install extended range Water Source Heat Pumps, as indicated on the plans with capacities and characteristics as listed in the schedule and the specifications that follow. All equipment shall be ARI Certified per ARI/ISO/ASHRAE/ANSI Standard 13256-1 for Water Loop Rating. All units shall be UL Listed for product safety. All units shall have ARI13256-1 and UL labels. Units shall be designed to operate with entering fluid temperatures between 50 F and 110 F in cooling mode and entering fluid temperatures between 20 F and 80 F in heating mode.

B. Basic Construction

1. Units shall have the air flow arrangement as shown on the plans. The heat pumps shall be fabricated from heavy gauge steel finished with a vinyl or galvanized coating. All interior surfaces shall be lined with foil faced insulation. Insulation shall comply with NFPA 90A. Units shall have a low leak 2-inch filter bracket for use with MERV 13 throwaway type filter. Duct collars shall be provided for both supply and return duct connections. Cabinets shall have separate holes and knockouts for entrance of line voltage and low voltage control wiring. Supply and return water connections shall be copper FPT fittings and shall be securely mounted flush to the cabinet. Unit cabinets shall have an insulated divider panel between the air handling section and compressor section. Compressors shall be mounted on a floating base to minimize noise and vibration transmission. All units shall have a stainless steel drain pan.

C. Fan and Motor Assembly

1. All units shall have a direct-drive centrifugal forward curved fan. The fan motor shall be variable speed, permanently lubricated, ECM type with thermal overload protection and soft start/stop. The fan and motor assembly shall be capable of overcoming the external static pressures as shown on the schedule. The fan motor shall vary the speed of the fan to maintain a constant airflow quantity. Air flow rates shall be varied according to the unit heating and cooling stages. Air flow rates shall be adjustable by +/- 15% of rated airflow. External static pressure rating of the unit shall be based on a wet coil.

D. Refrigerant Circuit – Two Stage Units

1. Units shall have a sealed, R-410A, refrigerant circuit including a two-stage hermetic scroll compressor or multiple compressors, thermal expansion valve, finned tube refrigerant-to-air heat exchanger, a reversing valve, a coaxial (tube-in-tube) refrigerant-to-water heat exchanger, and safety controls including a high pressure switch and a low pressure switch. The reversing valve shall be pilot operated sliding piston type with replaceable magnetic solenoid coils activated on a call for cooling, which fails to the heating position. Access fittings shall be factory installed on high and low pressure refrigerant lines to facilitate field service. Activation of any safety device shall prevent compressor operation via a lockout circuit. The lockout circuit shall reset itself after the first trip. In the event of a second trip within a period of one hour the unit must be reset at the disconnect switch. Hermetic scroll compressors with internal overload protection shall be mounted on rubber isolators and be located in an insulated compartment to minimize sound transmission.
2. Refrigerant-to-air heat exchanger shall utilize enhanced aluminum fins and rifled copper tube construction and shall have a 450 PSIG refrigerant working pressure. Refrigerant-to-water heat exchanger shall be of copper inner water tube and steel outer refrigerant tube design with a 450 PSIG working refrigerant pressure and 400 PSIG working water pressure. The water-to-refrigerant heat exchanger shall be insulated to prevent condensation at low fluid temperatures.
3. Two stage hermetic scroll compressor for unit sizes 2 tons cooling and higher shall be activated via a 2-stage control system. Stage one shall activate the part load capacity of the compressor for operation at approximately 70% of full load capacity. The EC fan motor shall automatically reduce the fan speed to maintain a constant airflow quantity at approximately 70% of the full load air quantity. Stage two shall activate the full load capacity of the compressor and the EC fan motor.
4. Units with two compressors shall be activated via a 2-stage control system. Stage one shall activate the first compressor for operation at approximately 60% of full load capacity. Stage two shall activate the second compressor/stage.

E. Sound Package

1. Provide units complete with factory applied sound reduction package including sound absorbing compressor wrap as well as heavy dampening material over the entire bottom section of the unit for radiated sound reduction.

F. Air Filter

1. Provide MERV 13 pleated filter complete with filter rack and associated access. Filter size shall be based upon heat pump unit scheduled airflow and maximum resistance of 0.25 inches WC.

G. Controls:

1. Heat Pump Unit Controls:
 - a. Low- and high-voltage protection.
 - b. Overcurrent protection for compressor and fan motor.
 - c. Random time delay, three to ten seconds, start on power up.
 - d. Time delay override for servicing.
 - e. Anti-short cycle for compressor.
 - f. Low and high refrigerant pressure
 - g. ECM fan motor programming
 - h. Minimum 50VA 24-volt control voltage transformer with circuit breaker.
 - i. Condensate overflow detection to disable compressor.
 - j. 24-volt controls and terminal strip to interface with building automation system
 - k. Two-position water valve

- I. LED indication for compressor, fan and system status
- m. DDC control interface for building automation system

H. Piping

- 1. Supply, return water and condensate drain connections shall be copper or brass female pipe thread fittings and mounted flush to cabinet exterior.

2.3 HOSE KITS

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

- 1. Hays Fluid Control model "Measurflo" or approved equal.

- B. General: Hose kits shall be designed for minimum 400 psig working pressure, and operating temperatures from 20 to 200 deg F. Tag hose kits to equipment designations.

- C. Hose: Minimum length 24 inches. Minimum diameter, equal to water-source heat-pump connection size.

- D. Isolation Valves: Two-piece bronze-body ball valves with stainless-steel ball and stem and galvanized-steel lever handle. Provide valve for supply and return.

- E. Strainer: Y-type with blowdown valve in supply connection.

- F. Balancing Device: Mount in return connection. Include meter ports to allow flow measurement with differential pressure gage.

- 1. Automatic balancing valve, factory set to operate within 10 percent of heat pump design flow rate over a 40:1 differential pressure range of 2 to 80 psig.

- G. Check Valve: Center guided non-slam.

- H. Meter Ports: Provide on supply and return connection to heat pump so water pressure drop can be measured across heat pump refrigerant-to-water coil.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

- B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Suspend horizontal water-source heat pumps from structure with threaded steel rods and vibration isolators. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."
- B. Place vertical water-source heat pumps on concrete housekeeping pad and neoprene vibration isolation pads. Vibration isolators are specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

- A. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:
 - 1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
- B. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

3.4 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. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.
 - 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions.

3.6 ADJUSTING

- A. Adjust initial temperature set points.
- B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.7 CLEANING

- A. Replace filters used during construction prior to air balance or substantial completion.
- B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps.

END OF SECTION 238146

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SECTION 238216 - AIR COILS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes electric air coils that are not an integral part of air-handling units.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil. Include rated capacity and pressure drop for each air coil.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and maintenance data.

1.3 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.

PART 2 - PRODUCTS

2.1 ELECTRIC COILS

- A. Manufacturers: Subject to compliance with requirements, provide Thermolec Model TER or an approved equal product by one of the following:
 - 1. Brasch Manufacturing Co., Inc.
 - 2. Chromalox, Inc., Wiegand Industrial Division; Emerson Electric Company.
 - 3. Daikin.
 - 4. INDEECO.
- B. Coil Assembly: Comply with UL 1995.
- C. Heating Elements: Open-coil resistance wire of 80 percent nickel and 20 percent chromium, supported and insulated by floating ceramic bushings recessed into casing openings, and fastened to supporting brackets.
- D. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.

1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
- E. Frames: Galvanized-steel channel frame, for slip-in mounting.
- F. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:
1. Magnetic contactor.
 2. SCR controller.
 3. Time-delay relay.
 4. Temperature sensor to control heater proportionally to maintain the pre-set air temperature in the duct.
 5. Air flow sensor to modulate the heating capacity according to the quantity of air flowing through the heater.
 6. Built-in Electronic Temperature Controller and Sensor.
- G. Capacities and Characteristics: Refer to schedule on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install coils level and plumb.
- B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."
- C. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

3.2 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.
 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 238216

SECTION 260001 - ELECTRICAL CERTIFICATION

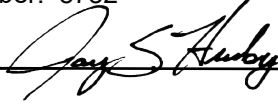
PART 1 - GENERAL

1.1 ELECTRICAL ENGINEER'S CERTIFICATION

A. I hereby certify that Division 26 of this Specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota.

B. Name: Jay S. Hruby, PE

C. License Number: 8782

D. Signature:  Date: July 22, 2022

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 260001

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SECTION 260010 - GENERAL PROVISIONS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 GENERAL

- A. The work shall consist of the furnishing of all labor, materials, services, and equipment necessary for, and incidental to the electrical work called for on the drawings and specifications.
- B. The work shall also include the completion of details of electrical work not mentioned or shown, which are necessary for the successful operation of the electrical systems described on the drawings and as required by the specifications.
- C. The only electrical work not included shall be those items explicitly indicated to be excluded.
- D. The Contractor shall assume full responsibility for additional costs which may result from unauthorized deviations from the contract documents.
- E. The final installed electrical systems shall be complete and in all respects ready for use, tested as indicated and/or required with test reports, prior to the final site observation and/or the Owner's acceptance. The work of these documents shall consist of furnishing all labor, materials, services, and equipment necessary for and incidental to the electrical work called for on the drawings or specifications.
- F. The Contractor is responsible for review of all drawings, including but not limited to architectural, civil and landscape for portions of their work to be included or coordinated. No extra credits will be allowed due to the Contractor's failure to review and coordinate with all other disciplines.
- G. Contractor shall visit the site and become familiar with on-site conditions before submitting their bid. Failure to visit the site will in no way relieve the contractor the necessity of performing work and any work required to complete the work intended by the drawings and specifications, which should be determined by the site visit.
- H. The drawings and specifications are intended to supplement each other, such that information contained in either shall be executed in the same manner.
- I. If a question exists regarding the exact intention of the documents, instructions shall be obtained from the Architect/Engineer before proceeding. If instructions cannot be obtained due to time or communication limitations, the greater quantity, superior quality, or condition most favorable to the Owner shall be assumed.
- J. The drawings are in general diagrammatic and not intended to show exact locations. The drawings are not intended to be scaled for rough-in dimensions or exact locations. Architectural, mechanical, structural, fixture, landscape drawings, etc. shall be consulted for exact locations if required. Only critical dimensions will be provided.
- K. Branch circuit wiring may not be shown on the drawings, but are designated by the indication of panel and circuit numbers, respectively. Panel designations may also be indicated by general plan notes on each drawing. Panel and circuit designations are shown adjacent to a device for lighting and receptacles. Motor branch circuiting is indicated on the motor and equipment schedule, while other circuiting requirements shall be as indicated in notes, schedules, etc.

- L. Locations and routing of all conduits, wiring, cables, homeruns, etc. shall be verified and coordinated by the Electrical Contractor prior to installation. If conflicts arise, or it is not clear as to the exact intent, the Contractor shall notify the Engineer for clarification. The complete installation shall be done in a neat and orderly fashion.

1.2 CODES & STANDARDS

- A. The complete installation shall conform to all of the requirements and recommendations of the following codes and standards.
 - 1. National Electrical Code.
 - 2. State, city and local electrical laws and ordinances.
 - 3. Institute of Electrical and Electronic Engineers.
 - 4. National Board of Fire Underwriters.
 - 5. National Electrical Manufacturers Association.
 - 6. Underwriters' Laboratories, Inc.
 - 7. NECA Standard of Installation.
 - 8. ADA Guidelines.
 - 9. Minnesota Energy Code.
- B. The codes and standards are minimum requirements with respect to the installation as shown and specified, and are intended to comply with these requirements. Where conflicts exist, the greater quantity, superior quality or condition most favorable to the Owner shall be assumed.

1.3 RELATED DOCUMENTS

- A. The General Conditions of the Contract for Construction, Supplementary Conditions and the General Requirements of Division 01 are hereby made a part of Division 26.
- B. The sections contained in Division 26 may conflict with the conditions of contract of the General Requirements. The statement requiring the greater quantity, superior quality, or condition most favorable to the Owner shall take precedence.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- D. The sections contained in Division 26 may conflict with Divisions 0-23. The statement requiring the greater quantity, superior quality, or condition most favorable to the Owner shall take precedence.
- E. Division 26 work shall include all electrical work referenced in Divisions 0-23 unless explicitly indicated otherwise.
- F. Provide for equipment operation instruction and training to the Owner's personnel. Refer to Division 01 Section "Demonstration and Training" and specific Division 26 Sections as applicable.

1.4 SPECIAL CHARGES

- A. All fees, permits, and licenses required for the electrical work are to be included in the contract.

- B. If more than two final site inspections are required by the Engineer, the Contractor will be billed at an hourly rate for the time associated with the additional site visits.

1.5 SUBMITTALS

A. General:

1. All requests for information, clarification, etc., shall be submitted in writing to the Engineer with a copy to the Owner/Architect.
2. All shop drawings and operating manuals shall be submitted to the Engineer with transmittal copies to the Owner/Architect.

B. Shop Drawings

1. Shop drawings shall be submitted on Division 26 items as specified in individual sections.
2. All Division 26 shop drawings must be submitted at the same time. Partial submittals will not be reviewed. Re-submittals (if required) may be submitted individually, as they become available.
3. Seven sets of shop drawings shall be submitted with each set individually bound, labeled and indexed. Each topic or item shall be preceded with a blank page for approval stamps and notes.
4. Shop drawings shall be stamped approved by the Contractor prior to submittal.
5. Shop drawings shall include detailed product information with catalog numbers, features, dimensions, wiring diagrams, and any other critical information clearly highlighted. The related specification sections may require additional information.
6. Shop drawings must be submitted in a format to allow easy identification of the exact item that is to be furnished, with all optional features or components clearly identified.
7. Shop drawings not properly submitted will be returned and not reviewed.

C. Electronic Shop Drawings

1. Refer to Section 01 3300 SUBMITTAL PROCEDURES for requirements pertaining to the electronic submittal procedures of shop drawings for this project.
2. Shop drawings shall be submitted on Division 26 items as specified in individual sections.
3. Shop drawings shall be submitted on Division 26 items, individually, by specific specification section number.
4. Shop drawings shall be stamped approved by the Contractor prior to submittal.
5. Shop drawings shall include detailed product information with catalog numbers, features, dimensions, wiring diagrams, and any other critical information clearly highlighted. The related specification sections may require additional information.
6. Shop drawings must be submitted in a format to allow easy identification of the exact item that is to be furnished, with all optional features or components clearly identified.
7. Shop drawings not properly submitted will be returned and not reviewed.

D. Operating Manuals

1. Upon completion of the project, two operating manuals shall be submitted to the Engineer with transmittal copies to the Owner and Architect. Manuals will be forwarded to the Owner upon review completion.
2. Operating manuals shall include information on all electrical equipment requiring shop drawings.
3. Manuals shall include, but not be limited to; one set each of shop drawings, manufacturers' maintenance and operating manuals, replacement parts lists, and local suppliers and service organizations.

4. All information shall be bound in hard covered three ring binders individually labeled and indexed.

E. Record Drawings

1. The Electrical Contractor shall provide record drawings reflecting all additions and/or modifications to the system(s) shown and required. These shall be submitted to the Engineer for approval upon completion of the project. Reproducible copies of the base contract documents shall be provided to the contractor upon request for this purpose.

F. Programming Documentation, Software

1. Operation and Maintenance Data: For security monitoring and control equipment components to include in emergency, operation, and maintenance manuals.
2. Program documentation, software licenses, and backup copies of software used on Project.

G. Other Information Submittals

1. Examination reports documenting inspections of substrates, areas, and conditions.

1.6 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections, routing to components furnished by utility companies (telephone, power, fiber optic, cable television, etc.).

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of Authorities Having Jurisdiction (AHJ) and of Utility Company providing electrical power and other services.

1.7 SYMBOLS AND ABBREVIATIONS

A. Refer to symbols and abbreviations on drawings. Other symbols are in common usage, but if uncertainty exists regarding any plan symbols or abbreviations, it shall be brought to the attention of the Engineer, and he shall clarify same by addendum.

B. Where the phrase "Provide ----" occurs; "provide" shall be construed to mean the same as "furnish and install ----".

1.8 CAD DRAWING FILES

- A. All Division 26 electronic CAD drawing files provided by the Architect/Engineer for this project are for use solely with respect to this project. Contractor may request copies of the Division 26 CAD drawing files for the preparation of Shop Drawings. However, CAD drawing files shall not be used on other projects, for additions to this project, or for completion of this project by others. Any intentional or unintentional revisions, additions, or deletions to these Division 26 CAD drawing files shall be made at the full risk of the person(s) making such revisions, additions, or deletions, and such person(s) shall hold harmless and indemnify Architect/Engineer of any and all responsibilities and liabilities.
- B. CAD diskettes are not to be construed as updated As-Built Construction Documents. The drawing files reflect only bidding documentation of original Construction Drawings. Addenda or written changes occurring during the construction process will not be incorporated into the Division 26 CAD drawing files.
- C. Cost for Division 26 CAD drawing files, provided in AutoCAD format (other formats will be available only by special arrangement with Engineering Design Initiative, Ltd), will be \$100 per drawing sheet, payable directly to Engineering Design Initiative, Ltd. CAD diskettes may be obtained on a COD basis at the office of Engineering Design Initiative, Ltd.
- D. Procedure for acquiring CAD files shall be as follows:
 - 1. Contractor shall make a request to Engineering Design Initiative, Ltd. in writing, including a list of the files desired.
 - a. Engineer will send the contractor an invoice and "Document Release and Indemnity Agreement".
 - b. Contractor shall sign this agreement and send a check for the amount to the Engineer.
 - c. Upon receipt of these items, Engineer will send the CAD files to contractor. Files can be sent on diskette, CD ROM, or e-mail as agreed between Contractor and Engineer.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 GENERAL

- A. Lay-out and coordinate all work well enough in advance to avoid conflicts or interferences with other work in progress. In case of interference, the electrical layout may be altered to suit the conditions, prior to the installation of any work, and without additional cost. Conflicts arising from lack of coordination shall be this contractor's responsibility.
- B. Work lines and established heights shall be in strict accordance with other related drawings and specifications. Verify all dimensions shown and establish all elevations and detailed dimension.
- C. Perform all work in conformity with the construction called for by other trades and afford reasonable opportunity for the execution of their work. Properly connect and coordinate all work

with the work of other trades at such time, and in such a manner as not to delay or interfere with their work.

- D. Promptly report to the Architect/Engineer any delay or difficulties encountered which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of work of other trades as being fit and proper for the execution of this work.
- E. Plan all work so that it proceeds with a minimum of interference with other trades. Inform all parties concerned of openings required for equipment or conduit for electrical work, and provide all special frames, sleeves and anchor bolts as required.

3.2 WORKMANSHIP

- A. Only quality workmanship will be accepted. All parts of the electrical systems such as conduits, cables, plates, boxes, lighting assemblies, etc., shall be square and true with the building or site geometry, and shall be neat and orderly in appearance.

3.3 SCHEDULE

- A. Schedule all work such that the progress of the electrical work will conform to the progress of the other trades. Complete the entire installation as soon as the conditions of the project will permit. Any cost resulting from defective or ill-timed work performed under this section shall be borne by this Contractor.

3.4 GUARANTEE

- A. Guarantee all materials and equipment installed under this subcontract against defects in workmanship and materials for a period of twelve (12) months after final acceptance of the work by the Owner. Repair and/or replace any materials or equipment developing such defects within that time promptly, upon due notice given by the Owner, at no addition expense to the Owner.
- B. All equipment bearing a manufacturer's guarantee shall be construed as an extended guarantee to the Owner by the Manufacturer. Any such equipment that proves to be defective in materials or workmanship within the guarantee period is to be replaced by the Subcontractor in accordance with the manufacturer's guarantee, at no additional expense to the Owner.

END OF SECTION 260010

SECTION 260100 - CONSTRUCTION POWER AND LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Provide temporary electrical service, including power and lighting distribution system for the construction portion of the project.
 - 2. All first time charges by the Contractor for installation and removal of the temporary system shall be included in this contract.

1.2 RELATED WORK

- A. All utility company charges for power consumed during the construction period shall be paid by the Owner. The construction period shall be defined as lasting until the owner assumes control of the project.
- B. The construction power system shall not be used for heating.

1.3 REGULATORY REQUIREMENTS

- A. The components and installation of the temporary lighting and power systems shall be, as a minimum, in conformance with the National Electrical Code and OSHA requirements.

1.4 PROJECT CONDITIONS

- A. Existing Service: Utilize existing on-site power for temporary power during construction of the project.

1.5 COORDINATION

- A. Coordinate utilities with Owner. Provide required connections per Owner's requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials for temporary services shall be of condition and quality to assure adequate operation and safety of use and shall have the listed approval of Underwriters Laboratories, Inc. where applicable.

2.2 ELECTRICAL SERVICE

- A. Service shall be a 200 amp (minimum) single-phase service rated 120/240 volts. At the contractor's option, service may be provided at 120/208 volts, 3-phase, 4-wire from the Owner's existing service.
- B. Service equipment shall be located at, or adjacent to the location of the permanent electrical service.
- C. The permanent electrical service may be used for temporary power when energized.
- D. Provide connection from utility service to temporary power system. Provide all wiring, hardware, and labor to complete the installation.

2.3 LIGHTING PROVISIONS

- A. A temporary lighting system shall be provided which will provide illumination suitable for the tasks to be performed throughout the facility.
- B. Maintain the lighting system with light bulbs, etc. throughout the construction process.
- C. Temporary lighting shall be provided at not less than ½ Watt per square foot with no less than one light per room.

2.4 POWER PROVISIONS

- A. A temporary miscellaneous power system shall be provided which shall consist of 20 amp, 120 volt duplex receptacles located throughout the facility. Receptacles shall be located to allow the use of 50 foot extension cords to reach all areas of the building.
- B. The service panel shall contain a sufficient number of various sizes and configurations of circuit breakers to allow temporary connection of other loads as required.
- C. All temporary power receptacles must be GFI protected.

2.5 MISCELLANEOUS POWER PROVISIONS

- A. Connections for miscellaneous equipment such as welders, compressors, etc. shall not be included in this contract. Connection costs associated with this equipment shall be borne by the contractor requiring the connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall comply with Temporary Wiring methods of applicable codes and ordinances.
- B. Grounding shall comply with applicable codes.

- C. Completed portions of the permanent installation or materials for use in the permanent installation shall not be used in the temporary installation without permission of the engineer.
- D. Open wiring methods may not be used in public areas of the construction area.
- E. Wiring and methods utilized shall follow industry and code accepted practices with the methods and materials utilized following the strictest available safety standards.
- F. The contractor shall be totally responsible for providing a safe and usable installation.
- G. Periodic maintenance of the temporary power and lighting system shall be provided, including replacing lamps and repairing equipment as damage occurs.

3.2 REMOVAL OF TEMPORARY POWER AND LIGHT

- A. The Electrical Contractor shall be responsible for the complete removal of the temporary Power and Lighting system by the time of Substantial Completion.
- B. The Contractor shall be responsible for patching all penetrations, to a finish like the adjacent surface.
- C. Cutting temporary wiring at wall will not be acceptable.

END OF SECTION 260100

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SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. Electrical equipment coordination and installation.
 - 2. Common electrical installation requirements.
 - 3. Concrete Bases

1.3 SUBMITTALS

- A. Product Data: None

1.4 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 2. So connecting raceways, cables, wire-ways, cable trays, and bus-ways will be clear of obstructions and of the working and access space of other equipment.

PART 2 - PRODUCTS

2.1 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
 - 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.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. 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.

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:

1.2 SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpha Wire.
 - 2. Belden Inc.
 - 3. Encore Wire Corporation.
 - 4. General Cable Technologies Corporation.
 - 5. Southwire Incorporated.
- B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Types THW, THHN-THWN and XHHW.
- D. Multiconductor Cable:
 - 1. Multiconductor cables SHALL NOT be used on this project unless specifically noted otherwise.
 - 2. Examples of excluded multiconductor cables include but are not limited to armored cable, Type AC; metal-clad cable, Type MC; mineral-insulated, metal-sheathed cable, Type MI; nonmetallic-sheathed cable, Type NM; Type SO; and Type USE with ground wire.

2.2 CONNECTORS AND SPLICES

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

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. IlSCO; a branch of Bardes Corporation.
6. NSI Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 GENERAL

- A. All Class I and Class II wiring that is underground or in contact with the earth shall be wet labeled for the installation.
- B. Wiring for 20 amp or less single phase lighting and power circuits shall be a minimum ½" conduit with two (2) #12 plus one (1) #12 ground, unless otherwise noted.
- C. Wiring for 30 amp single phase lighting and power circuits shall be a minimum ¾" conduit with two (2) #10 plus one (1) #10 ground, unless otherwise noted.

3.2 CONDUCTOR MATERIAL 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, except VFC cable, this shall be extra flexible stranded.

3.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Provide type THHN-THWN, single conductors in raceway for the following applications:
1. Service Entrance.
 2. Exposed Feeders.
 3. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground.

4. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground.

3.4 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-THWN, single conductors in raceway.
- B. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- C. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

3.5 INSTALLATION OF CONDUCTORS AND CABLES

- A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- 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.

3.6 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.7 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

END OF SECTION 260519

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment, including:
 - 1. Grounding conductors.
 - 2. Grounding of low voltage equipment.
 - 3. Grounding connectors.
 - 4. Grounding electrodes.
 - 5. Underground distribution grounding.
 - 6. Foundation steel electrodes.

1.2 SUBMITTALS

- A. Product Data: For each type of grounding device required. Include dimensions and manufacturers' technical data on features.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. Dossert; AFL Telecommunications LLC.
 - 3. ERICO International Corporation.
 - 4. Fushi Copperweld Inc.
 - 5. Galvan Industries, Inc.; Electrical Products Division, LLC.
 - 6. Harger Lightning and Grounding.
 - 7. ILSCO.
 - 8. O-Z/Gedney; A Brand of the EGS Electrical Group.
 - 9. Robbins Lightning, Inc.
 - 10. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: 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.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes:
 - 1. Copper or copper alloy.
 - 2. 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.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 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.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.
 - 4. Apply an antioxidant coating to all crimp-on-type connectors prior to making crimp. Wipe connectors clean.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Lighting Poles: Provide equipment grounding conductor from panel to pole. Provide ground rod below grade near base of pole. Bond equipment grounding conductor with ground rod, pole ground lug and luminaire ground.
- C. Grounding Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

3.3 EQUIPMENT GROUNDING

- A. 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.

3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished final grade unless otherwise indicated.
- C. 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. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

END OF SECTION 260526

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Boxes, enclosures, and cabinets.
 - 5. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:

1.2 DEFINITIONS

- A. EMT: Electrical Metallic Tubing
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. 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.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney; a brand of EGS Electrical Group.
 - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 - 7. Republic Conduit.
 - 8. Robroy Industries.
 - 9. Southwire Company.
 - 10. Thomas & Betts Corporation.
 - 11. Western Tube and Conduit Corporation.
 - 12. Wheatland Tube Company; a division of John Maneely Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. IMC: Comply with ANSI C80.6 and UL 1242.

- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT: Steel compression type. Set screw indenter type not allowed.
 - 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- H. Joint Compound for IMC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Anamet Electrical, Inc.
 - 3. Arco Corporation.
 - 4. CANTEX Inc.
 - 5. CertainTeed Corp.
 - 6. Condux International, Inc.
 - 7. Electri-Flex Company.
 - 8. Kraloy.
 - 9. Lamson & Sessions; Carlon Electrical Products.
 - 10. Niedax-Kleinhuis USA, Inc.
 - 11. RACO; a Hubbell company.
 - 12. Thomas & Betts Corporation.
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. RNC: Type EPC-40-PVC complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: Comply with UL 514B.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman; a Pentair company.
 - 3. Mono-Systems, Inc.
 - 4. Square D; a brand of Schneider Electric.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 (Type 3R for damp or wet locations) unless otherwise indicated, and sized according to NFPA 70.
 - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Adalet.
 - 2. Cooper Technologies Company; Cooper Crouse-Hinds.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a Pentair company.
 - 7. Hubbell Incorporated; Killark Division.
 - 8. Kraloy.
 - 9. Milbank Manufacturing Co.
 - 10. Mono-Systems, Inc.
 - 11. O-Z/Gedney; a brand of EGS Electrical Group.
 - 12. RACO; a Hubbell Company.
 - 13. Robroy Industries.
 - 14. Spring City Electrical Manufacturing Company.
 - 15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
 - 16. Thomas & Betts Corporation.
 - 17. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

- D. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- E. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 (Type 3R for damp or wet locations) with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- F. Cabinets:
 - 1. NEMA 250, Type 1 (Type 3R for damp or wet locations) 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.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation; Hubbell Power Systems.
 - d. NewBasis.
 - e. Nordic Fiberglass, Inc.
 - f. Oldcastle Precast, Inc.; Christy Concrete Products.
 - g. Synertech Moulded Products; a division of Oldcastle Precast, Inc.
 - h. Quasite
 - 2. Standard: Comply with SCTE 77.
 - 3. Color of Frame and Cover: Gray.
 - 4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
 - 5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
 - 6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 7. Cover Legend: Molded lettering to describe contents ("ELECTRIC", "FIBER", etc).
 - 8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Exterior: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: IMC.
 2. Concealed Conduit, Aboveground
 - a. Subject to Moisture: IMC; or RNC, Type EPC-40-PVC.
 - b. Not Subjected to Moisture: EMT; IMC; or RNC, Type EPC-40-PVC.
 3. Underground Conduit:
 - a. RNC, Type EPC-40-PVC.
 - b. Direct buried unless plans specifically require concrete encasement.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Interior: Apply raceway products as specified below unless otherwise indicated:
1. Exposed:
 - a. Not Subject to Severe Physical Damage: EMT.
 2. Concealed above Acoustical Tile (ACT) or Gypboard Ceilings: EMT
 3. Concealed within roofing construction or within 1-1/2" measured from the lowest surface of the roof decking: IMC or RMC.
 4. Interior Walls and Partitions: EMT.
 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.
 6. Damp or Wet Locations: IMC.
- C. Minimum Raceway Size:
1. 3/4-inch trade size for Power Systems.
 2. 1-inch trade size for low voltage systems.
 3. Unless noted otherwise in specific sections.
- D. 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. Comply with NEMA FB 2.10.
 2. EMT: Use compression, cast-metal fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install surface raceways only where indicated on Drawings.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Complete raceway installation before starting conductor installation.
- C. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- E. 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. Secure raceways to reinforcement at maximum 10-foot intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
- F. 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.
- G. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- I. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- J. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- K. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- L. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- M. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

- N. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.
- O. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line.

END OF SECTION 260533

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Identification for raceways.
 2. Identification of power and control cables.
 3. Identification for conductors.
 4. Underground-line warning tape.
 5. Warning labels and signs.
 6. Instruction signs.
 7. Equipment identification labels.

1.2 SUBMITTALS

- A. Product Data: None.

1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 2. Printing on tape shall be permanent and shall not be damaged by burial operations.

3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Inscriptions shall indicate type of underground line. Utilize red-colored tapes for line voltage lines (Electric Line, High Voltage, etc). Utilize orange-colored tapes for low voltage lines: (Telephone Cable, CATV Cable, Communications Cable, Optical Fiber Cable, etc).

2.3 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.

- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

- C. Warning label and sign shall include, but are not limited to, the following legends:

1. Workspace Clearance Warning:
 - a. "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
 - b. Revise dimension as required to meet working spaces as defined in Article 110.26 of NFPA 70.
2. Arc Flash Hazard Warning: "DANGER - REMOVAL OF COVER EXPOSES POTENTIAL ELECTRIC ARC FLASH HAZARD"

2.4 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

- B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Concealed Raceways, Duct Banks, More Than 600 V: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide.
- B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:

- 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
- c. Colors for 480/277-V Circuits:
- 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- D. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.
- G. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- H. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and load shedding.
- I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Stenciled legend 4 inches high.

- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
 - e. Provide labeling with respect to NEC 110.16 for Arc Flash protection labeling.
2. Equipment to Be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Enclosed switches.
 - f. Enclosed controllers.
 - g. Push-button stations.
 - h. Contactors.
 - i. Remote-controlled switches, and control devices.
 - j. Site Lighting Assemblies.

END OF SECTION 260553

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SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. The occupancy sensor lighting control shall automatically after reasonable time delay (field adjustable), turn off lighting when a room or area is vacated. The system shall also provide an input to the Division 23 Ventilation System to prove occupancy within the space. Occupancy sensors shall be equipped with dry contacts (input) points.
- B. The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.
- C. Where required, the occupancy sensors shall integrate seamlessly with the lighting control systems.
- D. Section Includes:
 - 1. Snap switches
 - 2. Time switches.
 - 3. Photoelectric switches.
 - 4. Indoor occupancy sensors.
 - 5. Outdoor motion sensors.
 - 6. Lighting contactors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.
 - 2. A custom wiring and interconnection diagram showing proper wiring including wire types and wire quantities for each system.
 - 3. Coordination Drawings: Custom engineered coverage plan, drawn to scale, on which the sensor coverage, location and orientation of the equipment on a floor plan are indicated. The drawings shall be engineered to not interfere with the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Structural members

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For each type of lighting control device the following shall be included in emergency, operation, and maintenance manuals.
 - a. Provide product cutsheet for each device installed.
 - b. Provide product installation manual for each device installed.

PART 2 - PRODUCTS

2.1 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Single Pole:
 - 1) Cooper; AH1221.
 - 2) Hubbell; HBL1221.
 - 3) Leviton; 1221-2.
 - 4) Pass & Seymour; CSB20AC1.
 - b. Two pole, three pole, four pole shall be similar model to single pole listed above.

C. Pilot-Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH1221PL for 120 and 277 V.
 - b. Hubbell; HBL1201PL for 120 and 277 V.
 - c. Leviton; 1221-LH1.
 - d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; AH1221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

- E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.

- F. 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.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.2 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. NSi Industries LLC; TORK Products.

- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Contact Configuration: SPST, DPST or DPDT (as required).
 - 3. Contact Rating: as required.
 - 4. Programs: 8 channels; each channel is individually programmable with 40 on-off operations per week and an annual holiday schedule that overrides the weekly operation on holidays.
 - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 - 6. Astronomic Time: Selected channels.
 - 7. Automatic daylight savings time changeover.
 - 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.3 WALL BOX TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Building Automation, Inc.
 - 2. Intermatic, Inc.
 - 3. NSi Industries LLC; TORK Products.

- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Time adjustable from 5 minutes to 12 hours.
 3. Single Gang.
 4. Contact Configuration: SPST.
 5. Contact Rating:
 - a. 120 VAC:
 - 1) 800 Watt – Tungsten
 - 2) 800 Watt – Fluorescent
 - 3) 1/6 HP – Motor
 - b. 277 VAC:
 - 1) 1200 Watt – Fluorescent
 6. Zero Arc Point Switching.
 7. Visual and audible warnings: Provides a light flicker and/or beep warning prior to turning fixtures off.
 8. Operating Environment: Indoor use only. Operating temperature 32d F to 122D F. Relative humidity (non-condensing) 0% to 95%.
 9. UL Listed.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. NSi Industries LLC; TORK Products.
 4. Tyco Electronics; ALR Brand.
- B. Description: Solid state, with SPST or DPST (as required) 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. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
 3. Time Delay: Fifteen second minimum, to prevent false operation.
 4. Surge Protection: Metal-oxide varistor.
 5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.5 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation, Inc.
 2. NexLight.
 3. Watt Stopper.
 4. Acuity Controls
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: 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. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Sensors shall include an auxiliary set of dry contacts for monitoring by the Building Automation System (BAS).
 6. 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.
 7. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 8. Bypass Switch: Override the "on" function in case of sensor failure.
 9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. 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 mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 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 mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. 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.

2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation, Inc.
 2. NexLight
 3. Watt Stopper.
 4. Acuity Controls
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
- C. Wall-Switch Sensor:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
 2. Sensing Technology: Dual technology.
 3. Switch Type: SP, manual "on," automatic "off."
 4. Voltage: Match the circuit voltage.
 5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

2.7 OUTDOOR MOTION SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation, Inc.
 2. Sensor Switch, Inc.
 3. Watt Stopper.
- B. General Requirements for Sensors: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. PIR type, weatherproof. 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.. Comply with UL 773A.
 3. Switch Rating:
 - a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent.
 - b. Separately Mounted Sensor: 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. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 4. Switch Type: SP.
 5. Voltage: Match the circuit voltage.
 6. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
 - b. Long Range: 180-degree field of view and 110-foot detection range.
 7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
 9. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.8 LIGHTING CONTACTORS

- A. 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 Corporation.
 4. Square D; a brand of Schneider Electric.
- B. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, 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.

2.9 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- C. Sensors shall be mounted on an approved electrical junction box.

3.2 SENSOR APPLICATION

- A. Provide occupancy sensors for the areas with Ultrasonic, Infrared and Dual Technology sensors that result in applications:
 1. Ceiling Mounted Ultrasonic:
 - a. Restrooms
 2. Ceiling Mounted Dual Technology:

- a. Other rooms
- 3. Programmable Timer Switch
 - a. Custodial Closets

3.3 SENSOR SEQUENCE OF OPERATION

A. Lighting control in spaces shall be controlled as follows unless noted otherwise.

1. **General areas (1 or more occupants):**

- a. The lighting in the room shall be controlled via low voltage switches and occupancy sensor. Multiple power packs shall be utilized to provide inboard/outboard switching where shown on the drawings. The low voltage switches shall "turn ON/OFF" and the occupancy sensor shall "turn OFF" all lighting in the space when the office is not occupied for a field adjustable time. Time delay off shall be set at 15 minutes.

2. **Restrooms:**

- a. The lighting shall be controlled in an ON-OFF manner via the ceiling mounted motion sensors as shown on the drawings. This control scheme shall have 24 hour a day operation. Time delay off shall be set at 15 minutes.

3. **Custodial Closet:**

- a. The lighting shall be controlled via a line voltage programmable timer switch. The push button switch shall "turn ON" the lighting in the space and a timer shall "turn OFF" all lighting in the space when a field adjustable time is measured. Time delay off shall be set at 10 minutes.

4. **Mechanical and Electrical Rooms:**

- a. The lighting shall not have a lighting control scheme and shall not be controlled via automatic controls.

B. Prior to rough-in and submittal of shop drawings the contractor shall bring to the Engineer's attention any deviation in the plans from the above controls descriptions.

3.4 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.

3.5 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 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. All terminations shall be made in an approved junction box. **NO FREE AIR** splices will be allowed.
- E. Provide neutral conductor, or conduit capacity for future, to all switch locations for switches controlling lighting loads.

3.6 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 4. Prepare test and inspection reports.

3.8 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

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SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Electronic Grade Panelboard.

1.2 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. TVSS: Transient voltage surge suppressor.

1.3 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.
 - 7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Provide manufacturer installation instructions.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
4. Provide copy of NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- 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 NEMA PB 1.
- E. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet.

1.8 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. See plans and schedules for detailed information on individual panelboards.
- B. Enclosures: Flush- and surface-mounted cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen/Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5 or Type 12, as indicated on schedules.
 2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 3. Finishes:
 - a. Boxes shall be hot zinc dipped galvanized steel constructed in accordance with UL 50 requirements. Unpainted galvanized steel is not acceptable.
 - b. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - c. Back Boxes: Same finish as panels and trim.
 4. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top or bottom, contractor's discretion.

- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 3. Extra-Capacity Neutral Bus:
 - a. Provide for electronic grade transformers, and where indicated on plans.
 - b. Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
 2. Main and Neutral Lugs: Mechanical type.
 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 4. Feed-Through Lugs (where indicated): Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 5. Subfeed (Double) Lugs (where indicated): Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 6. Extra-Capacity Neutral Lugs:
 - a. Provide for electronic grade transformers, and where indicated on plans.
 - b. Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- F. Service Equipment Label (where indicated): NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
1. Provide for UL series rated combination only as shown on the schedules.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or main lugs only (as indicated on drawings).
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.3 ELECTRONIC-GRADE PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Current Technology; a subsidiary of Danahar Corporation.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 3. Liebert Corporation.
 - 4. Siemens Energy & Automation, Inc.
 - 5. Square D; a brand of Schneider Electric.
- B. Panelboards: NEMA PB 1; with factory-installed, integral TVSS; labeled by an NRTL for compliance with UL 67 after installing TVSS.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
- D. Main Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- E. Branch Overcurrent Protective Devices: Bolt-on thermal-magnetic circuit breakers.
- F. Buses:
 - 1. Copper phase and neutral buses; 200 percent capacity neutral bus and lugs.
 - 2. Copper equipment and isolated ground buses.
- G. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, plug-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, short-circuit current rating complying with UL 1449, second edition, and matching or exceeding the panelboard short-circuit rating, redundant suppression circuits, with individually fused metal-oxide varistors.
 - 1. Accessories:
 - a. Fabrication using bolted compression lugs for internal wiring.
 - b. Integral disconnect switch.
 - c. Redundant suppression circuits.
 - d. Redundant replaceable modules.
 - e. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
 - f. LED indicator lights for power and protection status.
 - g. Audible alarm, with silencing switch, to indicate when protection has failed.
 - h. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
 - i. Four-digit, transient-event counter set to totalize transient surges.
 - 2. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

3. Minimum single-impulse current ratings, using 8-by-20-mic.sec. waveform described in IEEE C62.41.2.
 - a. Line to Neutral: 100,000 A.
 - b. Line to Ground: 100,000 A.
 - c. Neutral to Ground: 50,000 A.
4. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.
5. Protection modes and UL 1449 SVR shall be as follows:
 - a. For 480Y/277-V grounded wye circuits with three-phase, four-wire circuits :
 - 1) Line to Neutral: 800 V.
 - 2) Line to Ground: 800V.
 - 3) Neutral to Ground: 800 V.
 - b. For 208Y/120-V three-phase, four-wire or 240/120-V, single-phase, three-wire circuits:
 - 1) Line to Neutral: 400 V.
 - 2) Line to Ground: 400 V.
 - 3) Neutral to Ground: 400 V.
 - c. For 240-V, three-phase, three-wire, delta circuits:
 - 1) Line to Line: 1000 V for 240 V.
 - 2) Line to Ground: 800 V for 240 V.
 - d. For 480-V, three-phase, three-wire, delta circuits:
 - 1) Line to Line: 2000 V for 480 V.
 - 2) Line to Ground: 1500 V for 480 V.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Siemens Energy & Automation, Inc.
 3. Square D; a brand of Schneider Electric.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
 1. 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.
 2. GFCI Circuit Breakers (where indicated): Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers (where indicated): Class B ground-fault protection (30-mA trip).

4. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers (where indicated): Comply with UL 1699; 120/240-V, single-pole configuration.
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. Shunt Trip (where indicated): 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - f. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - g. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

C. Fused Switches for Distribution Panel-boards Distribution

1. Fused Switch Distribution: NEMA KS 1, Type HD; clips to accommodate Type J fusing with lockable handle.
2. Fuses are specified in Division 26 Section "Fuses."

2.5 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NECA 407.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NECA 407.
- B. Mount top of trim 90 inches above finished floor unless otherwise indicated.

- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
- E. Install filler plates in unused spaces.
- F. Spare Conduits for Recessed Panelboards: Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- H. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates:
 - 1. Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 2. Label service entrance panelboards with available fault current information as well as the date the fault calculation was performed. Do not use fault current rating of equipment for this value. If value is not readily available on plans obtain from project engineer, or if applicable from engineer as specified in 260573 "Overcurrent Protective Device Coordination Study".
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Provide arc flash labeling as required per NFPA 70 – 110.16 Arc-Flash Hazard Warning.

3.4 FIELD QUALITY CONTROL

- A. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.
- B. Perform tests and inspections.
 - 1. Acceptance Testing Preparation:
 - a. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

- b. Test continuity of each circuit.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

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SECTION 262726 – WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.

1.2 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. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

- A. Product Data: None.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 3. Leviton Mfg. Company Inc. (Leviton).
 4. Pass & Seymour/Legrand (Pass & Seymour).
- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors shall not be used.

2.3 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, non-feed-through type.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20.
 - b. Hubbell; GFR5352L.
 - c. Pass & Seymour; 2095.
 - d. Leviton; 7590.

2.4 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
 - 3. Material for Unfinished Spaces: Stainless or galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.5 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: Stainless Steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Conductors:
 - 1. Do not strip insulation from conductors until right 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.
- C. Device Installation:
 - 1. Replace devices that have been in temporary use during construction and that 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, two-thirds to three-fourths of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by 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.
- D. GFCI Devices:
 - 1. GFCI devices shall be installed in a non-feed-thru method. At all locations shown on the drawings, the Contractor shall install individual GFCI device. Where shown as a four-plex device, each device shall be a GFCI device installed in a non-feed-thru manor.
 - 2. GFCI devices shall be installed in readily accessible locations. Coordinate exact location of device with equipment, refrigerators, vending machines, etc. In situations where a GFCI receptacle cannot be located in a readily-accessible area it shall be permissible to feed a standard receptacle with a GFCI breaker or faceless GFCI device, provided that the interrupting device is accessible, clearly marked, and dedicated to the non-accessible receptacle.
- E. 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.

3.2 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."

- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 262726

SECTION 262813 – FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches and enclosed controllers.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Fuses: Equal to 5 percent of quantity installed for each size and type, but no fewer than two of each size and type.

1.5 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.

1.6 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.

1.7 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. 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.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 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.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Motor Branch Circuits: Class J, time delay.
 - 2. Other Branch Circuits: Class J, time delay.
 - 3. Control Circuits: Class J.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "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 262813

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SECTION 262816 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Enclosures.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 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. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 5. 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: None.
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- 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.

1.5 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.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.
- 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 required fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D; a brand of Schneider Electric.

- 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. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50.
- B. Provide enclosures with ratings to comply with environmental conditions at each type of installed location, unless noted otherwise:
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.

PART 3 - EXECUTION

3.1 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.

3.2 INSTALLATION

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- B. Provide custom uni-strut mounting frame where needed to mount switch.
- 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. Mount in service enclosure or on light pole as noted.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

END OF SECTION 262816

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes the following types of LED luminaires:
 - 1. Interior lighting fixtures, lamps, and ballasts.
 - 2. Emergency lighting units.
 - 3. Lighting fixture supports.
 - 4. Lighting rebate forms

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION 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. Arrange in order of luminaire designation.
 - 2. Physical description of lighting fixture including dimensions.
 - 3. Energy-efficiency data.
 - 4. Include data on features, accessories, and finishes.
 - 5. Include emergency lighting units, including batteries and chargers.
 - 6. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 7. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type.

The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

- a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.

8. Installation instructions.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Lighting Rebates: Copy of completed lighting rebate forms, including all backup information and receipts.

B. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all equipment used on the Project, use ANSI and manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

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 NFPA 70.

D. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

E. NSF Compliance: Lighting fixtures for use in commercial kitchens shall be listed and labeled suitable for such use per National Sanitation Foundation (NSF) standards.

F. For LED luminaires comply with:

1. IES-LM-79: Illuminating Engineering Society – Approved Methods: Electrical and Photometric Measurements of Solid-State Lighting Products
2. IES-LM-80: Illuminating Engineering Society – Approved Methods: Measuring Lumen Maintenance of LED Light Sources

- G. Provide luminaires from a single manufacturer for each luminaire type.
- H. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Furnish lighting fixtures completely assembled with wiring and mounting devices and ready for installation at the locations noted. Design and equip recessed fixtures in suspended ceilings for installation in type of ceiling in which the fixture is to be installed. Design fixture to be supported independent of the ceiling.
- 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. Standards:
 - 1. ENERGY STAR certified.
 - 2. California Title 24 compliant.
 - 3. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
 - 4. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
 - 5. UL Listing: Listed for damp location.
 - 6. Recessed luminaires shall comply with NEMA LE 4.
- D. Rated lamp life of 50,000 hours to L70.
- E. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- F. Internal driver.

2.2 MATERIALS

- A. Sheet Metal Parts:

1. Free of burrs and sharp corners and edges.
 2. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
 3. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
 4. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
 5. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, spring loaded latches shall function easily by finger action without the use of tools. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- B. 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.
- C. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
- D. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- E. Lighting fixtures shall have a specific means for grounding metallic wire-ways and housings to an equipment grounding conductor.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

2.5 LIGHTING FIXTURE PROVISIONS

- A. Coordinate fixture wiring configuration to provide multi-level or dimming with switching schemes as shown on the drawings.

2.6 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "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 gauge.
- E. Wires for Humid Spaces (where indicated): ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gauge.
- 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.

- B. Lighting fixtures:

1. Verify ceiling types with Architectural plans or with existing ceilings. Verify specified luminaires are compatible with specified ceiling type(s) prior to ordering luminaires.
2. Install in accordance with manufacturer's instructions.
3. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
4. Rectangular and square fixtures surface mounted or mounted in sheetrock, gypboard, plaster or similar ceilings shall be parallel or perpendicular to the building structure and accurately line up with respect to building elements and each other. If fixtures are not initially installed correctly the Contractor shall be responsible for all corrective work required to reinstall fixtures.

- C. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

- D. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Trim ring flush with finished surface.
3. Install at least two independent support rods or wires from structure to tabs on lighting fixture. Utilize tabs on opposite corners of fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3. Per UBC Standard 25-2, Section 25.213.

- E. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

- F. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- diameter aircraft cable supports adjustable to 120 inches in length.
2. Ceiling mount with hook mount.
3. Install at least two independent support rods or wires from structure to tabs on lighting fixture. Utilize tabs on opposite corners of fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3. Per UBC Standard 25-2, Section 25.213.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
5. Install at least two independent support rods or wires from structure to tabs on lighting fixture. Utilize tabs on opposite corners of fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3. Per UBC Standard 25-2, Section 25.213.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.
4. Install at least two independent support rods or wires from structure to tabs on lighting fixture. Utilize tabs on opposite corners of fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3. Per UBC Standard 25-2, Section 25.213.

I. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

J. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

K. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to one visit to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

3.7 CLEANING

- A. All luminaires and accessories shall be thoroughly cleaned after being installed. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lenses or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufactures' instructions.

3.8 LIGHTING REBATE

- A. Contractor shall coordinate with the local power company and the Owner as required to obtain all applicable lamp, ballast, and lighting control rebates. Apply the Utility **Lighting Incentive Program for New Construction** to this project.
- B. Secure on behalf of the Owner the maximum rebate.
- C. Complete all forms necessary to secure rebates.
- D. All Rebates shall be made directly to the Owner.
- E. Provide all invoicing and product information necessary to procure rebate.

END OF SECTION 265119

SECTION 270001 - COMMUNICATIONS CERTIFICATION


PART 1 - GENERAL

1.1 ELECTRICAL ENGINEER'S CERTIFICATION

A. I hereby certify that Division 27 of this Specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of South Dakota.

B. Name: Jay Hruby, PE

C. License Number: 8782

D. Signature:  Date: July 22, 2022

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 270001

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SECTION 270010 - GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers general installation practices and requirements for all work under Division 27.
- B. The General Conditions, Supplementary General Conditions, and Division 01 General Requirements apply to Division 27.
- C. The contractor shall adhere to local ordinances, laws, regulations, the National Electrical Code and OSHA Regulations.
- D. Raceways for Division 27 shall be furnished and installed by the Division 26 Contractor. All equipment, components, wiring and final terminations etc. shall be furnished and installed by Division 27.

1.2 DRAWINGS

- A. Communications floor plan drawings are too scale and are typically not dimensioned. The Contractor shall not scale drawings for equipment placement and clearances. Dimensions given on drawings shall always take precedence over scaled drawings.
- B. The Contractor shall field verify distances and equipment placements coordinating locations with other trades, construction managers, and general contractor prior to installation.
- C. Change orders requests for additional costs related to the contractor's misunderstanding related to the amount of work involved and lack of knowledge related to the site conditions will not be allowed.

1.3 PERMITS, FEES AND INSPECTIONS

- A. All permits, inspections, and licenses required for any communications system under the Division 27 specifications shall be the responsibility of the Contractor. The costs of all permits, fees, and inspections shall be included in the Contractor's bid.

1.4 CONTRACTOR QUALIFICATIONS

- A. The Contractor shall have at least five years experience in the installation of similar systems as specified herein and shall have completed at least two projects of similar size and scope within the last 24 months. The contract shall provide references upon request (including the project name, address, date of implementation, client name, title, telephone number, and project description).
- B. The Contractor bidding on communication systems specified herein shall be certified by the product manufacturer to install, service, and warranty the specified product prior to the time of

bid and throughout the duration of the installation; or, the bidding contractor shall utilize a sub-contractor(s) certified by the product manufacturer to install, service, and warranty the specified product. Manufacturer certifications shall not be project specific and should be valid for any and all projects completed by the Contractor.

- C. The Contractor must maintain a Wyoming low-voltage contractor's license as required by the Wyoming State Board of Electricity.
- D. The Contractor shall provide copies of certificates for proof of manufacturer's training, manufacturer's certified installer, authorized distributor in the shop drawing submittal and at the request of the engineer to verify compliance with specification prior to recommendations for awarding bid.

1.5 SUBMITTALS

- A. Submittal for bidding shall be as stated in the Bidding Requirements.
- B. Material lists, schedule of values, lists of subcontractors, and proof of contractor qualifications shall be provided to Engineer upon request and shall follow the guidelines as stated in the General Requirements (Division 01 of the specifications).
- C. Performance Bonds, Payment Bonds, and Insurance Certificates shall be submitted by the Contractor prior to execution of the contract; refer to General Requirements.
- D. Shop drawings shall be submitted as stated in the General Requirements (Division 01 of the specifications). In addition to items stated in the General Requirements, all communication system shop drawings shall included the following items:
 - 1. Manufacturer's data (specifications, "cut sheets")
 - 2. Detail drawing of any custom panels or jack plates
 - 3. Wiring diagrams for all installed cabling
 - 4. Equipment rack/cabinet layouts
 - 5. Proposed labeling schemes and labeling methods
 - 6. List of cabling distances (typical and maximum) for all structured cabling
 - 7. Equipment room floor plan layouts
 - 8. Copy of Contractors training and authorized installer certificates
 - 9. Copy of structured cabling extended warranty information

Submit shop drawings bound and labeling in accordance with specification section numbers. In addition, one paper copy of the submittal shall be sent directly to EDI.

- E. As-Built documentation requirements may be described in additional detail by other Division 27 specification sections. As-built documentation shall included the following items:
 - 1. A copy of the approved shop drawing submittal
 - 2. A complete list of all materials used on the project
 - 3. A copy of the Division 27 specifications (including addendum and change orders)
 - 4. Schematic drawings and block diagrams of components
 - 5. Floor plan drawings including devices locations and labeling
 - 6. Test results and output level readings (i.e., amplifier loads, RF tap reading)
 - 7. Warranties

Submit a minimum two complete copies of all as-built documentation (provide additional copies if more than two copies are required by General Requirements). As-built submittal shall be neatly bound, indexed, tabbed, and labeled.

- F. Close-out documentation shall include all as-built documentation and additional close-out documents as required in the General Requirements.

1.6 MATERIALS AND EQUIPMENT

- A. All materials used on this project shall be new. Used and refurbished equipment is not permitted. Provide equipment to site in original packaging whenever practical.
- B. The contractor is responsible for scheduling all deliveries and providing proper receipt, handling, and storage of all materials. Protect all equipment from physical damages (dents, scratches, dust, water, paint, chemicals, and temperature extremes) and vandalism, or theft. The contractor shall replace any damages or stolen equipment. The contractor is responsible for all equipment until the final project acceptance by the Owner.
- C. All material and equipment used on the project shall be as specified. Approval for substitute material will be considered prior to bidding as described in the instructions to bidders. Applications for prior approval will be considered only from Contractors intending to bid on the project.

PART 2 - PRODUCTS

- 2.1 Not Used

PART 3 - EXECUTION

3.1 GENERAL

- A. All cable, equipment, and components shall be installed in accordance with manufacturer's written instructions, in compliance with NEC, and in accordance with industry standard practices.
- B. All equipment shall be installed in a neat, professional manner, always vertically plumb and securely fastened.
- C. Most pathways for the communications systems are provided by other trades and not part of the Division 27 work; however, the Division 27 communications contractor may be required to create some pathways. Holes in masonry shall be made with rotary drills; impact tools are not permitted. Never penetrate through structural members or architectural finishes without prior approval from the architect or engineer. All penetration work shall be patched, sealed, cleaned, and returned to original conditions. All penetration in fire rated walls and floors shall be sealed with approved fire barriers systems in accordance with manufacturer's instructions.
- D. This communications contractor is responsible for creating a waterproof seal in and around openings to the building exterior created by or used by the communications contractor. All

waterproof sealing materials shall comply with appropriate codes and shall be installed in accordance with manufacturer's instructions.

- E. The communications contractor shall clean up all debris related to Division 27 work on a regular basis leaving the job site in a clean, safe condition.

3.2 FINAL ACCEPTANCE

- A. All project review reports ("Punch-Lists") submitted by the engineer shall be completed and signed by the Contractor prior to final project acceptance.
- B. The Contractor shall schedule and conduct a final project review meeting with the Owner and Engineer to discuss the following items:
 - 1. As-built drawings and documentation
 - 2. Test results
 - 3. Warranty and problem resolution procedures
 - 4. Special maintenance procedures
 - 5. Address any questions of the Owner and Engineer
- C. The Contractor shall complete all additional training for the Owner as specified in other Division 27 specification sections.

END OF SECTION 270010

SECTION 270100 - OPERATION, MAINTENANCE & WARRANTY

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes the general operation, maintenance, and warranty requirements relating to all Division 27 systems.
- B. This section will also cover any special training requirements the Contractor is required to provide to the Owner.

1.2 GENERAL COMMUNICATION SYSTEMS OPERATION AND MAINTENANCE REQUIREMENTS

- A. All Communications Systems shall be demonstrated to be operation to the Owner and Engineer by documented test results and/or actual performance demonstrations of installed components. Systems shall perform at or beyond levels described in this section or other Division 27 sections.
- B. Structured Cabling shall perform at or beyond levels required to obtain the specified connectivity hardware manufacturer's applications assurance warranties and as required by Section 27 08 00 (Commissioning and Testing of Communications Systems).

1.3 COMMUNICATION SYSTEM WARRANTIES

- A. All Communication Systems shall include a one-year workmanship warranty from the Contractor. The workmanship warranty will start at the Substantial Completion Date which is the date mutually agreed upon between by the Owner, Contract, and Architect/Engineer; A.I.A. form G704 (Certificate of Substantial Completion) will document this date. The Contractor's workmanship warranty shall provide corrective action, at no cost to the Owner and in a timely manner, for instances where products are found to be defective, poor installation practices have been discovered, specified work was found to be incomplete, or communications systems are unable to perform properly on the cabling systems.
- B. Extended and Special Manufactures Warranties and/or Service Agreements will be required as described below for the following systems or system components.
 - 1. Category 6 Cabling, Connectivity Hardware, and Patch Cables shall be covered by a 20-year (minimum) application assurance warranty offered by the connectivity hardware manufacturer; this warranty shall provided coverage if the cabling system fails to perform under any of the following applications:
 - a. 10BaseT, 100BaseT, or 1000BaseT
 - b. 155/622 Mbps ATM
 - c. Voice-Over-IP (analog or digital)
 - d. 100 Mbps TP-TMD

2. The application assurance warranty shall be structured in a manner that the Contractor providing corrective services will be reimbursed by the warranty provider when the manufacturer's warranty requirements have been met. The Contractor shall register the cabling system with the connectivity hardware manufacturer to obtain the warranty for the Owner and include the approved warranty certificate in the final as-built records. The Owner will be responsible for adhering to the warranty stipulations if they should desire to continue receiving applications assurance warranty coverage.

PART 2 - PRODUCTS – Not Used (refer to other Division 27 sections)

PART 3 - EXECUTION

3.1 GENERAL OPERATION, MAINTENANCE, AND WARRANTY DOCUMENTATION REQUIREMENTS

- A. System Operation Manuals for all system components shall be provided to the Owner and included with the as-built documentation. All documentation shall be presented in 3-ring binders with all documentation hole-punched and neatly organized with index tabs.
- B. Manufacture & Extended Warranties for all system components shall be provided to the Owner and included with the as-built documentation. All documentation shall be presented in 3-ring binders with all documentation hole-punched and neatly organized with index tabs.

3.2 COMMUNICATIONS SYSTEMS TRAINING

- A. Structured Cabling System Training shall be review by the Contractor in a final project close-out meeting with the Engineer and Owner's representatives. The training on the structured cabling system shall include, but not limited to, the following items:
 1. Review of the distribution and labeling method schemes
 2. Review of patch panel and rack layouts
 3. Review of as-built drawings and documentation
 4. Explanation of test results and data
 5. Review of Engineer's Final Project Review Report with discussion of resolutions for any outstanding items
 6. Explanation of Quality Assurance Warranties, 1-Year workmanship warranty, and any other extended warranties
 7. Discussion of future problem resolution procedures

The Contractor shall provide a written outline of the meeting including important contact information (i.e., phone numbers and contact personal for problem resolution).

END OF SECTION 270100

SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes the overall work results relating all Division 27 section on the facility.
- B. Refer to other Division 27 sections for product information, installation practices, schedules, warranty, performance/testing requirements, and other systems information details.

1.2 DESCRIPTION OF WORK FOR STRUCTURED CABLING SYSTEMS

- A. Voice and data cabling system shall be complete, include all specified and ancillary components, be ready for use and installation of telephone and data equipment, and consist of the following criteria:
 - 1. For the voice horizontal cabling, One (1) Category 6 cables shall be installed from rack mounted patch panels in communication rooms to information outlet jacks as shown on the drawings. The Category 6 voice cabling shall be fully tested and documented and shall have a connectivity hardware manufacturer's quality and applications assurance warranty.
 - 2. For the data horizontal cabling, One (1) Category 6 cables shall be installed from rack mounted patch panels in communication rooms to information outlet jacks and wireless antenna locations as shown on the drawings. The Category 6 data cabling shall be fully tested and documented and shall have a connectivity hardware manufacturer's quality and applications assurance warranty.
 - 3. For the voice/data horizontal cabling, Two (2) Category 6 cables shall be installed from rack mounted patch panels in communication rooms to information outlet jack locations as shown on the drawings. The Category 6 data cabling shall be fully tested and documented and shall have a connectivity hardware manufacturer's quality and applications assurance warranty.
 - 4. For the wireless access point horizontal cabling, One (1) Category 6A cable shall be installed from rack mounted patch panels in communication rooms to each wireless antenna locations as shown on the drawings. At each exterior wireless access point location, provide a Transtector #1101-994 data line surge protection device bonded to building steel. The Category 6A data cabling shall be fully tested and documented and shall have a connectivity hardware manufacturer's quality and applications assurance warranty.
 - 5. The voice backbone cabling shall consist of Category 3 UTP multi-pair cables routed from the main equipment room to communication rooms in a star configuration as shown on the schematic (one-line) drawings. All cable pairs shall be terminated on rack mounted 110 blocks in telecommunication room, wall mounted 110 blocks in the DEMARC room, and shall be fully tested and documented.
 - 6. The data backbone cable shall consist of 50/125 multi-mode optical fiber cable main equipment room to communication rooms in a star configuration as shown on the schematic (one-line) drawings. All strands of the optical fiber cables shall be terminated in rack mounted enclosures with SC type connectors and shall be fully tested and documented.
 - 7. Patch cords and station cords shall be furnished to the Owner (for final installation by the Owner) with quantities, types, and lengths as specified herein in section 27 1619.

- B. Other structured cabling components including racks, cabinets, enclosures, accessories, cable pathways, and grounding system will consist of the following criteria:
1. All racks, cabinets, enclosures, and accessories necessary for the structured cabling system shall be furnished and installed by the communications cabling contractor as specified herein and as shown on detail drawings.
 2. Major pathways for the structured cabling system including cable trays, conduits, backbones, and conduit sleeves (2" and larger) are specified in Division 26. Cable runway in communication rooms, J-hooks for locations where structured cabling leaves cable trays, and conduit sleeves (1½" and smaller) are specified in this section and shall be furnished and installed by the communications cabling contractor.
 3. The major components for the communications grounding and bonding system including grounding busbars in communication rooms, ground rods, and grounding conductors (larger than #2 AWG) are specified in Division 26 and schematic drawings. The communications cabling contractor shall furnish and install #2 AWG grounding conductors with required lugs and fasteners from all communications equipment and components to the communications grounding system.

PART 2 - PRODUCTS – Not Used (refer to other Division 27 sections).

PART 3 - EXECUTION – Not Used (refer to other Division 27 sections).

END OF SECTION 270500

SECTION 270526 - GROUNDING FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes grounding and bonding requirement for all Division 27 communications systems.
- B. Ground conductors and ground rods are specified in Division 26 and as shown on detail drawings.
- C. Ground bus-bars and accessories for communication rooms and small cabinets are additionally specified in this section.

1.2 GENERAL COMMUNICATIONS GROUNDING AND BONDING REQUIREMENTS

- A. Communications systems grounding and bonding shall adhere to NFPA 70 (National Electric Code), J-STD-607-A (Commercial Building Grounding and Bonding Requirements for Telecommunications), and as specified herein and as indicated on drawings.
- B. All work related to the communications grounding system shall be completed by the electrical and/or communications contractors. The determinations of work responsibilities shall be coordinated between the electrical contractor(s), communication contractors(s), general contractor, and construction manager prior to bidding.

1.3 CONDUCTOR SIZES

- A. The minimum conductor size for all communications grounding system shall be #2 AWG to connect equipment racks/cabinets to the ground bus-bars and #6 AWG to bond rack-mount components or cable sheathing to equipment racks.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS GROUNDING EQUIPMENT

- A. Horizontal Rack Bus-bar shall be installed on a minimum of one equipment rack/cabinet in each communication rooms and shall meet the following requirements:
 - 1. Constructed of 3/16" by 3/4" copper alloy with eight #6-32 lugs
 - 2. UL Listed
 - 3. Approved manufacturers and product number: Chatsworth (10610-019) or equal

- B. Ground Terminal Block shall be installed on all racks and cabinets (when horizontal rack busbar is not installed) and shall meet the following requirements:
 - 1. Constructed of high strength aluminum with two hole mounting attachment and stainless steel set screws
 - 2. Accepts #14 AWG through 2/0 conductors
 - 3. UL Listed
 - 4. Approved manufacturers and product number: Chatsworth (40167-001) or equal
- C. Clean-Thread Screws shall be provided for the installation ground conduction hardware on painted finishes of racks and cabinets. Clean-Thread screws shall be #12-24 with a zinc finish, Chatsworth (40605-001) or equal.
- D. C-Type Compression Taps shall be used when connecting two TBB copper conductors. Compression taps shall be Chatsworth (40163-0xx) or equal; sized correctly to match conductor size.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices
- B. Provide grounding lugs and other accessories for a complete communications grounding systems

3.2 COMMUNICATIONS GROUNDING CONNECTIONS

- A. Mechanical compression tools shall be utilized to attach compression lugs to butt splices. Tools shall be compatible with conductor and lug sizes.
- B. C-clap compression taps shall be installed utilizing a hydraulic compression tool.
- C. The Division 27 Communication Contractor shall bond telecommunication equipment racks, cabinets, and ladder rack to the telecommunications grounding bus-bar with a #2 AWG ground wire.

END OF SECTION 270526

SECTION 270528 - PATHWAYS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers the pathways for all Division 27 communications systems.
- B. Conduit, surface raceways and junction boxes for communications systems are specified and installed in Division 26 and as shown on floor plan and detail drawings. Division 26 will provide basic raceways for use by Division 27. If any additional raceways are required for completion of the work of this contract, it shall be the responsibility of this contract to provide all labor and materials.
- C. Conduit sleeves (1½" and smaller), innerduct for optical fiber cable, and miscellaneous cable supports shall be furnished and installed by the communications cabling contractor and are specified in this section.

1.2 GENERAL COMMUNICATIONS PATHWAY REQUIREMENTS

- A. Communications pathways shall adhere to ANSI/TIA/EIA 569 standards and recommendations as specified herein and as indicated on drawings.
- B. The same manufacturer for cable runway and cable duct shall be used through the project.
- C. Cable runway in communication rooms (also referred to as ladder rack) is specified in Section 27 11 23.
- D. J-hooks shall be furnished and installed for supporting cables at intervals not greater than five feet (for the structured cabling system) when communications cables are not installed in cable trays or conduits in ceiling spaces.
- E. Innerduct shall be furnished and installed to protect and identify optical fiber cables when optical fiber cables are not installed in cable trays or cable runways.
- F. All communications cables installed in exposed areas shall be installed in raceway/conduit.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS CABLE SUPPORTS

- A. Cable Hooks (J-Hooks) shall comply with the following requirements:
 - 1. Include fasteners as required
 - 2. 2" wide full radius cross-section to support cables without sagging or crimping
 - 3. Approved manufactures: Chatsworth "RapidTrack", Erico "Caddy", or B-Line

- B. Vertical Cable Supports. Provide vertical cable supports in communication rooms and other areas where vertical pathways where cables can become stressed due to the weight of the cable, cause potential hazards, or become damaged from dangling loose. Vertical cabling shall be supported at regular intervals of 3' to 6' as required. Acceptable vertical cable support methods include Erico "Caddy" No. WM60 vertical cable support, D-rings attached to plywood backboards with tie-rop supports, or ladder rack/cable tray with tie-rop supports.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices.
- B. All communications cabling shall be installed above accessible ceilings with the use of J-hooks. J-hooks shall be installed at intervals not exceeding 5' and shall be installed directly to beams, ceiling structure, or walls independent of other trades anchoring/hanging systems; furnish and install all required fasteners and anchoring equipment for J-hook support system. Install J-hooks in accordance with manufacture manufactures fill capacities.
 - 1. Consult with structural engineer for mounting details for anchoring into double Tee structure. Provisions shall be made to insure the installation does not damage the structural members.
- C. The communications cabling contractor shall verify bushings have been installed on all conduit ends and conduit sleeves, and provide bushings as required, prior to installing communications cabling to avoid damaging cable sheathing. Failure to comply will result in this contractor removing, discarding and re-pulling all cables routed through the un-bushed pathway.
- D. Provide innerduct for additional protection of optical fiber cables when optical fiber cable exits cable trays or cable runways. Innerduct shall be support at both end to cable trays, cable runways, or equipment racks and at regular interval with cable ties.

END OF SECTION 270528

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for pathway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Grout.
 - 3. Silicone sealants.
- B. Provide firestopping for all penetrations through rated walls.
- C. Related Requirements:
 - 1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:
 - 1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
 - 2. Sealant shall have VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SEAL APPLICATIONS

- A. Sleeve Installation for non-fire-rated electrical penetrations
- B. Comply with NECA 1.
- C. Comply with NEMA VE 2 for cable tray and cable penetrations.
- D. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."
 - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- E. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- F. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
 - G. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway sleeves. Grout annular clear space between sleeve and wall.
 - H. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between pathway sleeves. Grout annular clear space between sleeve and wall.

END OF SECTION 270544

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SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers the identification and labeling for all Division 27 communications systems.
- B. Identification and labeling for communications shall conform to ANSI/TIA/EIA 606 standards, labeling requirements specified herein and as indicated on detail drawings.

1.2 SUBMITTALS

- A. Included with the shop drawing submittals, the Contractor shall provide a sample of all label types and labeling methods planned for use on the project. The labeling sample submittal shall include the following items:
 - 1. Labels attached to an 8½x11 sheet of paper with a written description of each label and the intended use for each label
 - 2. Provide one sample of custom style faceplates including engraved labeling
 - 3. Indicate the labeling method and labeling scheme intended for identifying both end of cables (on cabling sheathing)

PART 2 - PRODUCTS (Not Used.)

PART 3 - EXECUTION

3.1 GENERAL

- A. Labels shall be machine generated (unless other methods are specifically indicated) and shall be made with the Brady TLS 2200 thermal labeling system or other approved labeling system. Labels shall be a permanent polyester material clear in color (or color matching/near color of material affixed to label) with label lettering black in color (or of a contrasting color; i.e., white letters on black label when label is placed on black surface).
- B. Surfaces shall be cleaned before attaching labels. All labels shall be attached firmly and vertically plumb on equipment, faceplates, patch panels, termination blocks, etc.
- C. The Engineer and Owner shall approve the Labeling scheme prior to the installation of any cabling.
- D. All labeling of cables, equipment, and components shall be included in as-built documentation, floor plan drawings, and schematic diagrams.

3.2 LABELING OF CABLES

- A. All structured cables (horizontal and backbone) shall be labeled at both ends within 3" of cable termination point. Where voice backbone cables extend behind termination blocks, cable labels shall be placed at a location on the cable where the labels are visible from the front of the termination blocks.
- B. Labels shall have an adhesive backing and shall wrap completely around the circumference of the cable sheathing. Label and lettering sizes shall be of appropriate size for the varying cable sizes.

3.3 LABELING OF EQUIPMENT RACKS AND TERMINATION HARDWARE

- A. All communications equipment racks, cabinets, and termination hardware shall be clearly labeled at the top, left-hand corner of the equipment.
- B. Equipment Racks and Cabinets shall have 3/4" to 1" high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character in sequence for each rack/cabinet (i.e., TR2-A represents the first rack/cabinet in Telecommunications Room #2)
- C. Modular Patch Panels shall have 3/8" to 1/2" high lettering and shall be labeled with the telecommunications room number followed by an alphanumeric character of the rack/cabinet and the patch panel number (i.e., TR3-C-2 represents the second patch panel, third rack/cabinet in Telecommunications Room #3). Additionally, each jack position on the patch panel shall be identified with the jack position number (i.e., a 48-port patch panel shall have number 1 through 48 silk screen printed on the patch panel or shall have labeling strips with numbers 1 through 48 machine printed above/below corresponding jack position).

3.4 LABELING OF FACEPLATES

- A. Voice and Data Outlets shall have 3/16" high lettering with the labeling method as indicated in Specifications Section 27 1543 and on detail drawings. Voice and data outlets shall be identified with the telecommunication room where cables are terminated, the rack/cabinet number, the patch panel number, and the jack position number (i.e., TR3-C-2-28 represents the outlet is located on the second patch panel in the third rack/cabinet in Telecommunications Room #3 and is jack position #28). The contractor shall terminate all cabling in a sequential method.

END OF SECTION 270553

SECTION 270600 - SCHEDULES FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section provides an overview of the communication work schedules for the Division 27 sections on the new Wind River Cares Addition located in Riverton, Wyoming.

1.2 GENERAL WORK SCHEDULE REQUIREMENTS

- A. All communications work shall be coordination with the general construction and general contractor/project manager. Refer to Division 01 – General Requirements, Bidding Requirements, and Condition of the Contract for specific information regarding the project schedule, including any penalties imposed for not meeting completion dates; information contained on the general and Division 01 Sections shall superseded schedule information in this section.
- B. The Communications Contractor(s) shall attend construction meetings on a regular basis, as required, by the construction project manager to obtain on-going construction schedule progress updates and to provide communication systems scheduling updates and work coordination with other trades.
- C. Construction schedule are subject to change due to unforeseen circumstances. The Communications Contractor(s) shall be required to adjust work schedule accordingly.
- D. No communication systems work shall commence on-site and no equipment shall be ordered prior the successfully completion and execution of the following items:
 - 1. Owner/Contractor Agreement (Contract)
 - 2. Insurance Certificates
 - 3. Permits and licenses (as required)
 - 4. Shop Drawings (with “No Exceptions Take” notification from Engineer)
 - 5. Other documentation requirement of General Condition

1.3 COMMUNICATION SYSTEM SCHEDULES

- A. Structured Cabling work shall be substantial complete in accordance with the general construction schedule.

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION - Not Used.

END OF SECTION 270600

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SECTION 270800 - TESTING OF COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers commissioning, contractor testing, and test result documentation for all Division 27 communications systems.
- B. The communications systems in Division 27 will not require commissioning by an independent commissioning specialist. All communications systems shall be tested and documented by the contractor installing each system as specified herein.
- C. The Engineer and/or Owner may test up to 5% of the cable runs for any communication cabling system prior to substantial completion of the project.

1.2 OVERVIEW OF COMMUNICATION SYSTEMS TESTING REQUIREMENTS

- A. Structured Cabling System testing shall be completed for all segments of the structured cabling systems including Category 6 horizontal cabling, copper backbone cabling, optical fiber cabling, and coaxial cabling. All cables shall be tested and documented as specified herein.
- B. Cabling from the patch panels to the end user data jacks shall be CAT 6. All cabling and connections provided between switches and major infrastructure shall be suitable and certified to 10 GB.

PART 2 - PRODUCTS - Not Used.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall notify the Engineer a minimum of one week prior to any testing and shall provide a testing schedule prior to the testing of cabling and equipment. Owner's representatives and the Engineer may be in attendance to witness the test procedures. The Contractor shall re-schedule testing as necessary to accommodate the schedules of the Owner/Engineer for any testing the Owner/Engineer may want to witness.
- B. All cable runs shall be tested. Any segment with failing or receiving marginal test results shall be evaluated and receive corrective action. Cable runs continuing to fail test results should be evaluated with the Engineer and shall be replaced when necessary to obtain passing test results.
- C. All cable runs must receive passing test results prior to final acceptance of the project.
- D. All test results shall be documented and included with contractor's final as-built documentation and will be review by the Engineer prior to final acceptance and closeout of the project.

- E. The test equipment manufacturer shall calibrate all test equipment at regular intervals as recommended by the manufacturer. Calibration reports shall be provided to the Engineer upon request.
- F. Technicians who have completed an appropriate training course for the use of specified test equipment shall conduct all testing.

3.2 CATEGORY 6 HORIZONTAL CABLE TESTING

- A. All Category 6 horizontal cable runs shall be tested with a Level III tester capable of testing 4-pair UTP cable frequencies from 1.0-250 MHz. The Contractor shall use one of the following testers: Agilent Wirescope 350, Fluke DSP-4000, or Ideal LanTek 7
- B. All Category 6A horizontal cable runs shall be tested with a Level III tester capable of testing 4-pair UTP cable frequencies from 1.0-500 MHz. The Contractor shall use one of the following testers: Agilent Wirescope 350, Fluke DSP-4000, or Ideal LanTek 7
- C. Category 6 and 6A cabling shall include the following tests:
 - 1. Wire Map
 - 2. Length
 - 3. Attenuation (insertion loss)
 - 4. NEXT (near end cross talk—to be performed on all Category 6 cables BI-directionally)
 - 5. Power Sum PSNEXT
 - 6. Pair to pair ACR-F (equal level far end cross-talk)
 - 7. Power Sum PSACR-F
 - 8. Return Loss
 - 9. Propagation Delay
 - 10. Delay Skew
- D. Permanent Link testing shall be performed and shall conform to the following test result parameters defined by ANSI/EIA/TIA 568-C.2 for Category 6 and 6A. Minimum test results are listed in the tables below.

Category 6

Frequency MHz	Insertion Loss	NEXT	PSNEXT	ACR-F	PSACR-F	Return Loss
1.0	2.1	65.0	62.0	63.3	60.3	19.0
4.0	4.0	63.0	60.5	52.1	48.2	19.0
8.0	5.7	58.2	55.6	45.2	42.2	19.0
10.0	6.3	56.6	54.0	43.3	40.3	19.0
16.0	8.0	53.2	50.6	39.2	36.2	18.0
20.0	9.0	51.6	49.0	37.2	34.2	17.5
31.25	11.4	48.4	47.3	33.4	30.4	16.5
62.50	16.5	43.4	40.6	27.3	24.3	14.0
100.0	21.3	39.9	37.1	23.3	20.3	12.0
200.0	31.5	34.8	31.9	17.2	14.2	9.0
250.0	35.9	33.1	30.2	15.3	12.3	8.0
300.0	---	---	---	---	---	---
400.0	---	---	---	---	---	---
500.0	---	---	---	---	---	---

All values are measured in (dB.) per 100m (328 feet) length @20C.
 Delay skew shall not exceed 45.0 ns/100m.
 Propagation delay at 10 MHz shall not exceed 545.0 ns/100m.
 Propagation delay at 250 MHz shall not exceed 536.0 ns/100m.

Category 6A

Frequency MHz	Insertion Loss	NEXT	PSNEXT	ACR-F	PSACR-F	Return Loss
1.0	2.3	65.0	62.0	63.3	60.3	19.0
4.0	4.2	63.0	60.5	52.1	48.2	19.0
8.0	5.8	58.2	55.6	45.2	42.2	19.0
10.0	6.5	56.6	54.0	43.3	40.3	19.0
16.0	8.2	53.2	50.6	39.2	36.2	18.0
20.0	9.2	51.6	49.0	37.2	34.2	17.5
31.25	11.5	48.4	47.3	33.4	30.4	16.5
62.50	16.4	43.4	40.6	27.3	24.3	14.0
100.0	20.9	39.9	37.1	23.3	20.3	12.0
200.0	30.1	34.8	31.9	17.2	14.2	9.0
250.0	33.9	33.1	30.2	15.3	12.3	8.0
300.0	37.4	31.7	28.8	13.7	10.7	7.2
400.0	43.7	28.7	25.8	11.2	8.2	6.0
500.0	49.3	26.1	23.2	9.3	6.3	6.0

All values are measured in (dB.) per 100m (328 feet) length @20C.
 Delay skew shall not exceed 45.0 ns/100m.
 Propagation delay at 10 MHz shall not exceed 545.0 ns/100m.
 Propagation delay at 250 MHz shall not exceed 536.0 ns/100m.

- E. In addition to 100% of the cables passing all Permanent Link test parameters, the contractor is required to provide a manufacturer's warranty covering the Channel Link (including patch cords/station cords). Refer to Section 27 01 00 for more information on manufacturer's warranty requirements.
- F. Test results (in summary format) shall be printed and bound in a 3-ring binder. Provide two copies of the printed test results with the as-built documentation submittal. In addition to the printed test results, the Contract shall provide the detailed electronic test results (on compact disk) and a copy of the test manufacturer's software to view the test results with the as-built documentation submittal. The test equipment manufacturer's software can be provided on CD or can be instructions on how to download the software (free of charge).

END OF SECTION 270800

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SECTION 271000 - STRUCTURED CABLING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers general installation practices for all Division 27 10 00 series communications cabling and equipment products.
- B. All work specified under Division 27 10 00 series sections shall follow installation practices described herein and all guidelines as established by the following codes and standards:
 - 1. ANSI/EIA/TIA-568-B.1 (Commercial Building Telecommunications Cabling Standard – General Requirements)
 - 2. ANSI/EIA/TIA-568-B.2 (Commercial Building Telecommunications Cabling Standard – Balanced Twisted-Pair)
 - 3. ANSI/NECA/BICSI-568 (Standard for Installing Commercial Building Telecommunications Cabling)
 - 4. NFPA 70 (National Electrical Code)
 - 5. OSHA Regulations

All addenda to the codes, standards, and regulations lists above shall be applicable.

1.2 OVERVIEW OF STRUCTURED CABLING WORK

- A. The structured cabling work includes all cabling and components required for the voice, data, systems at the facility.

PART 2 - PRODUCTS – Not Used (refer to other Section 27 10 00 series sections for product information).

PART 3 - EXECUTION

3.1 GENERAL

- A. All cable, equipment, and components shall be installed in accordance with manufacturer's written instructions, in compliance with NEC, and in accordance with industry standard practices.
- B. All equipment shall be installed in a neat, professional manner, always vertically plumb and securely fastened.
- C. Equipment and cable colors shall be consistent throughout the entire project unless specifically noted otherwise. In example, if horizontal data UTP cable is specified as blue, then blue cable shall be used throughout the entire project; or, if equipment racks are specified as black, then black racks, black rack mounting screws, and black cable mangers shall be used throughout the entire project.

- D. All equipment racks/cabinets, cable tray, cable runways, and metallic sheathing on cables shall be bonded and grounded to the communications grounding system; refer to Section 27 05 26 (Grounding and Bonding for Communications Systems) for more information.
- E. All equipment, cabling, and terminations shall be labeled; refer to Section 27 05 53 (Identification of Communications Systems) for more information.
- F. Cables installed in return air plenum ceiling spaces shall be plenum rated; cables installed in below grade pathways shall have water blocking capabilities and rated for use in below grade applications.
- G. The communications cabling contractor shall provide approved fire-stopping materials in and around any opening created for communications cabling where code or good installation practices suggests or requires fire-stopping materials.

3.2 CABLING INSTALLATION PRACTICES

- A. All cabling shall be installed in accordance with manufacturers' written bend radius and pulling tensions. General industry guidelines recommend the following bend radius and pulling tensions:
 - 1. Tensile loading on a single 4-pair copper UTP cable shall not exceed 25 lbf.
 - 2. Bend radius of a single 4-pair copper UTP cable shall not exceed 4 times the diameter of the cable.
 - 3. Bend radius of multi-pair copper UTP and optical fiber cable shall not exceed 10 times the diameter of the cable.
- B. All conduits and conduit sleeves shall have bushings or grommets shall be installed prior to the installation of communications cables to avoid damage and abrasions to cable sheathing and insulation. If bushings have are installed by the electrical contractor, the communications cabling contract shall furnish and install bushings prior to pulling communications cabling.
- C. Horizontal cable length for 4-pair copper UTP cables shall not exceed 295 feet. Prior to bidding and installation, the contractor shall review the drawings and verify no cable run exceeds 295 feet and notify the communications designer of cable runs that may exceed 295 feet.
- D. Splices are not permitted in any voice or data cable unless other specified or show on drawings.
- E. Avoid placing copper cables near sources of extreme heat (i.e., boilers, radiators, heat coils).
- F. Maintaining cable twists for all UTP cables. For terminations cable sheathing shall be stripping back no more than ½" back from termination point for all Category 6 cables.
- G. All cables shall be installed in runway unless a cable tray is provided. When large quantities of cables leave trays or runways, cables shall be supported by drop-outs or cable support hardware manufactured specifically for the purpose of supporting cables. J-hooks shall be installed a minimum of every 5 feet and cabling shall maintain minimal deflection and strain (less than 12" deflection). Cables shall not be supported from ceiling grid wires. Cables shall not run above iron joists.
- H. All cables shall be separated and bundled into like groups by cable sheathing colors.
- I. Service loops shall be provided at both ends of installed horizontal and backbone cabling. A 10'-0" service loop shall be installed in the ceiling space near workstation outlets (excessive

cable shall not be coiled in outlet boxes). A 10' service loop shall be provided in communication rooms and shall be installed to allow for future equipment rack/cabinet relocations without the need to re-terminate patch panels; the 10' service loop shall be neatly bundled and secured in ceiling space with large D-rings or place in cable trays.

- J. Any cabling installing in equipment rooms shall be neatly placed in cabling trays, cabling runways, or horizontal and vertical rack/cabinet cable managers. When tray, runways, or cable managers are not specified, cable shall be neatly installed with D-rings. Cables shall always be installed vertically/horizontally or at right angles to structure.
- K. Nylon plastic cable ties may be used to secure permanently installed horizontal and backbone cabling; any cable ties installed in plenum ceiling spaces shall be rated for use in plenum spaces. Cable ties shall never be secured too tight whereby potentially changing the cable geometry.

END OF SECTION 271000

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SECTION 271119 - TERMINATION BLOCKS & PATCH PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers termination blocks and patch panels utilized for all Division 27 sections.
- B. Quantities for all communications termination equipment shall be provided as required to terminate all outlet locations and cabling as shown on floor plans and riser diagrams.

1.2 RELATED SECTIONS

- A. Sections 27 00 10 and 27 05 00 contain general installation practices relevant to the communications cabling systems.
- B. Section 27 01 00 contains important information regarding manufacturer's warranties for the voice and data cabling systems.
- C. Section 27 05 53 contains information regarding the labeling of termination blocks and patch panels.

PART 2 - PRODUCTS

2.1 VOICE CABLING TERMINATION BLOCKS

- A. Rack-Mounted 110 Blocks shall be utilized for voice backbone cabling and shall comply with the following requirements:
 - 1. TIA/EIA Category 5E compliant
 - 2. Molded plastic block with horizontal index strips for terminating 25-pair cables
 - 3. Clear plastic holder for holding custom printed labels
 - 4. Equipped with 4-pair clips for cable cross-connect connections
 - 5. Equipped with plastic legs for mounting block to plywood backboard
 - 6. Approved manufacturers: Systimax, Ortronics, Leviton, Panduit

2.2 VOICE AND DATA PATCH PANELS

- A. Category 6 Patch Panels shall be utilized for voice/data cabling and shall comply with the following requirements:
 - 1. TIA/EIA Category 6 compliant
 - 2. Non-Angled design
 - 3. 8-position/8-conductor modular connector
 - 4. Support T568A/B universal wiring schemes
 - 5. 19" rack mountable, black in color
 - 6. Accept 110-type termination tool

7. 24 connectors in 1 rack unit or 48 connectors in 2 rack units
8. Include front labeling, clear plastic holders for laser printed labels
9. Approved manufacturers: Commscope, Leviton, Panduit, Ortronics, Seimon, or Systimax

B. Fiber Optic Cable Patch Panels shall comply with the following requirements:

1. TIA/EIA Fiber cable compliant
2. Match the type of fiber cable being used and number of strands.
3. 19" rack mountable, black in color
4. Front and rear removable doors, removable top, large front mounted fiber guides and integrated hinged optical jumper manager.
5. Provide full complement of blank adapter panels, labels, cable storage accessories and cable routing accessory kit.
6. Provide connector panels and connectors as indicted for the fiber.
7. 24 connectors in 1 rack unit or 48 connectors in 2 rack units
8. Multi-mode connector panels shall be color coded according to the fiber type for which they are applied. Laser optimized 50/125 micron multimode shall be aqua.
9. Include front labeling, clear plastic holders for laser printed labels
10. Approved manufacturers: Commscope, Leviton, Panduit, Ortronics, Seimon, or Systimax

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices.

3.2 TERMINATION BLOCK AND PATCH PANEL INSTALLATION PRACTICES

- A. Securely attach all termination blocks and patch panels to rack/cabinet mounting rails (or plywood backboards for wall mounted termination blocks) with appropriate mounting hardware at all four corners for all blocks and panels.
- B. Cabling shall be terminated to patch panel with a 110 tool following the T568B wiring scheme.
- C. Wall-mounted termination blocks shall be fastened to plywood backboards. When plywood backboards are not provided by other trades, backboard shall be furnished and installed by this contractor as shown and noted on the drawings; provide 3/4" plywood backboard with two coats of fire retardant gray paint on all sides of the plywood.
- D. All cabling terminated to blocks and patch panels can be neatly secured in place with tie-raps (or removable straps). Provide metal D-Rings or other approved support method for securing vertically routed cable; support at intervals less than four feet in length to limit strain and movement of cabling.

END OF SECTION 271119

SECTION 271123 - CABLE MANAGEMENT & LADDER RACK

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers communications cable management and ladder rack hardware and accessories for all Division 27 cabling.
- B. Other systems (communications, electronic safety, and security) may utilize portions of the cable management systems specified herein. Other system may also include additional cable management components included in other specification sections.
- C. Unless otherwise indicated in the specifications, quantities for horizontal cable managers, vertical cable managers, and ladder rack shall be as indicated on the detail drawings. All other cable management components (i.e., D-rings, straps, cable ties, cable drop-out, etc.) shall be provided as required to support and maintain the specified cabling systems.

1.2 RELATED SECTIONS

- A. Sections 27 00 10 and 27 05 00 contain general installation practices relevant to the communications cabling systems.
- B. Section 27 01 00 contains important information regarding manufacturer's warranties for the voice and data cabling systems.
- C. Sections 27 11 16 specify cabinets and racks used in conjunction with the cable management system.

PART 2 - PRODUCTS

2.1 CABLE MANAGEMENT

- A. Rack-mounted vertical cable managers shall be provided on all open-frame racks and shall comply with the following requirements:
 - 1. 84' in height
 - 2. Black in color
 - 3. 1RMU plastic cable guides on front side for fanning out patch cabling
 - 4. Extended cable manager fingers on front and rear sections
 - 5. Cover over front and rear cable managers shall swing open from the left or right side
 - 6. 6" wide (on end racks or non-ganged racks)
 - 7. 10" wide (between racks when ganged together)
 - 8. Compatible with 3" deep standard rack
 - 9. Approved manufacturers: Chatsworth, Panduit, Systimax, or prior approved equivalent
- B. Rack-mounted horizontal cable managers shall be provided on all open-frames racks and shall comply with the following requirements:

1. 2 RMU in height (unless otherwise indicated on detail drawings)
 2. Black in color
 3. Plastic cable guides (cable manager fingers) shall be extended depth to match vertical cable managers
 4. Past-through slot to allow cables to be routed to back side of rack
 5. Cover snaps on at four points allowing to remain on cable manager while hinged up or down
 6. Compatible with standard 19" mounting rails
 7. Horizontal cable managers shall be flush with vertical cable managers
 8. Approved manufactures and part numbers: Chatsworth, Panduit, Systimax, or prior approved equivalent
- C. Rack-mounted patch panel wire management bar shall be provided for each voice/data patch panels and shall comply with the following requirements:
1. 19" rack mountable
 2. Black in color
 3. Approved manufacturers and part numbers: Chatsworth (12176-701) or other approved strain relief method offered from patch panel manufacturer

2.2 LADDER RACK

- A. Ladder Rack shall be installed where shown on drawings and shall comply with the following requirements:
1. Constructed of 1½" tubular stringers with ½" x 1" welded rungs every 9" minimum
 2. 12" wide unless noted otherwise.
 3. Black in color
 4. UL Classified as equipment grounding conductor
 5. Equipped with metal cable dropouts from ladder rack manufacturer as required to meet EIA recommended bend radius requirements
 6. Equipped with 5" high (minimum) retaining posts every 18"
 7. Equipped with walls supports, protective end caps, bend radius sections, corner brackets, splice kits, rack/cabinet mounting plates, and other mounting hardware as required.
 8. Equipped with grounding straps and lugs as required
 9. Equipped with cable runway elevation kit as required to install 4 to 6 inches above equipment racks/cabinets.
 10. Approved manufacturers and part numbers: Chatsworth (11275-718), Cooper B-Line (SB-17-18-FB), Mono-Systems (MR-17T-18-PB)

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices.

3.2 CABINET MANAGEMENT INSTALLATION PRACTICES

- A. Always follow manufacturer's installation instructions.

- B. Securely attach all cable managers to cabinet or rack equipment. Ladder rack shall installed 4 to 6 inches above racks/cabinet and shall be fastened rack/cabinets with ladder rack manufacturers cable runway elevation kit.
- C. Damaged equipment including twisted or bend ladder rack, scratches through painted metal surfaces, and broken cable managers shall be replaced or repaired to the satisfaction of the Owner and Engineer.
- D. Securely attach all runways to equipment racks and cabinets with bolt assembly.
- E. Where ladder rack and large D-ring are installed at locations without plywood backboards, securely attached to stud walls or concrete walls.
- F. Rack mounted patch panels shall always include wire management bars to provide cable strain relief at cable terminations.
- G. Cable runway radius drops shall be installed on cable runways where large quantities of cables (12 or more 4-pair cables) exit the cable runway.

END OF SECTION 271123

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SECTION 271126 - RACK MOUNTED POWER PROTECTION & POWER STRIPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers communications rack and cabinet mounted power strips, power supplies, and power protection devices for all Division 27 sections.
- B. Unless otherwise indicated in the specifications, quantities for rack and cabinet mounted power devices shall be as indicated on the detail drawings.

1.2 RELATED SECTIONS

- A. Sections 27 00 10 and 27 05 00 contain general installation practices relevant to the communications cabling systems.
- B. Section 27 01 00 contains important information regarding manufacturer's warranties for the voice and data cabling systems.

PART 2 - PRODUCTS

2.1 POWER STRIPS

- A. Rack-Mounted Power Strips shall be provided on racks and shall comply with the following requirements:
 - 1. Rack mounted (vertically)
 - 2. Include mounting hardware with 6.5" standoff compatible with EIA standard rack
 - 3. 60" to 67" in length
 - 4. Single 20 amp circuits with 20 NEMA 5-15R receptacles
 - 5. Input power cord with NEMA L5-20P plug
 - 6. Black in color
 - 7. UL Listed
 - 8. No surge protection or circuit breaker
 - 9. Approved manufacturers and model: Hewlett Packard, Chatsworth or equal

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices.

3.2 POWER STRIP INSTALLATION

- A. Securely attach one power strip to each open-frame rack with appropriate mounting hardware.
- B. Power cords shall be neatly fastened to racks and cabinet with tie-raps or reusable straps. Excess power cord shall be neatly coiled and tie-rapped.
- C. Avoid placing power supply devices and power cords near communications cabling as much as possible. Ideally, power supply devices and power cords and be installed on one side of the rack/cabinet with communications cabling routed on the other side.

END OF SECTION 271126

SECTION 271513 - COPPER HORIZONTAL CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers copper horizontal cabling utilized by all Division 27 systems and possibly other intelligent building systems specified by other Divisions.
- B. Quantities for all copper horizontal cabling shall be provided as required to complete cabling to all outlets as shown on the floor plans.
- C. Horizontal copper cabling are those cable routed from the termination blocks and patch panels in the communication rooms to the outlet locations at the workstations.

1.2 RELATED SECTIONS

- A. Sections 27 00 10 and 27 05 00 contain general installation practices relevant to the communications cabling systems.
- B. Section 27 01 00 contains important information regarding manufacturer's warranties for the voice and data cabling systems.
- C. Section 27 05 53 contains information regarding the labeling of horizontal cabling.

PART 2 - PRODUCTS

2.1 HORIZONTAL VOICE & DATA CABLING

- A. Category 6 Cable shall met the following criteria:
 - 1. Exceed TIA/EIA transmission performance requirements of Category 6
 - 2. 4-pair, 23 AWG solid bare copper conductor, unshielded twisted pair
 - 3. Industry standard conductor insulation color coding (blue, orange, green, brown)
 - 4. Plenum rated, UL Listed type CMP marking on cable
 - 5. Product identifications and cable distance markings at regular intervals on cable
 - 6. White in color (cable jacket)
 - 7. ISO 9001 certified manufacturer
 - 8. Transmission performance verified by UL
 - 9. Normal product in inventory of local distributor
 - 10. Approved manufactures: General, Superior Essex, Systemax
- B. Category 6 Cable shall met the following criteria:
 - 1. Exceed TIA/EIA transmission performance requirements of Category 6A
 - 2. 4-pair, 23 AWG solid bare copper conductor, unshielded twisted pair
 - 3. Industry standard conductor insulation color coding (blue, orange, green, brown)
 - 4. Plenum rated, UL Listed type CMP marking on cable

5. Product identifications and cable distance markings at regular intervals on cable
6. White in color (cable jacket)
7. ISO 9001 certified manufacturer
8. Transmission performance verified by UL
9. Normal product in inventory of local distributor
10. Approved manufactures: General, Superior Essex, Systemax

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices.
- B. All horizontal cabling shall be labeled in accordance with labeling standards; refer to Section 27 05 53.

3.2 HORIZONTAL CABLING INSTALLATION PRACTICES

- A. The same manufacturer's product shall be utilized throughout the entire project for all voice and data horizontal cabling.
- B. All horizontal cables shall be terminated at both ends on faceplate jacks and patch panels. Any cables pulled for spare cables shall be neatly coiling in ceiling support system, clearly labeled are both ends, and identified on as-built drawings.

END OF SECTION 271513

SECTION 271543 - FACEPLATES & CONNECTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers faceplates and connectors utilized for all Division 27 sections.
- B. Quantities for all communications faceplates and connectors shall be provided as required to terminate all outlet locations and cabling as shown on the floor plans.

1.2 RELATED SECTIONS

- A. Sections 27 00 10 and 27 05 00 contain general installation practices relevant to the communications cabling systems.
- B. Section 27 01 00 contains important information regarding manufacturer's warranties for the voice and data cabling systems.
- C. Section 27 05 53 contains information regarding the labeling of faceplates.

PART 2 - PRODUCTS

2.1 FACEPLATES

- A. Stainless-steel faceplates shall be utilized for communications cabling. Faceplates shall comply with the following requirements:
 - 1. Stainless-steel construction
 - 2. Labeling field with clear plastic cover for pre-printed labels or provide clear permanent polyester adhesive labels with black ink
 - 3. Snap-in flush fit for connector modules
Accept up to 4 connectors in single-gang or up to 8 connectors in double-gang configurations.
 - 4. UL Listed
 - 5. Approved manufactures: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax and 4MP.
- B. Stainless-Steel Wall Phone Plate shall be utilized for all wall telephone outlet locations.
 - 1. Stainless-steel construction
 - 2. Accept Category 6 jack
 - 3. Single-gang
 - 4. Studs mounted in standard positions to accommodate any standard wall telephone
 - 5. UL Listed
 - 6. Approved manufactures: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax

2.2 CONNECTORS

- A. Category 6 Voice/Data Jack shall be utilized for voice/data cabling and shall comply with the following requirements:
 - 1. TIA/EIA Category 6 compliant
 - 2. 8-position/8-conductor modular connector
 - 3. Blue color for voice/data jacks.
 - 4. Flush design for snap-in flush fitting on faceplate
 - 5. Approved manufacturers: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax
- B. Category 6A Wireless Access Point Jack shall be utilized for voice/data cabling and shall comply with the following requirements:
 - 1. TIA/EIA Category 6A compliant
 - 2. 8-position/8-conductor modular connector
 - 3. Green color for wireless access point jacks.
 - 4. Flush design for snap-in flush fitting on faceplate
 - 5. Approved manufacturers: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax
- C. Blank Inserts shall be provided for all blank faceplate opening and shall comply with the following requirements:
 - 1. Gray in color
 - 2. Flush design for snap-in flush fitting on faceplate
 - 3. Approved manufacturers: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Sections 27 00 00 and 27 10 00 for all typical installation practices.
- B. All faceplates shall be labeled in accordance with labeling standards; refer to Section 27 05 53.
- C. Verify modular furniture outlet locations and modular furniture manufacturer products with Architect prior to ordering communications devices for modular furniture locations.

3.2 FACE PLATE LOCATIONS

- A. See Appendix A in 26 27 26 for faceplate types and application.

3.3 FACEPLATE AND CONNECTOR INSTALLATION PRACTICES

- A. All faceplates shall be installed vertically plumb. When faceplates allow for adjustments, the contractor shall always adjust plate vertically plumb. Where faceplates offer no adjustment (i.e., stainless steel), the contractor shall communicate to other trades the importance of installing back boxes vertically plumb and shall notify other trades of corrective actions necessary to repair severely out-of-plumb locations.

- B. Faceplates shall fit flush with no gaps to the installed surface.
- C. Faceplates shall be securely fastened. Screws shall be tight; however, not tightened to the point of deforming, bending, or cracking the faceplate.
- D. Any deformed, broken, bent, or crack faceplates for connector hardware shall be replaced.
- E. Faceplates installed in not secure areas may be installed with standard screw hardware. Faceplates installed in secure perimeter areas shall be installed with tamper-proof screws.
- F. All snap-in faceplate jacks, adapters, and blank inserts shall be flush with the faceplate so the devices are not pushed through faceplates with connection of cables. Defective or broken components shall be replaces.
- G. Excess cable shall not be coiled behind faceplates. Excess cable loop shall be pulled back into ceiling spaces.
- H. Any blank faceplate connector opening shall be filled with blank inserts.
- I. Category 6 jack shall be terminated with T568B the wiring scheme.

END OF SECTION 271543

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SECTION 271619 - PATCH CORDS & CROSS CONNECT WIRE

PART 1 - GENERAL

1.1 SUMMARY

- A. This section covers copper horizontal cabling utilized by all Division 27 voice and data systems. Any patch cords, station cords, or cross connect wire required for audio, video, television, paging, intercom, or other systems utilizing the communications cabling infrastructure will be specified in other sections.
- B. All patch cords and station cables shall be furnished to the Owner for installation by the Owner.
- C. Quantities, colors, and lengths for all patch cords and station cables shall be indicated on the schedule at the end of this specification section.

1.2 RELATED SECTIONS

- A. Sections 27 00 10 and 27 05 00 contain general installation practices relevant to the communications cabling systems.
- B. Section 27 01 00 contains important information regarding manufacturer's warranties for the voice and data cabling systems. Patch cables and stations cables shall conform to manufacturer warranty requirements.

PART 2 - PRODUCTS

2.1 COPPER PATCH CORDS AND STATION CORDS

- A. Category 6 Patch Cords and Station Cords shall comply with the following requirements:
 - 1. Exceed TIA/EIA transmission performance requirements Category 6
 - 2. Impedance matched with manufacture of structured cabling system
 - 3. RJ45 plugs at both ends of cable terminated with T568B pin-out scheme
 - 4. Build-in strain relievers at plug terminations
 - 5. 4-pair round cords with stranded copper conductors
 - 6. Approved manufacturers: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax
- B. Category 6A Patch Cords and Station Cords shall comply with the following requirements:
 - 1. Exceed TIA/EIA transmission performance requirements Category 6A
 - 2. Impedance matched with manufacture of structured cabling system
 - 3. RJ45 plugs at both ends of cable terminated with T568B pin-out scheme
 - 4. Build-in strain relievers at plug terminations
 - 5. 4-pair round cords with stranded copper conductors
 - 6. Approved manufacturers: Commscope, Leviton, Ortronics, Panduit, Siemon, Systimax

2.2 OPTICAL FIBER PATCH CORDS AND STATION CORDS

- A. 50/125µm Multi-Mode Patch Cords shall have same transmission performance characteristics as optical fiber backbone cable and comply with the following requirements:
 - 1. Duplex cable construction with duplex SC connectors as indicated by Patch/Station Cord Schedule
 - 2. Build-in strain relievers at connector terminations
 - 3. Aqua-blue in color (outer cable jacket)
 - 4. Factory assembled and 100% optically tested
 - 5. Approved manufacturers: ADC, Corning, Systimax

PART 3 - EXECUTION

3.1 GENERAL

- A. All patch cords and station cords shall be furnished to Owner neatly boxed in original packaging from the manufacturer.
- B. The Contractor is responsible secure storage for all patch/station cords and shall carefully inventory and document the quantities and time of delivery to the Owner.
- C. Prior to ordering Category 6 and fiber patch cords, review the order with the Owner/Engineer to verify fiber connector type, cable colors, quantities, lengths, and delivery instructions.

SCHEDULE FOR COPPER PATCH/STATION CORDS

Cable Type	Quantity	Length	Color
Category 6	25%	5 feet	gray
Category 6	25%	7 feet	gray
Category 6	25%	14 feet	gray
Category 6	25%	20 feet	gray
Category 6A	25%	5 feet	green
Category 6A	25%	7 feet	green
Category 6A	25%	14 feet	green
Category 6A	25%	20 feet	green

SCHEDULE FOR OPTICAL FIBER PATCH/STATION CORDS

Connector Type	Quantity	Length	Fiber Type
SC to TBD	6	1 meter	62.5 µm (orange)
SC to TBD	6	3 meter	62.5 µm (orange)
SC to TBD	6	5 meter	50 µm (aqua)

END OF SECTION 271619