SECTION 220000 - GENERAL MECHANICAL REQUIREMENTS

PART 1 -GENERAL

1.01 SUMMARY

A. Related Documents:

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

2. The requirements listed in this document are applicable to Divisions 21, 22, and 23 specifications.

1.02 WARRANTIES

A. Warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted beginning at the time of substantial completion or for longer periods of time as specified in those divisions of the Project Manual. Repair or replace, at no additional cost to the Owner, any item which may become defective within the warrant period. Any manufacturers' warranties concerning any item installed will run to the benefit of the Owner. The Contractor agrees not to void or impair, or to allow Sub-Contractors to void or impair, any warranties regarding products or items installed as part of this project. The repair of faulty workmanship shall be considered to be included in the contract.

B. Provide as base bid extended warranty as needed to accommodate any temporary use of any and all equipment prior to substantial competition. During this period, units shall be run at 100 percent outside air. Coordinate operation of unit with Engineer and appropriate subcontractors to verify capacity and run conditions.

1.03 QUALITY ASSURANCE

A. Source Limitations: To fullest extent possible, provide products of same kind, from a single source.

1. When specified product are available only from sources that do not, or cannot, produce a quality adequate to complete Project requirements in a timely manner, consult with Architect and Owner to determine most important product qualities before proceeding. Qualities may include attributes, such as visual appearance, strength, durability, or compatibility. When a determination has been made, select products from sources producing products that possess these qualities, to fullest extent possible.

B. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.

a. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect shall determine which products shall be used.

C. Comply with all State, and local codes and ordinances.

D. Make application, obtain, and pay for all required permits and certificates of inspection of the work.

E. Required access for servicing and maintenance shall be provided for all equipment (valves, specialties, filters, etc.) Provide architectural access panels as required.

F. Manufacturer's Qualifications: Firms regularly engaged in manufacture of equipment of types, materials, and sizes required for the project, whose products have been in satisfactory use in similar service for not less than five (5) years.

G. Installers Qualifications: Firm with at least three (3) years of successful installation experience on projects with equipment installation work similar to that required for project.

1.04 INTERPRETATION OF DOCUMENTS

A. All questions from contractors or subcontractors as it pertains to contract documents during the bidding phase or construction shall be submitted to the Engineer for clarification. Clarification will be issued through official written correspondence. Verbal interpretation or explanation not issued in the form of an addendum or supplemental instruction shall not be considered part of the bidding documents or contract. The Engineer shall be the sole judge regarding interpretations of conflicts within contract documents.

B. If any ambiguities should appear in the contract documents, request clarification from the Engineer before proceeding with the work. Failure to obtain clarification may result in work not being accepted by the Engineer. Should a conflict occur within the contract documents, the Contractor is deemed to have estimated the more expensive way of doing the work.

1.05 PERMITS, FEES, AND NOTICES

A. Secure and pay for permits and governmental fees, licenses, and inspections necessary for proper execution and completion of the Work, and for Owner to occupy and operate systems.

B. Comply with and file notices required by laws, ordinances, rules, regulations, and lawful orders of public authorities applicable.

1.06 CODES

A. The work shall be performed by persons skilled in the trade involved and shall be done in a manner consistent with normal industry standards. All work shall conform to all applicable sections of currently adopted editions of all applicable codes. The contractor is responsible for verifying the local codes in the jurisdiction with which the work is performed and installing the work as listed by said codes.

1.07 PROJECT COORDINATION AND LAYOUT

A. The contractor is responsible for laying out and coordinating all work prior to installation. Produce coordination documents incorporating all mechanical, fire protection, electrical and other trades in conjunction with the building structure and architectural features. Coordinate all routing of systems prior to installation. Payment for changes due to pre-fabricating or moving of piping, ductwork, conduit, cable trays, equipment, or any other mechanical, electrical, plumbing, or technology system due to lack of coordination will not be approved.

B. Documents produced by Specialized Engineering Solutions are diagrammatical in nature. Not all system offsets are shown to accommodate final elevations and avoid interference with all other building structural, architectural, mechanical, electrical, fire protection, and technology systems. Include in base scope of work, offsets necessary to negotiate the building appropriately.

C. Specifications list specialties, valve, damper, and systems installation requirements in addition to what is shown on drawings. Not all valves, dampers, and accessories are shown on drawings.

1.08 EQUIPMENT ELECTRICAL CONNECTIONS

A. Electrical connections identified are for the specific equipment manufacturer and model scheduled, and includes equipment furnished by this trade or furnished by other trades under these contract documents. If the Contractor chooses to provide equipment found acceptable from a different manufacturer and model than that scheduled but listed as equivalent in the specifications, or otherwise accepted by the Architect/Engineer, include electrical connection revisions associated with that manufacturer's electrical connection requirements in bid. Upon approval of a manufacturer and model other than that specifically scheduled, request clarification of the required electrical connection revision from the Engineer for incorporation into the electrical design and construction documents. If the necessary revision is found to require extensive design modification by the Engineer, provide the Engineer reasonable compensation for incorporation of the selected manufacturer's equipment into the project design.

B. Coordinate short circuit current ratings of equipment electrical components to meet or exceed fault levels calculated at the equipment location by the Fault and Coordination study performed under the electrical sub-contract. Where this study is not required by the contract, short circuit current ratings of equipment shall meet or exceed the short circuit current rating of the branch source electrical panel serving the equipment.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Manuals to be bound in 3 ring binders and include:

1. Title page with project name and location and date of submittal.

2. Title, Name, address, and telephone number all contractors and suppliers.

3. Table of contents with corresponding tabs to mark sections.

B. Manual to contain the following:

1. Equipment record document submittal.

2. Warranty details, expiration dates, and contacts.

3. Licensing requirements including inspection and renewal dates.

4. Equipment location.

5. Operating manuals including wiring and control diagrams.

6. Operating procedures.

7. Precautions against improper use.

8. Startup shutdown and switchover procedures.

9. Emergency procedures.

10. Schedule for routine cleaning and maintenance.

C. Provide the Operation and Maintenance manuals as hardcopy, electronically and on a thumb drive. Provide a thumb drive of the scanned as-built redlines, in addition to the hardcopy.

1.10 OPERATOR TRAINING

A. Schedule and conduct complete owner training for every system and associated piece of equipment. Operating and maintenance manuals shall be complete and accepted by owner and engineer prior to training. Coordinate a training session which will include the Owner/Owner's Representatives and all Sub-Contractors or equipment representatives needed to explain and train on the system. A training agenda shall be submitted prior to training. The agenda shall be reviewed and amended as necessary by the Engineer and Owner. Cover all information submitted in the operation and maintenance.

1.11 ALLOWANCES

A. Include in bid, appropriate allowances for material and labor for pulley changes on equipment, impeller changes on pumps, and air baffles necessary in air handling equipment.

1.12 PROJECT CONDITIONS

A. Participate in the development of infection control risk assessments and perform work in strict compliance with the work plan developed in conjunction with the Owner and all other Contractors. Take great care in performance of work to limit dust and debris. Aid in the erection of dust-free partitions and work within confines. Environments to include but shall not be limited to negative pressure partitions, HEPA filtered air, pressure and particle monitored environments.

1.13 COORDINATION OF WORK

Item	Supplier	Installer	Power	Control (4)
Motors	MC	MC (3)	EC	CC
Motor Control Center	EC	EC	EC	CC
Equipment Mounted Electrical Components	MC	MC	EC	CC
Loose Mounted Electrical Components	EC	EC	EC	CC
Control Relays, Transformers, Power	MC	EC	EC (4)	CC
120V Thermostats	MC	MC	MC	CC (1)
Temperature Control Sensors	MC	MC	CC	CC
Temperature Control Panels	MC	CC	EC (4)	CC
Variable Speed Drives	MC	MC	EC	CC
Terminal Box Controls	MC	MC	EC (4)	CC
PE/EP Switches, Solenoid Valves, Actuators	CC	CC	EC (4)	CC

Pushbutton Stations	EC	EC	EC (4)	EC
Electric Heaters	MC	MC	EC	EC
Time Clocks	EC	EC	EC	EC
Fan Coil Units	MC	MC	EC	CC (1)
DX Condensing Units and Condensers	MC	MC	EC	CC (1)
Smoke Dampers	MC	MC	EC	EC
Medical Gas Alarm Wiring	MC	MC	EC	MC (2)

(1) If no CC in Contract, MC to wire controls and EC to pipe conduit.
(2) All low voltage wiring of panels to be covered in MC bid, Wiring Contractor to be Subcontractor to MC.
(3) Installing Contractor is responsible for field alignment services when required by Common Motor Requirements specification or by individual equipment specifications.
(4) All hardware, software, equipment, accessories, wiring (power and sensor), piping, relays, sensors, power supplies, transformers, and instrumentation required for a complete and operational DDC system, but not shown on the electrical drawings, are the responsibility of the CC.

END OF SECTION 220000

SECTION 220500 - COMMON WORK RESULTS FOR MECHANICAL

PART 1 -GENERAL

1.01 SUMMARY

A. Section Includes:

1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Concrete bases and housekeeping pads.
8. Equipment installation requirements common to equipment sections.
9. Supports and anchorages.

B. Related Sections include the following:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
2. The requirements listed in this document are applicable to Divisions 21, 22, and 23 specifications

1.02 SUBMITTALS

A. Not required.

1.03 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.

3. Electrical Characteristics for Mechanical 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 without additional cost. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.04 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.

PART 2 -PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual 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.

2.02 JOINING MATERIALS

A. Refer to individual Piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is 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 or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

F. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.03 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: Not permitted.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.04 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

C. Pressure Plates: Reinforced nylon polymer. Include two for each sealing element.

D. Connecting Bolts and Nuts: Type 316 Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.05 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe:

1. Pipe sizes through 10 inch: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

2. Pipe sized 12 inch and greater: ASTM A 53, Type E, Grade B, wall thickness no less than 0.375 inches, galvanized, plan 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. Sleeve length: as required to extend through structure.

E. PVC Pipe: ASTM D 1785, Schedule 40.

2.06 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, 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.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.07 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.08 CONCRETE BASES AND HOUSEKEEPING PADS

A. Form Materials:

1. Comply with Building Code and ACI 347. Design, erect, support and maintain forms to safely carry all superimposed loads until such time as such loads can be safely supported by the concrete work. Construct formwork to shape, sizes and dimensions as required to ensure accurate alignment and elevation, and level and plumb finished concrete work.

2. Nails, spikes, lag bolts, through bolts, anchorages: Sized as required of strength and character to maintain formwork in place while placing concrete.

B. Concrete:

1. Cement:

a. ASTM C150, Type I/II or ASTM C595 Type IS.

b. 3000-psi, 28-day compressive-strength concrete

2. Aggregate:

a. Coarse aggregate for stone concrete: ASTM C33, with maximum size 3/4 in.

b. Fine aggregate: Clean, durable sand, uncoated, grains free from silt, loam, and clay. Graded from fine to coarse with 95-100 percent by weight passing a No. 4 sieve and 3-8 percent passing a No. 100 sieve. ASTM C33 with following maximum permissible limits for deleterious substances, measured in percentage by weight: clay lumps 1.00; coal and lignite 0.25; materials finer than No. 200 sieve 3.00.

3. Controlled concrete proportioned as outlined in Section 5.3 ACI 318, unless specified otherwise. Allowable design stresses are based on minimum 28-day compressive strength indicated.

4. Proportions of aggregate to cement shall produce non-segregating plastic mixture of consistency required to be worked readily into corners and angles of forms and around reinforcement with method of placement employed. Accomplish variations in consistency by changes in proportioning of mix with changing W/C (water/cement) ratios established.

C. Concrete reinforcement materials:

1. New, free from rust, and complying with the following:

a. Bars for reinforcement: A615, grade 60; stirrups and ties grade 60. 2.

b. Wire fabric: 6” x 6”, W1.4-W1.4 welded wire fabric complying with ASTM A185. 3.

c. Bar supports: "Bar Support Specifications," CRSI Manual of Standard Practice, Type: plastic tipped accessories.

d. Tie Wire: Cold drawn steel; ASTM A-82.
1) Supports for reinforcement: Provide supports including bolsters, chairs, spacers and other devices for supporting and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI recommendations.

PART 3 -EXECUTION

3.01 BUILDING ELEMENTS

A. Where required for the removal or installation of elements within Contractor’s scope, Contractor shall include all necessary building element removal, modification, and reinstallation required to facilitate work. Such building elements include but are not limited to ceilings, floors, walls, roofs, doors, beams, piping, ductwork, conduits, and lights. Elements shall only be removed to the extent required to facilitate work and shall minimize the impact to the facility.

B. Where building elements are not required to be removed but are subject to potential damage during the execution of Contractor’s work, Contractor shall protect building elements from damage.

C. Where building elements are removed and reinstalled or subject to potential damage, Contractor shall walk construction area prior to work with Owner and document condition of building elements and finishes prior to work. Contractor shall restore all building elements and finishes to their original condition noted during the walkthrough. Items not documented shall be considered in “as new” condition.

D. Where building elements must be modified prior to reinstallation to accommodate new work and such modification is not specifically indicated on the plans, Contractor shall obtain Owner approval prior to making modifications. Failure to obtain approval shall not be grounds for additional compensation.

E. Contractor shall coordinate all building element removal and reinstallation with Owner. Where removal constitutes a significant impact to the Owner's operations, such work shall be performed during off hours as defined by the Owner. Significant impacts include but are not limited to utility shutdowns, facility access, occupant safety, occupant comfort, and noise.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 and 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. Drainage piping shall not be routed over the following spaces. Where this is unavoidable, the drainage piping shall be accompanied by 18 gauge galvanized, sealed, 2" deep secondary containment drain pans with drain routed to floor drain in observable location.

1. Electrical rooms.
2. Communication/IT rooms.
3. Central Services/sterile processing department
4. Trauma rooms.
5. Operating rooms.
6. Delivery rooms.
7. Imaging rooms and associated equipment rooms.
8. Other locations identified on the plans.

D. Pressurized piping containing liquid shall not be routed over the following spaces or within one foot laterally from the edge of electrical and electronic/IT equipment in other spaces. Where this is unavoidable, the piping shall be accompanied by 18 gauge galvanized, sealed, 2" deep secondary containment drain pans with drain routed to floor drain in observable location. Pressurized piping dedicated to fixtures, equipment, and sprinkler heads in the below spaces shall not require drain pans provided that it is not within one foot laterally of the edge of electrical and electronic/IT equipment.

1. Electrical rooms.
2. Communication/IT rooms.
3. Operating rooms.
4. Delivery rooms.
5. Imaging rooms and associated equipment rooms.

6. Other locations identified on the plans.

E. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

F. 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.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping to permit valve servicing.

I. Install piping at indicated slopes.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install piping to allow application of insulation.

M. Select system components with pressure rating equal to or greater than system operating pressure.

N. Install escutcheons for penetrations of walls, ceilings, and floors.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions.

P. Installation of Install manufactured stack sleeve fittings and field installed water dams for pipes passing through concrete floor and roof slabs.

1. Install manufactured stack sleeve fittings per manufacturers recommendations.

2. Seal annular space around piping and insulation.

3. Maintain fire and smoke ratings at pipe penetrations of fire/smoke rated building elements.

4. Provide stack sleeve fittings or water dams around pipes penetrating the floor above rooms requiring drain/drip pans and in wet areas including but not limited to the following:

a. Mechanical rooms.

b. Boiler rooms.

c. Sterile Processing Areas.

d. Locations indicated on plans.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with UL listed through penetration firestop systems. Refer to Division 07 Section "Through-Penetration Firestop Systems" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Specifications Sections for roughing-in requirements.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and other Specification 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. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.

2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Install dielectric flange or nipple fittings to connect piping materials of dissimilar metals.

a. Use of brass or bronze ball valves in place of a dielectric nipple is acceptable.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.06 CONCRETE BASES AND HOUSEKEEPING PADS

A. Furnish and install concrete bases and housekeeping pads (not specifically indicated on the Drawings or in the Specifications of either the General Construction or Mechanical work as provided by another Contractor) for all floor mounted equipment provided.

B. All concrete bases and housekeeping pads shall be reinforced in accordance with ACI 315.

C. Existing concrete bases and housekeeping pads may be used for new equipment. Where concrete base or housekeeping pad is too small to accommodate new equipment, do not extend concrete base or housekeeping pad; demolish concrete base or housekeeping pad and provide new.

D. Forms:

1. Construct forms to the exact sizes, shapes, lines and dimensions as required to obtain accurate alignment, locations, grades, level and plumb work in the finished structures.

2. Chamfer exposed external corners and edges.

3. Inserts, embedded parts and openings:

a. Provide formed openings where required for work embedded in or passing through concrete.

b. Coordinate work of other sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, and other inserts.

c. Install accessories in accordance with manufacturer`s instructions, level and plumb. Ensure items are not disturbed during concrete placement.

4. Form removal:

a. Do not remove forms and bracing until concrete has sufficient strength to support its own weight, and construction and design loads which may be imposed upon it.

b. Do not damage concrete surfaces during form removal.

5. Cleaning:

a. Clean forms to remove foreign matter as erection proceeds.

b. Ensure that water and debris drain to exterior through clean out ports.

c. During cold weather, remove ice and snow from forms. Do not use deicing salts. Do not use water to clean out completed forms, unless formwork and construction proceed within heated enclosure.

E. Reinforcement:

1. Before start of concrete placement, accurately size and place concrete reinforcement in accordance with ACI 315, positively securing and supporting by concrete blocks, metal chairs or spacers, or metal hangers.

2. Clearance: Clear space between bars and cover for bars shall conform to the Requirements of ACI 318.

3. Splicing:

a. Horizontal bars:
1) Place bars in horizontal members with laps at splices in accordance with the Contract Documents and the Requirements of ACI-318 (Latest Edition).
2) Bars may be wired together at laps.
3) Wherever possible, stagger the splices of adjacent bars.

b. Wire fabric:
1) Make splices in wire fabric at least 1-1/2 meshes wide.

c. Other splices:

1) Place required steel dowels and securely anchor into position before concrete is placed.

4. Coordinate placement with conduits, piping, inserts, sleeves or other items.

F. Concrete Bases and Housekeeping Pads: Anchor equipment to concrete bases and housekeeping pads according to equipment manufacturer`s written instructions.

1. Construct concrete bases and housekeeping pads not less than 4 inches larger in both directions than supported unit. Concrete bases and housekeeping pads shall be nominal 4 inches thick unless indicated otherwise on plans and details. Where a base is less than 12 inches from a wall, extend the base to the wall.

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. Place, install, and secure anchorage devices. Use manufacturer`s setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

5. Curing:

a. Keep forms in place for a seven-day curing period. Keep top exposed concrete surface wet and forms moist. Loosen forms to allow curing water to run down between concrete and forms.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.08 GROUTING

A. Mix and install grout for mechanical 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

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR MECHANICAL

PART 1 -GENERAL

1.01 SUMMARY

A. Related Documents:

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

2. The requirements listed in this document are applicable to Divisions 21, 22, and 23 specifications.

1.02 SUBMITTALS

A. None.

1.03 CLOSE-OUTS

A. None.

1.04 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 electrical supply circuit and required control sequence.

4. Ambient and environmental conditions of installation location.

PART 2 -PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: NEMA 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. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer`s standard starting characteristic.

J. Enclosure Material: Rolled steel or cast iron construction. 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.

K. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. 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.

L. Provide factory installed bearing protection ring, AEGIS or equal on all motors powered by VFD.

2.04 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.

5. Electronic commutation.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type or electronic commutation 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 or electronic commutation type.

E. Electronic commutation motors shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal.

F. 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

3.01 ROTATING EQUIPMENT FIELD ALIGNMENT

A. All coupled rotating equipment over 1 horsepower shall be laser-aligned, using a dual receiver coupling laser aligner or other approved laser alignment equipment after installation. Thermal growth calculations shall be made where appropriate to reflect operating conditions. If applicable, equipment, structure, and attached piping thermal growths shall be considered in addition to operational effects such as oil wedge, pressure/vacuum pull-down, etc. to insure in service alignment tolerances are achieved. The acceptable in service alignment tolerances shall be determined by the equipment manufacturer. Where no value is given, tolerance shall be 0.0005”. The installing contractor must check for and correct any soft foot conditions before attempting the laser alignment of any coupled rotating equipment. The soft foot tolerance is the differential at any foot on the equipment. Fluid film bearing machine shafts shall be level while in service.

B. A record of the final alignment settings, alignment setup, alignment tolerances, machine ID/Name, date of alignment, and alignment technician ID shall be printed and signed by the technician responsible for the alignment. Calculations for thermal effects and other operational considerations shall be attached to this printout. A copy shall be forwarded to the Owner and Engineer for review and acceptance. The accepted copy shall be included in the final Operation and Maintenance Manuals.

C. A minimum of two jacking bolts shall be installed at each hold-down bolt position to facilitate controlled movement in the axial (in line with the shaft, perpendicular to the bolt body) direction and “horizontal” (perpendicular to hold-down bolt body and axial direction). The jacking bolts must be positioned so that they do not interfere with the installation and removal of shim packs.

D. Hold-down bolts shall be tightened using a calibrated torque wrench in at least three stages (50%, 80%, and 100% of final torque value), each stage following a “cross” pattern. After alignment and tightening of hold-down bolts, all jacking bolts shall be backed-off ~0.100” and locked with jam nuts.

END OF SECTION 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Pipe sleeves.

B. Manufactured sleeve-seal systems.

1.02 RELATED REQUIREMENTS

A. Section 078400 - Firestopping.

B. Section 099123 - Interior Painting: Preparation and painting of interior piping systems.

C. Section 220523 - General-Duty Valves for Plumbing Piping.

D. Section 220553 - Identification for Plumbing Piping and Equipment: Piping identification.

E. Section 220716 - Plumbing Equipment Insulation.

F. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type); 2016.

B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

1.05 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified this section.

1. Minimum three years experience.

2. Approved by manufacturer.

C. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store sleeve and sleeve seals in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel sleeves if shipped loose.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 -PRODUCTS

2.01 PIPE SLEEVES

A. Manufacturers:

1. Flexicraft Industries; Pipe Wall Sleeve: www.flexicraft.com/#sle.

B. Vertical Piping:

1. Sleeve Length: 1 inch (25 mm) above finished floor.

2. Provide sealant for watertight joint.

3. Drilled Penetrations: Provide 1-1/2 inch (40 mm) angle ring or square set in silicone adhesive around penetration.

C. Pipe Passing Through Mechanical, Laundry, and Animal Room Floors above Basement:

1. Galvanized steel pipe or black iron pipe with asphalt coating.

2. Connect sleeve with floor plate except in mechanical rooms.

D. Clearances:

1. Provide allowance for insulated piping.

2. Wall, Floor, Floor, Partitions, and Beam Flanges: 1 inch (25 mm) greater than external; pipe diameter.

3. All Rated Openings: Caulked tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

2.02 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. Advance Products & Systems, LLC; Innerlynx: www.apsonline.com/#sle.

2. Flexicraft Industries; PipeSeal: www.flexicraft.com/#sle.

3. Substitutions: See Section 016000 - Product Requirements.

B. Modular/Mechanical Seal:

1. Synthetic rubber interlocking links continuously fill annular space between pipe and wall/casing opening.

2. Provide watertight seal between pipe and wall/casing opening.

3. Elastomer element size and material in accordance with manufacturer's recommendations.

4. Glass reinforced plastic pressure end plates.

PART 3 -EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

3.02 INSTALLATION

A. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

B. Install piping to conserve building space, to not interfere with use of space and other work.

C. Install piping and pipe sleeves to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

D. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 m).

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

E. Structural Considerations:

1. Do not penetrate building structural members unless indicated.

F. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

1. Underground Piping: Caulk pipe sleeve watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.

2. Aboveground Piping:

   a. Pack solid using mineral fiber complying with ASTM C592.

   b. Fill space with an elastomer caulk to a depth of 0.50 inch (15 mm) where penetrations occur between conditioned and unconditioned spaces.

3. All Rated Openings: Caulk tight with fire stopping material complying with ASTM E814 in accordance with Section 078400 to prevent the spread of fire, smoke, and gases.

G. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.

2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.

3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a water-tight seal.

6. Install in accordance with manufacturer's recommendations.

H. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

END OF SECTION 220517

SECTION 220519 - METERS AND GAUGES FOR MECHANICAL

PART 1 -GENERAL

1.01 SUMMARY

A. Section Includes:

1. Thermometers.
2. Pressure gauges.
3. Test plugs.

B. Related Documents:

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. The requirements listed in this document are applicable to Divisions 21, 22, and 23 specifications.

1.02 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.

B. Informational Submittals:

1. Operation and maintenance data.

1.03 CLOSE-OUTS

A. None.

PART 2 -PRODUCTS

2.01 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Miljoco Corporation.
    b. Weiss Instruments, Inc.
    c. Winters Instruments - U.S.

2. Standard: ASME B40.200.

3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.

4. Case Form: Adjustable angle unless otherwise indicated.

5. Tube: Glass with magnifying lens and blue or red organic liquid.

6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.

7. Window: Glass.

8. Stem: Aluminum and of length to suit installation.

   a. Design for Air-Duct Installation: With ventilated shroud.

   b. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.

10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.02 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.

2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.

3. Material for Use with Copper Tubing: Brass.

4. Material for Use with Steel Piping: Type 304 Stainless Steel.

5. Type: Stepped shank unless straight or tapered shank is indicated.

6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.

7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.

8. Bore: Diameter required to match thermometer bulb or stem.

9. Insertion Length: Length required to match thermometer bulb or stem.

10. Lagging Extension: Include on thermowells for insulated piping and tubing.

11. Bushings: For converting size of thermowell`s internal screw thread to size of thermometer connection.

2.03 PRESSURE GAUGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

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

   a. Miljoco Corporation.

   b. Weiss Instruments, Inc.

   c. Winters Instruments - U.S.

2. Standard: ASME B40.100.

3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.

4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.

5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.

6. Movement: Mechanical, with link to pressure element and connection to pointer.

7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.

8. Pointer: Dark-colored metal.

9. Window: Glass.

10. Ring: Metal.

11. Accuracy: Grade 1A, plus or minus 1% of full scale or span.

2.04 GAUGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Siphons: Loop-shaped section of stainless-steel pipe with NPS 1/4 or NPS 1/2 pipe threads.

C. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install duct-thermometer mounting brackets in walls of ducts. Attach to duct with screws.

H. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.

I. Install valve and snubber in piping for each pressure gauge for fluids (except steam).

J. Install valve and syphon fitting in piping for each pressure gauge for steam.

K. Install thermometers in the following locations:

1. Inlet and outlet of each domestic water heater, heat exchanger, and storage tank.

2. Other locations indicated on plans

L. Install pressure gauges in the following locations:

1. Building water service entrance into building.

2. Inlet and discharge of each hydronic or domestic pressure-reducing valve.

3. Suction and discharge of each domestic water pump.

4. Other locations indicated on plans.

3.02 CONNECTIONS

A. Install thermometers and gauges adjacent to machines and equipment to allow service and maintenance of gauges, machines, and equipment.

3.03 ADJUSTING

A. Adjust faces of thermometers and gauges to proper angle for best visibility.

3.04 APPLICATION

A. Suitable for temperature and pressure application.

END OF SECTION 220519

SECTION 220523 - GENERAL-DUTY VALVES FOR MECHANICAL

PART 1 -GENERAL

1.01 SUMMARY

A. Section includes:

1. Ball valves.
2. Butterfly valves.
3. Check valves.

B. Valves for specialty applications are specified in sections applicable to those services. This includes but is not limited to:

1. Plumbing.
2. Medical gas.
3. High purity water.

C. Related Sections:

1. Divisions 22 and 23 mechanical piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Mechanical Identification" for valve tags and schedules.

1.02 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.03 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.

C. NSF Compliance:

1. NSF 61 for valve materials for potable-water service.
2. NSF 372: Drinking water system components – lead content for valve materials for potable-water service.

PART 2 -PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to Part 3 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.

E. Valves in Insulated Piping: With stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows full operation of valve without breaking the vapor seal or disturbing insulation.

2. Butterfly Valves: With extended stem.

F. Valve-End Connections:

1. Valve end connection shall match the joints specified for the associated piping systems used.

a. Flanged: With flanges according to ASME B16.1 for iron valves.

b. Grooved: With grooves according to AWWA C606.

c. Solder Joint: With sockets according to ASME B16.18.

d. Threaded: With threads according to ASME B1.20.1.

G. Valves intended for domestic water service shall be certified lead-free per NSF standards.

2.02 BRASS/BRONZE BALL VALVES

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

1. Conbraco/Apollo.

2. Hammond Valve.

3. Jamesbury; a subsidiary of Metso Automation.

4. Milwaukee Valve Company.

5. Watts.

B. Two-Piece, Brass/Bronze Ball Valves:

1. Description:

   a. Standard: MSS SP-110.

   b. SWP Rating: 150 psig.

   c. CWP Rating: 600 psig.

   d. Body Design: Two piece.

   e. Body Material: Forged brass.

   f. Seats: PTFE or TFE.

   g. Stem:
      1) Blowout proof.
      2) Stainless steel.

   h. Ball: Stainless steel.

   i. Port: Full.

2.03 IRON, LUGGED BUTTERFLY VALVES

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

1. Bray Controls; a division of Bray International.

2. Conbraco Industries, Inc.; Apollo Valves.

3. Crane Co.; Crane Valve Group; Stockham Division.

4. Crane/Centerline.

5. DeZurik Water Controls.

6. Hammond Valve.

7. Milwaukee Valve Company.

8. NIBCO INC.

2.04 BRONZE SWING CHECK VALVES

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

1. Crane Co.; Crane Valve Group; Crane Valves.

2. Crane Co.; Crane Valve Group; Jenkins Valves.

3. Crane Co.; Crane Valve Group; Stockham Division.

4. Hammond Valve.

5. Kitz Corporation.
6. Milwaukee Valve Company.
7. NIBCO INC.
8. Powell Valves.
9. Red-White Valve Corporation.
10. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

B. Class 125, Bronze Swing Check Valves:

1. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 200 psig.
   c. SWP Rating: 125 psig saturated.
   d. Body Design: Horizontal flow.
   e. Body Material: Bronze.
   f. Disc: Bronze.

2.05 BRONZE SILENT CHECK VALVES

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

1. Crane Co.; Crane Valve Group; Crane Valves.
2. Crane Co.; Crane Valve Group; Jenkins Valves.
3. Crane Co.; Crane Valve Group; Stockham Division.
4. Hammond Valve.
5. Milwaukee Valve Company.
6. NIBCO INC.
7. Powell Valves.
8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

B. Class 125, Bronze Silent Check Valves:

1. Description:
   a. Standard: MSS SP-139.
   b. CWP Rating: 250 psig.

c. Body Design: In-line lift type, spring actuated.

d. Body Material: Bronze.

e. Disc: PTFE.

PART 3 -EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

F. Provide extended stems on insulated piping systems to extend handle above insulation.

3.03 ADJUSTING

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

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Unless indicated otherwise, use the following:

1. Shutoff Service, Domestic Water: Gate valves and ball valves or ball valves.

2. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze silent check valves.

b. NPS 2-1/2 and Larger, except for Sanitary Waste and Storm Drainage: Iron silent check valves.

c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves.

B. Select valves, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends. Valves with soldered ends may be used in water systems only where soldered joints are permitted in other sections.

2. For Copper Tubing, NPS 2-1/2 and above: Flanged ends. Valves with grooved ends may be used in water systems only where grooved mechanical joints are permitted in other sections.

3. For Steel Piping, NPS 2 and Smaller: Threaded ends.

4. For Steel Piping, NPS 2-1/2 and above: Flanged ends. Valves with grooved ends may be used in water systems only where grooved mechanical joints are permitted in other sections.

C. Select valves to meet or exceed maximum anticipated maximum system operating pressure for intended service. 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.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR MECHANICAL

PART 1 -GENERAL

1.01 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Documents

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. The requirements listed in this document are applicable to Divisions 21, 22, and 23 specifications.

1.02 SUBMITTALS

A. Action Submittals

1. Product Data: For each type of product indicated.

1.03 CLOSE-OUTS

A. None.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

1.05 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry.

B. Terminology: As defined in MSS SP-90, “Guidelines on Terminology for Pipe Hangers and Supports”.

C. ASME B31.9: Building Services Piping.

D. ASME B31.1: Power Piping.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

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

1. B-Line Systems, Inc.; a division of Cooper Industries.

2. ERICO/Michigan Hanger Co. (Caddy-Pentair).

3. Grinnell Corp.

4. PHD Manufacturing, Inc.

5. Thermal Pipe Shields.

6. Tolco, Inc.

2.02 PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.

3. Nonmetallic Coatings: Plastic coating, jacket, or liner.

4. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.

2. Hanger Rods and Hardware: Continuous-thread rod, nuts, and washer made of 304 stainless steel.

C. Copper Pipe/Tube Hangers and Supports

1. Split ring hangers and clamps.

D. Materials:

1. Provide appropriate materials and protective coatings to prevent failure from environmental and galvanic corrosion.

2. Material that comes in contact with pipe shall be compatible with piping material so that neither has a deteriorating effect on the other.

E. Hanger Rods: Continuous-thread rod, nuts and washer made of stainless steel.

2.03 TRAPEZE PIPE HANGERS

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

2.04 METAL FRAMING SYSTEMS

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

1. B-Line Systems, Inc.; a division of Cooper Industries.

2. ERICO/Michigan Hanger Co. (Caddy-Pentair).

3. Tolco, Inc.

4. Unistrut.

B. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.

2. Standard: MFMA-4.

3. Channels: Continuous slotted steel channel with inturned lips.

4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

6. Coating: Suitable for piping system supported.

2.05 THERMA-HANGER SADDLE AND SHIELD INSERTS

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

1. Carpenter & Paterson, Inc.

2. ERICO/Michigan Hanger Co. (Caddy-Pentair).

3. Pipe Shields, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield to cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield to cover the lower 180 degrees of pipe.

F. Insert Length: Extend a minimum of 2 inches, or greater as recommended by manufacturer, beyond sheet metal shield for piping operating below ambient air temperature.

G. Fire Rating: 25/50 rated flame/smoke plenum rated.

2.06 FASTENER AND ANCHORING SYSTEMS

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

1. Hilti, Inc.

2. ITW Ramset/Red Head.

3. Powers Fasteners.

4. Simpson Strong - Tie

B. Post-pour concrete inserts shall be selected based on “cracked concrete” applications, shall be installed in accordance with manufacturers’ requirements and shall be designed for “cracked concrete” in accordance with Appendix D of American Concrete Institute (ACI) standard 318 and have a current ICC-ES report.

C. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Must be designed and approved for “cracked concrete” in accordance with Appendix D of American Concrete Institute (ACI) standard 318 and have a current ICC-ES report.

D. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used. Must be designed and approved for “cracked concrete” in accordance with Appendix D of American Concrete Institute (ACI) standard 318 and have a current ICC-ES report.

2.07 PIPE STANDS

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

1. B-Line.

2. ERICO.

3. MIFAB.

4. MIRO.

5. Unistrut.

B. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

C. Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made form structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.08 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 in commercial applications.

2.09 EQUIPMENT SUPPORTS

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

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

PART 3 -EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Do not support piping, ductwork equipment, or systems from metal roof decking material.

B. Where powder actuated or mechanical expansion hangers are used, notify Owner one week in advance of installation.

C. Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

D. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

E. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 Section "Plumbing Fixtures" for requirements for pipe positioning systems for plumbing fixtures.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate form welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Anchor piping at appropriate location and utilize guides to allow proper pipe expansion where expansion loops or expansion joints are used.

N. Install lateral bracing with pipe hangers and supports to prevent swaying.

O. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, 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.

P. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

Q. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping and ASME B31.1 for power piping.

R. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.

b. Piping Operating Below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert. Provide protection saddle shield insert, minimum 4 inch, 180 degrees.

c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping and ASME B31.1 for power piping.

d. Insert Material: Length of at least as long as protective shield.

e. Thermal Hanger Shields: Install with insulation same thickness as piping insulation.

S. All piping when supported by non-rigid hangers in excess of 18 inches in length shall be braced against movement in any direction.

T. PVC, polypropylene, and other plastic piping: Follow pipe manufacturer's recommendations for hanger type, support, and spacing. Hanger material must be chemically compatible with the plastic pipe material.

3.02 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.

3.03 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.04 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 and taper ends.

3.05 HANGER AND SUPPORT SCHEDULE

A. Comply with MSS SP-69 for all pipe-hanger selections and applications.

B. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

C. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

D. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

E. Use stainless-steel pipe hangers and corrosion-resistant attachments for hostile environment applications.

F. Use thermal-hanger shield inserts for insulated piping and tubing.

G. 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. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 4.

3. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 4.

4. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 4.

5. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

I. 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. Steel Weldless Eye Nuts (MSS type 17): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. C-Clamps (MSS Type 23): For support of pipes to NPS 4, attached to structural shapes. Provide retaining strap.

6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

9. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

10. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

11. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

K. 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.

L. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Install spring hangers and supports in the following areas:

a. All piping and equipment above, below, in, and adjacent to medical equipment rooms.

b. All piping and equipment above, below, in, and adjacent to operating rooms.

2. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.

3. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.

4. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.

6. Variable-Spring Base Supports (MSS type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.

8. Constant Supports: For critical piping stress and if necessary, to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.

c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

O. Use powder-actuated fasteners or mechanical-expansion anchors rated for “cracked concrete” instead of building attachments where required in concrete construction.

P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220548 - VIBRATION AND SEISMIC CONTROLS FOR MECHANICAL

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

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

B. The requirements listed in this document are applicable to Divisions 21, 22 and 23 specifications.

1.02 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Restrained vibration isolation roof-curb rails.
12. Seismic snubbers.
13. Steel, vibration isolation equipment bases.

1.03 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed.
2. Building Classification Category: I.

3. Minimum 10 lb/sq. ft. multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.04 SUBMITTALS

A. Action Submittals:

1. Product Data: For the following:

a. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

b. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
1) Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
2) Annotate to indicate application of each product submitted and compliance with requirements.

c. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic and wind forces required to select vibration isolators, seismic and wind restraints, and for designing vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

C. Informational submittals:

1. Coordination Drawings: Show coordination of seismic bracing for piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

2. Welding certificates.

3. Qualification Data: For professional engineer and testing agency.

4. Field quality-control test reports.

1.05 QUALITY ASSURANCE

A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

1. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage or preapproval by agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 -PRODUCTS

2.01 VIBRATION ISOLATORS

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

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.

3. Isolation Technology, Inc.

4. Kinetics Noise Control.

5. Mason Industries.

6. Vibration Eliminator Co., Inc.

7. Vibration Isolation.

8. Vibration Mountings & Controls, Inc.

B. 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. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

E. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

2. Minimum Additional Travel: 50 percent of the required deflection at rated load.

3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig.

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

F. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

G. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.

2. Base: Factory drilled for bolting to structure.

3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel up or down before contacting a resilient collar.

H. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

I. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. 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.

K. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig and for equal resistance in all directions.

L. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.02 VIBRATION ISOLATION EQUIPMENT BASES

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

1. Amber/Booth Company, Inc.

2. California Dynamics Corporation.

3. Isolation Technology, Inc.

4. Kinetics Noise Control.

5. Mason Industries.

6. Vibration Eliminator Co., Inc.

7. Vibration Isolation.

8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.03 FACTORY FINISHES

A. Finish: Manufacturer`s standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel or powder coat for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation and seismic- and wind-control devices to indicate capacity range.

PART 3 -EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application 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.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install seismic snubbers on equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.

3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.

2. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.

3. Brace a change of direction longer than 12 feet.

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer`s recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.

2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days` advance notice.

3. Obtain Architect`s approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.

6. Measure isolator restraint clearance.

7. Measure isolator deflection.

8. Verify snubber minimum clearances.

9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.05 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.06 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Refer to drawings for schedules.

END OF SECTION 220548

SECTION 220553 - MECHANICAL IDENTIFICATION

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

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

B. The requirements listed in this document are applicable to Divisions 21, 22, and 23 specifications.

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.
4. Fire/smoke wall penetration labeling.
5. Wiring/Cable labels.

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.

B. Informational submittals.

1. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label. Equipment Label Schedule shall be approved by the Owner prior to labeling.
2. Valve numbering scheme: Approved by Owner prior to labeling.
3. Valve Schedules: For each piping system to include in maintenance manuals. Provide electronic Excel document to Owner in addition to hard copy in operation and maintenance manuals.

PART 2 -PRODUCTS

2.01 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Plastic minimum 2-inch by 3/4-inch, black with white letters, mechanically fastened. Size shall increase appropriately for larger equipment.

B. Label Content: Owner shall designate all labeling names. Label shall include description of areas served.

2.02 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, applied with adhesive directional tape.

C. Pipe Label Contents: Include identification of piping service using full name designations per Drawings and an arrow indicating flow direction. Steam per systems shall bear pressure designation. Domestic water system shall bear water temperature designation.

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: Per ASME/ANSI A13.1.

3. Pumped condensate systems:

a. Provide a label near the system condensate pump noting the termination location of the condensate pipe. Ex. "TERMINATES AT ROOM 143 MOP SINK", "TERMINATES AT ROOM 146 FLOOR DRAIN NEAR DI"

2.03 FIRE BARRIER PENETRATION

A. Provide sticker complying with penetration sealant product requirements listing product, date, company name, and initials of installer. Sticker to be minimum 3-inch by 5-inch and red in color. Stickers to be affixed both sides of wall.

2.04 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. Provide additional Excel format electronic version of schedule to Owner.

2.05 WIRING/CABLING IDENTIFICATION

A. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

PART 3 -EXECUTION

3.01 COORDINATION

A. Coordinate equipment designation labeling with Owner before procuring labels.

3.02 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.

3.03 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.04 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed in above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment and in equipment rooms.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Meet ASME/ANSI A13.1.

2. Match existing facility standard.

3. For projects performed in Omaha, Contractor shall conform to labeling and identification section of the Omaha Plumbing Code. This includes tagging, spacing, lettering size, color coding, and locations.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; faucets; convenience and lawn-watering hose connections. List tagged valves in a valve schedule.

B. Where valve location exceeds reasonable distance from floor, valve tag to be extended down to within 24 inches of finished ceiling height.

3.06 FIRE/SMOKE WALL PENETRATION LABELING

A. Affix label at every rated fire and/or smoke wall penetrated with mechanical piping and duct systems, both sides of wall.

3.07 WIRE/CABLE LABELING

A. Install identification devices in accordance with manufacturer's written instruction and requirements of NEC.

B. Alarm Circuit Identification: Tag or label conductors as follows:

1. For control and communications/signal wiring, use colored marking tape and/or wire/cable designation tape markers at terminations in wiring boxes, troughs, and control cabinets. Use consistent colors and/or letter/number conductor designations throughout on wire/cable marking tape.

2. Match identification markings with designations used in equipment shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

3. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system and identity of contained circuits on outside of box cover. Labeling shall be 3/8-inch Kroy tape or Brother self-adhesive label color-coded same as conduits or permanent magic marker (color coded), neatly hand printed. In rooms that are painted out, provide labeling on inside of cover.

C. Provide typed legend of wire/cable wiring indicating tag, color, system, signal, starting room name and ending room name.

END OF SECTION 220553

SECTION 220700 - MECHANICAL INSULATION

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes mechanical insulation for mechanical system components, including the following:

1. Insulation Materials:
    a. Cellular glass
    b. Flexible elastomeric.
    c. Mineral fiber.
2. Fire-rated insulation systems.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Valve and specialty fitting wraps.

B. Related Documents

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
2. The requirements listed in this document are applicable to Divisions 22 and 23 specifications.

1.02 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PSK: Metalized polypropylene scrim kraft.

D. FSP: Foil, scrim, polyethylene.

E. PVDC: Polyvinylidene chloride.

F. SSL: Self-sealing lap.

G. MICA: Midwest Insulation Contractor's Association.

H. Indoor: Outside surfaces are inside building within conditioned space or insulated building envelope.

I. Outdoor: Outside surfaces are exposed to weather or outside ambient air temperatures. This includes concealed locations such as ventilated attics, uninsulated soffits, and other locations not protected by the insulated building envelope.

J. Concealed: Outside surfaces are isolated from room ambient air conditions by physical barrier.

1. Concealed items are typically accessed through suspended ceilings, through access doors, or by cutting and patching.

2. Listed below are examples of spaces that typically contain concealed items:

a. Walls.

b. Partitions.

c. Chases.

d. Shafts.

e. Ceiling spaces.

K. Exposed: Outside surfaces are not isolated from room ambient air conditions by physical barrier.

1. Exposed items are typically accessed directly from within a room or space.

2. Listed below are examples of rooms/spaces that typically contain exposed items:

a. Mechanical rooms.

b. Rooms without ceilings.

1.03 HOT AND COLD WATER SYSTEM REQUIREMENTS

A. Insulation specified for hot water equipment and piping includes all systems that operate at temperatures greater than 105 deg F, with and without glycol. This includes the following:

1. Domestic hot water

2. Domestic hot water recirculating.

B. Insulation specified for cold water equipment and piping includes all systems that operate at temperatures less than 60 deg F, with and without glycol. This includes the following:

1. Domestic cold water.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Application schedule.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, 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.

C. MICA Standards Manual, current edition.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

B. Material shall be sealed and protected from dirt, debris, and moisture throughout staging and construction.

1.07 COORDINATION

A. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

B. Coordinate installation and testing of heat tracing.

C. Verify and document compliance with all local, state, and applicable energy codes.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

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

2.02 INSULATION MATERIALS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds. Products shall be certified no voc and low odor.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials in contact with austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products:

a. Cell-U-Foam Corporation; Ultra-CUF.

b. Pittsburgh Corning Corporation; Foamglas Super K.

2. Block Insulation: ASTM C 552, Type I.

3. Special-Shaped Insulation: ASTM C 552, Type III.

4. Board Insulation: ASTM C 552, Type IV.

5. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.

6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

E. 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:

a. Aeroflex USA Inc.; Aerocel.

b. Armacell LLC; AP Armaflex.

c. Rubatex

d. K Flex USA

e. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

F. Mineral-Fiber, Preformed Pipe Insulation:

1. Products:

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 Part 2 "Factory-Applied Jackets" Article.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

C. Cellular-Glass, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

F. ASJ, PSK, FSK, and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II. Color shall match insulation color. Service shall match insulation application vapor permeance and installation environment.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

2.06 SEALANTS

A. Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates. Color shall match insulation or jacket color. Service shall match insulation application, vapor permeance, and installation environment.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. PSK Jacket: Metalized white polypropylene, fiberglass-reinforced kraft paper backing; complying with ASTM C 1136, Type II.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.

2. Color: White.

3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

4. Factory-fabricated tank heads and tank side panels.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Width: 3 inches.

2. Thickness: 11.5 mils.

3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches.

2. Thickness: 6 mils.

3. Adhesion: 64 ounces force/inch in width.

4. Elongation: 500 percent.

5. Tensile Strength: 18 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Install pins, hangers, and securements according to manufacturer's installation recommendation.

2.11 VALVE AND SPECIALTY FITTING WRAPS

A. All valves, strainers, autoflow valves, circuit setters, ball valves, balancing valves, and combination valves, etc., in chilled water, heating hot water, and steam systems shall be insulated with a factory fabricated removable and reusable cover.

B. Type 1:

1. Insulation shall have a minimum k- factor .26, using fiberglass blanket. Flame and smoke spread shall be 25/50 per ASTM E-84.

2. Installation shall not require the use of any special hand tools.

3. Manufacturers: No Sweat Valve Wraps, Inc., or approved equal.

PART 3 -EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.

2. Verify that surfaces to be insulated are clean and dry.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install insulation after completion of pressure testing.

3.03 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.

3.04 COMMON INSTALLATION REQUIREMENTS

A. Where vapor barrier is breeched by fastener, seal to maintain vapor permeance.

B. 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.

C. 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.

D. 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.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials protected and dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. For all cold systems operating below ambient temperature, provide continuous vapor barrier. 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. Insulate all system components the same as connecting piping and ductwork to eliminate condensation.

3. 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.

4. 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.

5. 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.

L. Apply adhesives, mastics, and sealants at manufacturer`s recommended coverage rate and wet and dry film thicknesses.

M. 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 required, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. 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.

Q. 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.

R. MICA plate numbers referenced are provided to clarify the scope of installation. Install Insulation and accessory components per applicable MICA and manufacturers recommendations.

3.05 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 Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations on ductwork. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches. Install insulation at dampers as recommended by the SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.

3.06 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Identify all specialties with labels on exterior of insulation.

2. Install preformed sections or cut, miter, and bond all elbows and tees to provide continuous quality fitting contour.

3. 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.

4. 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.

5. 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.

6. 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.

7. For services not specified to receive a field-applied jacket except for flexible elastomeric, 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.

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.

3.07 CELLULAR-GLASS INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are required, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.

4. Install jacket material with manufacturer`s recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer`s written instructions.

2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

E. For all system components without factory applied jackets, cover insulation with factory furnished jacketing material appropriate for service and application.

3.08 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.

3.09 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 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 2inch, and seal joints with flashing sealant.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where fiberglass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.

3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer`s recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous UL-listed fire rating.

B. Penetrations through fire rated walls and floors shall be installed with UL listed through penetration fire stopping system specific for the fire-rated insulation system manufacturer.

C. Insulate duct access panels and doors to achieve same fire rating as duct in accordance with its UL listing.

3.12 FINISHES

A. Flexible Elastomeric Thermal Insulation, Outdoor: After adhesive has fully cured, apply two coats of insulation manufacturer`s recommended protective UV coating.

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.

3.13 PIPING INSULATION, 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. Fire-suppression piping.

2. Drainage piping located in crawl spaces.

3. Below-grade piping.

4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 ABOVEGROUND PIPING INSULATION SCHEDULE

PIPING SYSTEM FLUID	TEMP. RANGE DEG. F.	THICKNESS IN INCHES FOR PIPE SIZES THROUGH SIZE LISTED					INSULATION TYPE (Note 1)	NOTES
		<1	1 TO 1.25	1.5 TO 3	4 TO 6	=8		
HPS AND MPS	251 TO 350	3	4	4.5	4.5	4.5	MF	
(STEAM PRESSURES UP TO 120 PSIG INCLUDING CONDENSATE)								
LPS	TO 250	2.5	2.5	2.5	3	3	MF	
(STEAM PRESSURES UP TO 15 PSIG INCLUDING CONDENSATE AND BOILER FEEDWATER.)								
INDOOR STEAM VENT AND BOILER BLOWDOWN	140 TO 200	1.5	1.5	2	2	2	MF	
INDOOR HOT WATER	140 TO 200	1.5	1.5	2	2	2	MF	2
INDOOR HOT WATER	105 TO 140	1	1	1.5	1.5	1.5	MF	2
OUTDOOR HOT WATER	140 TO 200	2.5	2.5	3	3	3	MF	2
OUTDOOR HOT WATER	105 TO 140	2	2	2.5	2.5	2.5	MF	2
VACUUM PUMP EXHAUST	TO 350	2	2	2	2	2	MF	3
INDOOR COLD WATER	40 TO 60	0.5	0.5	1	1	1	MF, E	

PIPING SYSTEM FLUID	TEMP. RANGE DEG. F.	THICKNESS IN INCHES FOR PIPE SIZES THROUGH SIZE LISTED					INSULATION TYPE (Note 1)	NOTES
		<1	1 TO 1.25	1.5 TO 3	4 TO 6	=8		
INDOOR COLD WATER	<40	0.5	1	1	1	1.5	MF, E	
OUTDOOR COLD WATER	40 TO 60	1.5	1.5	2	2	2	E	
OUTDOOR COLD WATER	<40	1.5	2	2	2	2.5	E	
REFRIGERANT	ANY	0.5	1	1	1	NA	E	4
STORM, STORM OVERFLOW AND DRAIN BODIES	ANY	1	1	1	1	1	MF, E	
AIR COMPRESSOR INTAKE	ANY	1	1	1	1	1	MF, E	
PLASTIC IN RETURN AIR PLENUM	ANY	0.5	0.5	0.5	0.5	0.5	MF	
HEAT TRACED	ANY	2	2	2	2	2	MF	3
INDOOR CONDENSATE AND EQUIPMENT DRAINS	BELOW 60	0.5	0.5	0.5	0.5	0.5	MF, E	5
CRYOGEN VENT	BELOW -100	2	2	2	2	2	CG	

ABBREVIATIONS: MF = MINERAL FIBER/FIBERGLASS, E = ELASTOMERIC, CG = CELLULAR GLASS

SCHEDULE NOTES:

1. MICA REFERENCE PLATES FOR PIPING ARE 1-100 FOR FIBERGLASS AND CELLULAR GLASS PIPE INSULATION, 1-200 FOR ELASTOMERIC AND 1-900 FIBERGLASS WITH HEAT TRACE.
2. HOT WATER SYSTEM TEMPERATURES EXCEEDING 200 DEG F TO BE TREATED FOR APPROPRIATE TEMPERATURE RANGE AS LISTED UNDER LPS OR HPS.
3. HEAT TRACED PIPING SHALL BE INSULATED TO THICKNESS INDICATED OR TO THICKNESS SPECIFIED FOR SPECIFIC SYSTEM, WHICHEVER IS GREATER.
4. UNDERGROUND REFRIGERANT PIPING SHALL BE INSULATED AS SPECIFIED FOR ABOVEGROUND PIPING AND INSTALLED IN PVC CONDUIT.
5. INCLUDES AIR CONDITIONING CONDENSATE, P-TRAPS FOR FLOOR DRAINS/SINKS RECEIVING AIR CONDITIONING CONDENSATE OR ICE MAKER DRAIN PIPING, AND SANITARY DRAINAGE PIPING FROM ELECTRIC WATER COOLERS TO MAIN.

3.15 VALVES AND SPECIALTY FITTINGS FOR PIPING SYSTEMS

A. Insulated Systems Operating Below Ambient Temperature:

1. NPS 6 and Smaller: Type 1.

2. Above NPS 6: Type 2.

B. Insulated Systems Operating Above Ambient Temperature and Below 200 Deg F:

1. NPS 6 and Smaller: Type 1.

2. Above NPS 6: Type 2.

3.16 FIELD-APPLIED JACKET GENERAL APPLICATION

A. Install field-applied jacket on piping as follows:

1. On exterior piping.

2. On all changes in direction and fittings.

3. In areas subject to traffic and damage exposed in mechanical rooms and tunnels. This includes the following:

a. Piping within 7 feet of finished floor.

b. Other areas specifically indicated on plans.

4. On exposed piping insulated in finished spaces including but limited to storage rooms, closets, and work areas.

5. Piping within air handling units.

B. Field-applied jacketing shall be installed on entire piping system including fittings, valves, strainers, and other piping components, except where jacketing is specifically limited to only fittings.

C. MICA Reference Plates:

1. Field applied metal jacketing: 1-400.

2. Field applied non-metal jacketing: 1-500.

3.17 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor`s option.

C. High temperature equipment and piping:

1. Stainless Steel, Type 304, Smooth 2B Finish: 0.010 inch thick.

D. Piping, Concealed:

1. PVC 30 mil fitting covers on all fittings.

E. Piping, Exposed:

1. PVC 30 mil fitting covers on all fittings.

2. PVC 30 mil for the exposed indoor piping systems listed above under “FIELD-APPLIED JACKET GENERAL APPLICATION.”

END OF SECTION 220700

SECTION 221005 - PLUMBING PIPING

PART 1 -GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, specialties, and connections for piping systems.

1. Sanitary sewer.
2. Domestic water.
3. Flanges, unions, and couplings.
4. Pipe hangers and supports.
5. Manufactured sleeve-seal systems.
6. Ball valves.
7. Balancing valves.
8. Water pressure reducing valves.

1.02 RELATED REQUIREMENTS

A. Section: Roof penetrations.

B. Section 078400 - Firestopping.

C. Section 083100 - Access Doors and Panels.

D. Section 099123 - Interior Painting.

E. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.

F. Section 220553 - Identification for Plumbing Piping and Equipment.

G. Section 220719 - Plumbing Piping Insulation.

H. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

I. Section 312316 - Excavation.

J. Section 312316.13 - Trenching.

K. Section 312323 - Fill.

L. Section 330110.58 - Disinfection of Water Utility Piping Systems.

1.03 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

C. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; 2016.

D. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes; 2018.

E. ASME B31.9 - Building Services Piping; 2017.

F. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

G. ASSE 1003 - Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems; 2009.

H. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2020.

I. ASTM B42 - Standard Specification for Seamless Copper Pipe, Standard Sizes; 2020.

J. ASTM B68/B68M - Standard Specification for Seamless Copper Tube, Bright Annealed; 2011.

K. ASTM B75/B75M - Standard Specification for Seamless Copper Tube; 2020.

L. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

M. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

N. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

O. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2015.

P. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2017.

Q. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012 (Reapproved 2018).

R. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2017.

S. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2019a.

T. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2015.

U. ASTM F437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2015.

V. ASTM F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2017.

W. ASTM F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2019.

X. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2014.

Y. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.

D. Shop Drawings: For non-penetrating rooftop supports, submit detailed layout developed for this project, with design calculations for loadings and spacings.

E. Sustainable Design Documentation: For soldered copper joints, submit installer's certification that the specified installation method and materials were used.

F. Sustainable Design Documentation: For products meeting regulatory lead-content restrictions.

G. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.

B. PVC Pipe: ASTM D2665 or ASTM D3034.

1. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.02 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.

2.03 DOMESTIC WATER PIPING, BURIED WITHIN 5 FEET (1500 MM) OF BUILDING

A. Copper Pipe: ASTM B42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints: AWS A5.8M/A5.8, BCuP copper/silver braze.

2.04 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Mechanical Press Sealed Fittings: Double-pressed type, NSF 61 and NSF 372 approved or certified, utilizing EPDM, nontoxic, synthetic rubber sealing elements.

2.05 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 3 Inches (80 mm) and Under:

1. Ferrous Pipe: Class 150 malleable iron threaded unions.

2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. Flanges for Pipe Size Over 1 Inch (25 mm):

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F (minus 34 degrees C) to 230 degrees F (110 degrees C).

D. No-Hub Couplings:

1. Gasket Material: Neoprene complying with ASTM C564.

2. Band Material: Stainless steel.

3. Eyelet Material: Stainless steel.

2.06 PIPE HANGERS AND SUPPORTS

A. Plumbing Piping - Drain, Waste, and Vent:

1. Hangers for Pipe Sizes 1-1/2 Inches (50 mm) and Over: Carbon steel, adjustable, clevis.

2. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.

3. Wall Support for Pipe Sizes 4 Inches (100 mm) and Over: Welded steel bracket and wrought steel clamp.

4. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

B. Plumbing Piping - Water:

1. Hangers for Cold Pipe Sizes 1/2 Inch (50 mm) and Over: Carbon steel, adjustable, clevis.

2. Hangers for Hot Pipe Sizes 1/2 Inches (50 mm) to 4 Inches (100 mm): Carbon steel, adjustable, clevis.

3. Wall Support for Pipe Sizes to 3 Inches (80 mm): Cast iron hook.

4. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

5. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Hanger Fasteners: Attach hangers to structure using appropriate fasteners, as follows:

1. Concrete Wedge Expansion Anchors: Complying with ICC-ES AC193.

2. Other Types: As required.

3. Manufacturers:

a. Powers Fasteners, Inc: www.powers.com/#sle.

b. Substitutions: See Section 016000 - Product Requirements.

2.07 MANUFACTURED SLEEVE-SEAL SYSTEMS

A. Manufacturers:

1. The Metraflex Company; MetraSeal: www.metraflex.com/#sle.

2. Substitutions: See Section 016000 - Product Requirements.

2.08 BALL VALVES

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com/#sle.

2. Grinnell Products: www.grinnell.com/#sle.

3. Nibco, Inc: www.nibco.com/#sle.

2.09 BALANCING VALVES

A. Manufacturers:

1. Griswold Controls: www.griswoldcontrols.com/#sle.

B. Construction: Class 125, brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet, blowdown/backflush drain.

C. Manual Operated Y-Pattern Globe, Size 1/2 Inches (15 mm) to 2 Inches (50 mm):

1. Class 125, brass or bronze body, multi-turn handwheel, memory stop, variable orifice, soldered connections, dual PT (hot and cold pressure-temperature) test ports for 300 psi (2,068 kPa), minus 4 to 250 deg F (minus 20 to 121.1 deg C) WOG service.

D. Automatic Flow Limiting Cartridge, Size 3/4 Inches (20 mm):

1. Class 125, brass or bronze body, stainless steel cartridge, threaded connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi (2,758 kPa), 0.5 gpm (1.9 lpm) WOG service.

E. Automatic Flow Limiting Cartridge with Ball Valve, Size 1/2 to 1 Inches (15 to 25 mm):

1. Class 125, brass or bronze body, stainless steel cartridge, leak-proof stem, threaded or soldered connections with built-in union, dual PT (hot and cold pressure-temperature) test ports for 400 psi (2,758 kPa), 0.25 to 1.5 gpm (0.9 to 5.6 lpm) WOG service.

F. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi (24 kPa).

2.10 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Apollo Valves: www.apollovalves.com/#sle.

2. Watts Regulator Company: www.wattsregulator.com/#sle.

3. Substitutions: See Section 016000 - Product Requirements.

B. Up to 2 Inches (50 mm):

1. ASSE 1003, bronze body, stainless steel, and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

PART 3 -EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.

G. Provide access where valves and fittings are not exposed.

1. Coordinate size and location of access doors with Section 083100.

H. Install vent piping penetrating roofed areas to maintain integrity of roof assembly

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories for finish painting.

1. See Section 099123 for painting of interior plumbing systems and components.

J. Excavate in accordance with Section 312316.

K. Backfill in accordance with Section 312323.

L. Install bell and spigot pipe with bell end upstream.

M. Install valves with stems upright or horizontal, not inverted. See Section 220523.

N. Install water piping to ASME B31.9.

O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

P. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

Q. Sleeve pipes passing through partitions, walls, and floors.

R. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

S. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9.

2. Support horizontal piping as indicated.

3. Install hangers to provide minimum 1/2 inch (15 mm) space between finished covering and adjacent work.

4. Place hangers within 12 inches (300 mm) of each horizontal elbow.

5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

6. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.

7. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

8. Provide copper plated hangers and supports for copper piping.

9. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

a. Painting of interior plumbing systems and components is specified in Section 099123.

b. Painting of exterior plumbing systems and components is specified in Section 099113.

10. Provide hangers adjacent to motor-driven equipment with vibration isolation; see Section 220548.

11. Support cast iron drainage piping at every joint.

T. Manufactured Sleeve-Seal Systems:

1. Install manufactured sleeve-seal systems in sleeves located in grade slabs and exterior concrete walls at piping entrances into building.

2. Provide sealing elements of the size, quantity, and type required for the piping and sleeve inner diameter or penetration diameter.

3. Locate piping in center of sleeve or penetration.

4. Install field assembled sleeve-seal system components in annular space between sleeve and piping.

5. Tighten bolting for a watertight seal.

6. Install in accordance with manufacturer's recommendations.

U. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.03 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Provide spring-loaded check valves on discharge of water pumps.

C. Provide flow controls in water recirculating systems where indicated.

3.04 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch (10 mm) vertically of location indicated and slope to drain at minimum of 1/8 inch per foot (1:100) slope.

B. Water Piping: Slope at minimum of 1/32 inch per foot (1:400) and arrange to drain at low points.

3.05 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Disinfect water distribution system in accordance with Section 330110.58.

B. Prior to starting work, verify system is complete, flushed, and clean.

C. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

D. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

E. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.06 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

3.07 SCHEDULES

A. Pipe Hanger Spacing:

1. Metal Piping:

a. Pipe Size: 1/2 inches (15 mm) to 1-1/4 inches (32 mm):
1) Maximum Hanger Spacing: 6.5 ft (2 m).
2) Hanger Rod Diameter: 3/8 inches (9 mm).

b. Pipe Size: 1-1/2 inches (40 mm) to 2 inches (50 mm):
1) Maximum Hanger Spacing: 10 ft (3 m).
2) Hanger Rod Diameter: 3/8 inch (9 mm).

c. Pipe Size: 2-1/2 inches (65 mm) to 3 inches (75 mm):
1) Maximum Hanger Spacing: 10 ft (3 m).
2) Hanger Rod Diameter: 1/2 inch (13 mm).

d. Pipe Size: 4 inches (100 mm) to 6 inches (150 mm):
1) Maximum Hanger Spacing: 10 ft (3 m).
2) Hanger Rod Diameter: 5/8 inch (15 mm).

END OF SECTION 221005

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 -GENERAL

1.01 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.

2. Encasement for piping.

3. Specialty valves.

4. Flexible connectors.

B. Related Section:

1. Division 02 Section "Water Distribution" for water-service piping and water meters outside the building from source to the point where water-service piping enters the building.

1.02 SUBMITTALS

A. Informational Submittals:

1. Water Samples: Specified in "Cleaning" Article.

2. Field quality-control reports.

1.03 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components.

C. Comply with NSF 61 for potable domestic water piping and components.

D. Comply with NSF 372: Drinking water system components – lead content for potable domestic water piping and components.

1.04 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than 14 days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 -PRODUCTS

2.01 PIPING MATERIALS

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

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.

1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

2.03 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: ASNI A21.51/AWWA C151, cement lined in compliance with AWWA C104, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.

2. Compact-Pattern, Mechanical-Joint Fittings: AWWA C153, ductile iron.

a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

2.04 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.

2.05 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or Tube.

C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.

D. Color: Manufacturer’s Standard.

2.06 FLEXIBLE CONNECTORS

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

1. Flex-Hose Co., Inc.

2. Hyspan Precision Products, Inc.

3. Mercer Rubber Co.

4. Metraflex, Inc.

5. Unaflex, Inc.

6. Universal Metal Hose; a Hyspan company

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.

2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.

3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

PART 3 -EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA`s "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Mechanical" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level and plumb.

H. Rough-in domestic water piping for water-meter installation according to utility company`s requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping adjacent to equipment and specialties to allow service and maintenance.

M. Install piping to permit valve servicing.

N. 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.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Mechanical" for pressure gages.

S. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.

T. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Mechanical" for thermometers.

3.03 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. Steel-Piping Grooved Joints: Cut or roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

G. 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.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.04 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Mechanical" 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.

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 calibrated balancing valves in each hot-water circulation return branch. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.05 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing in accordance with specification section 22 05 00.

3.06 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports and installation requirements are specified in Division 22 Section "Hangers and Supports for Mechanical".

3.07 CONNECTIONS

A. Install piping adjacent to equipment and machines to allow service and maintenance.

B. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.

2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 Section "Plumbing Fixture" for connection sizes.

4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.08 SLEEVE INSTALLATION

A. Refer to section 22 05 00 for project sleeve requirements.

3.09 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Mechanical Identification" for identification materials and installation.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

6. Prepare reports for tests and for corrective action required.

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

E. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

6. Remove and clean strainer screens. Close drain valves and replace drain plugs.

7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

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

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:
1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses. Protect piping from dirt and debris by sealing ends of piping when work on piping is not occurring.

3.13 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 3 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper solder-joint fittings; and brazed joints.

D. Under-building-slab, domestic water, building-service piping, and fire-service main piping, NPS 4 to NPS 12 and larger, shall be the following:

1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern mechanical-joint fittings; and mechanical joints.

E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be the following:

1. Soft copper tube, ASTM B88, Type K; wrought-copper solder-joint fittings; and brazed joints.

F. 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 brazed soldered joints.

G. 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 brazed soldered joints.

2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

3.14 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 valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.

3. Hot-Water Circulation Piping, Balancing Duty: Calibrated balancing valves.

4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Flood Control Valves.
5. Balancing valves.
6. Temperature-actuated water mixing valves.
7. Strainers.
8. Outlet boxes.
9. Hose bibbs.
10. Hydrants.
11. Drain valves.
12. Water hammer arresters.
13. Trap-seal primers.

1.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated.

B. Informational Submittal:

1. Trap-seal primer systems: power, signal, and control wiring diagrams.

C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, maintenance manuals, and field quality-control test reports.

1.04 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."

3. Comply with NSF 372, “Drinking Water System Components – Lead Content.

PART 2 -PRODUCTS

2.01 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.

B. Hose-Connection Vacuum Breakers:

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 1011.

3. Body: Bronze, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.

5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

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

a. Ames Co.

b. Conbraco Industries, Inc.

c. FEBCO; SPX Valves & Controls.

d. Flomatic Corporation.

e. Toro Company (The); Irrigation Div.

f. Watts Industries, Inc.; Water Products Div.

g. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1020.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.

5. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

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.

2. Standard: ASSE 1056.

3. Operation: Continuous-pressure applications.

4. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products 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. Body: Bronze for NPS 2 and smaller; stainless steel for NPS 2-1/2 and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed for horizontal, straight through flow.

8. 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.

9. Flood Control Valves:

   a. Application: backflow preventers 2-1/2 inch and larger.

   b. Flood control valve by same manufacturer as backflow preventer.

   c. Solenoid Valve:
      1) Standard: ANSI/AWWA C530 and NSF/ANSI 61.
      2) Pressure Rating: ANSI Class 150: 250 psig maximum.
      3) Body: Ductile iron ASTM A536.
      4) Trim: Stainless Steel
      5) End Connections: Flanged.
      6) Normally open operation with manual operator on solenoid valve.

   d. Controller Features:
      1) Automatic closure of solenoid valve upon detection of relief valve discharge.
      2) Time delay function to prevent activation due to intermittent discharges of less than 50 gallons.
      3) Input from and output to building automation system for activation and monitoring. Activation shall occur based on auxiliary water detection device. Upon activation, the operator interface shall be notified.

B. Beverage-Dispensing-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 Plumbing Products Group; 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. Hose-Connection 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. Woodford Manufacturing Company.

2. Standard: ASSE 1052.

3. Operation: Up to 10-foot head of water back pressure.

4. Inlet Size: NPS 1/2 or NPS 3/4.

5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.

6. Capacity: At least 3-gpm flow.

2.03 WATER PRESSURE-REDUCING VALVES

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

1. Cash Acme.

2. Conbraco Industries, Inc.

3. Honeywell Water Controls.

4. Watts Industries, Inc.; Water Products Div.

5. Zurn Plumbing Products Group; Wilkins Div.

B. Standard: ASSE 1003.

C. Pressure Rating: Initial working pressure of 150 psig.

D. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.

E. Valves for Booster Heater Water Supply: Include integral bypass.

F. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.04 FLOOD CONTROL VALVES

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

1. Watts Industries, Inc.; Water Products Div.

2. Zurn Plumbing Products Group; Wilkins Div.

B. Solenoid Valve:

1. Standard: ANSI/AWWA C530 and NSF/ANSI 61.

2. Pressure Rating: ANSI Class 150: 250 psig maximum.

3. Body: Ductile iron ASTM A536.

4. Trim: Stainless Steel

5. End Connections: Flanged.

6. Normally open operation with manual operator on solenoid valve.

C. Controller:

1. Features:

a. Automatic closure of solenoid valve upon detection of relief valve discharge.

b. Time delay function to prevent activation due to intermittent discharges of less than 50 gallons.

c. Input from and output to building automation system for activation and monitoring. Activation shall occur based on auxiliary water detection device. Upon activation, the operator interface shall be notified.

2.05 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

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

a. Armstrong International, Inc.

b. Flo Fab Inc.

c. ITT Industries; Bell & Gossett Div.

d. NIBCO INC.

e. TAC Americas.

f. Taco, Inc.

g. Watts Industries, Inc.; Water Products Div.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.

3. Body: Brass or bronze.

4. Size: Same as connected piping, but not larger than NPS 2.

2.06 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

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

a. Armstrong International, Inc.

b. Leonard Valve Company.

c. Powers; a Watts Industries Co.

d. Symmons Industries, Inc.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psig.

4. Type: Thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded or union inlets and outlet.

7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Valve Finish: Provide chrome plated finish in occupied areas. In non-occupied areas Rough bronze is acceptable.

B. Primary, Thermostatic, Water Mixing Valves:

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

a. Armstrong International, Inc.

b. Lawler Manufacturing Company, Inc.

c. Leonard Valve Company.

d. Powers; a Watts Industries Co.

e. Symmons Industries, Inc.

2. Standard: ASSE 1017.

3. Pressure Rating: 125 psig.

4. Type: Exposed-mounting, thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.

6. Connections: Threaded or union inlets and outlet.

7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

9. Valve Finish: Polished, chrome plated in occupied areas.

10. Piping Finish: Chrome plated in occupied areas.

C. Individual-Fixture, Water Tempering Valves:

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

a. Cash Acme.

b. Conbraco Industries, Inc.

c. Honeywell Water Controls.

d. Lawler Manufacturing Company, Inc.

e. Leonard Valve Company.

f. Powers; a Watts Industries Co.

g. Watts Industries, Inc.; Water Products Div.

h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1016, thermostatically controlled water tempering valve.

3. Pressure Rating: 125 psig minimum, unless otherwise indicated.

4. Body: Bronze body with corrosion-resistant interior components.

5. Temperature Control: Adjustable.

6. Inlets and Outlet: Threaded.

7. Finish: Rough or chrome-plated bronze.

2.07 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. Perforation Size:

a. Strainers NPS 2 and Smaller: 0.062 inch.

b. Strainers NPS 2-1/2 to NPS 4: 0.125 inch.

c. Strainers NPS 5 and Larger: 0.25 inch.

6. Drain: Provide hose-end drain valve in mechanical rooms. Provide end plug for above ceiling or occupied area locations.

2.08 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

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

a. Acorn Engineering Company.

b. Guy Gray Manufacturing Co., Inc.

c. IPS Corporation.

d. LSP Products Group, Inc.

e. Oatey.

f. Plastic Oddities; a division of Diverse Corporate Technologies.

g. Symmons Industries, Inc.

h. Watts Industries, Inc.; Water Products Div.

i. Whitehall Manufacturing; a div. of Acorn Engineering Company.

j. Zurn Plumbing Products Group; Light Commercial Operation.

2. Mounting: Recessed.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.

5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.

6. Drain: NPS 2 inch, unless noted otherwise on plans, standpipe and P-trap for direct waste connection to drainage piping.

7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.

8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

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

a. Acorn Engineering Company.

b. IPS Corporation.

c. LSP Products Group, Inc.

d. Oatey.

e. Plastic Oddities; a division of Diverse Corporate Technologies.

2. Mounting: Recessed.

3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.

4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.

5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.09 HOSE BIBBS

A. Hose Bibbs:

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

a. Josam Company.

b. MIFAB, Inc.

c. Prier Products, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Woodford Manufacturing Company.

h. Zurn Plumbing Products Group; Light Commercial Operation.

i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.18.1 for sediment faucets.

3. Body Material: Bronze.

4. Seat: Bronze, replaceable.

5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.

6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

7. Pressure Rating: 125 psig.

8. Vacuum Breaker: Integral or field-installation, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.

10. Finish for Finished Rooms: Chrome or nickel plated.

11. Operation for Equipment Rooms: Wheel handle.

12. Operation for Finished Rooms: Wheel handle.

13. Include operating key with each operating-key hose bibb.

14. Include wall flange with each chrome- or nickel-plated hose bibb.

2.10 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

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

a. Josam Company.

b. MIFAB, Inc.

c. Prier Products, Inc.

d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Woodford Manufacturing Company.

h. Zurn Plumbing Products Group; Light Commercial Operation.

i. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.

3. Pressure Rating: 125 psig.

4. Operation: Loose key.

5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.

6. Inlet: NPS 3/4 or NPS 1.

7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

8. Box: Deep, flush mounting with cover.

9. Box and Cover Finish: Polished nickel bronze.

10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.

11. Nozzle and Wall-Plate Finish: Polished nickel bronze.

12. Operating Keys(s): One with each wall hydrant.

2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Size: NPS 3/4.

2. Refer to valve specification for ball valve requirements as applicable to system type and pressure. Provide the following additional accessories:

3. Size: NPS 3/4.

4. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 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: Metal bellows.

4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.13 TRAP-SEAL PRIMER VALVES

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

1. MIFAB, Inc.

a. PPP Inc.

b. Sioux Chief Manufacturing Company, Inc.

c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

d. Watts Industries, Inc.; Water Products Div.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig minimum.

4. Body: Bronze.

5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.

6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.

7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.14 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

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

a. PPP Inc.

2. Standard: ASSE 1044.

3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.

4. Cabinet: Surface-mounting steel box with stainless-steel cover.

5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.

6. Vacuum Breaker: ASSE 1001.

7. Number Outlets: Four.

8. Size Outlets: NPS 1/2.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Mechanical" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply entrance and at each connection to equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Install drain for backflow preventers with pressure relief fittings using air-gap fitting. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

2. Route drain for backflow preventer relief to nearest floor drain. Floor drain shall have a waste connection size at least that of the backflow preventor relief piping.

3. Install flood control valves on all reduced pressure type backflow preventors 2-1/2” and larger. Connect all accessories, sensors, wiring and controls necessary for proper operation. Connect flood control valve controller to building automation system.

4. Install water detector at each backflow preventer location. Connect water detector to building automation system.

5. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

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 Y-pattern strainers for water on supply side of each water meter, control valve, water pressure-reducing valve, solenoid valve, and pump.

F. Install outlet boxes recessed in wall. Reinforce outlet boxes between studs using 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement or metal brackets.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical."

C. Connect wiring according to Division 26 Section "Conductors and Cables for Electrical."

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each backflow preventer according to authorities having jurisdiction and the device`s reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.04 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221123 - DOMESTIC WATER PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Circulators.

1.02 RELATED REQUIREMENTS

A. Section 220513 - Common Motor Requirements for Plumbing Equipment.

B. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

C. Section 253500 - Integrated Automation Instrumentation and Terminal Devices for HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata (2023).

B. ASME A13.1 - Scheme for the Identification of Piping Systems; 2020.

C. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NSF 61 - Drinking Water System Components - Health Effects; 2019.

F. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:

1. Provide certified pump curve with duty point marked over pump and system operating conditions and NPSH curve and power requirement by pump tag.

2. Manufacturer's catalog sheets for fixtures, fittings, accessories, and supplies.

C. Shop Drawings: Include dimensions and performance data.

D. Project Record Documents: Record actual locations of components.

1.05 QUALITY ASSURANCE

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

B. Certifications: Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc, as suitable for purpose specified and indicated.

C. Identification: Provide pumps with manufacturer's name, model number, and rated capacity identified by permanently attached label.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

A. See Section 017800 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 1-year manufacturer warranty for pumps except circulator type. Complete forms in Owner's name and register with manufacturer.

C. Manufacturer Warranty: Provide 5-year manufacturer warranty for circulators. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 CIRCULATORS

A. Manufacturers:

1. Bell & Gossett, a Brand of Xylem, Inc: www.xylem.com/#sle.

2. Grundfos Pumps Corporatio: www.grundfos.com/#sle.

B. Casing: Cast iron with impeller, and stainless steel rotor assembly.

C. Shaft: Alloy steel with integral thrust collar and two oil-lubricated bronze sleeve bearings.

D. Mechanical Seal: Carbon rotating against a stationary ceramic seat.

E. Pipe-End Connection: Flange connection.

F. Maximum Discharge Pressure: 145 psi (1000 kPa).

G. Motor: 1,750 rpm, ECM duty with flexible coupling.

H. Service Temperature Range: Minus 30 to 250 degrees F (Minus 34.4 to 121.1 degrees C).

I. Controls: Provide aquastat set for high-temp cutoff, electric plug, and illuminated hand switch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products with related fittings, and accessories according to manufacturer instructions.

B. Potable and Drinking Water Service: Provide NSF 61 certified; comply with ICC (IPC).

C. Electrical-Driven Pump Work:

1. Provide electric-motor-driven equipment specified complete with local disconnect switch and control panel with starter, controls, safety devices, and related wiring.

2. Provide automatic control and protective devices field-wired to interface-related devices required for specified operation.

D. Ensure that small pressure gauges are installed on both upstream and downstream ends.

E. Factory-Provided Pump Controls: Factory provided, tested for use.

F. ECM, VSD, or VFD Controlled Motors: Configure unit to operate within manufacturer-listed pump curve points unless factory set to do so. Then adjust to operate in automatic to maintain downstream pressure setpoint.

G. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are nonoverloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

H. Coordinate BAS, BMS, or Integrated Automation linking between unit controller and remote software app or terminal; see Section 253500.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Operational Tests: Upon completion and sterilization of plumbing systems, conduct operating tests to demonstrate satisfactory, functional, and operating efficiency.

3.03 CLEANING

A. Thoroughly clean plumbing fixtures and equipment.

3.04 PROTECTION

A. Protect installed products from damage due from subsequent construction operations.

B. Repair or replace products damaged before Date of Substantial Completion.

END OF SECTION 221123

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.
3. Encasement for underground piping.

1.02 SUBMITTALS

A. Action Submittals:

1. Product Data: For pipe, tube, fittings, and couplings.

B. Informational Submittals:

1. Field quality-control inspection and test reports.

1.03 QUALITY ASSURANCE

A. Piping and fittings marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) or receive prior approval of the Engineer.

B. Plastic piping to Comply with NSF-14, “Plastic Piping Systems Components and Related Materials” and be marked accordingly.

1.04 PERFORMANCE REQUIREMENTS

A. Components and installation capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.05 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.

G. CISPI: Cast Iron Soil Pipe Institute.

H. CPVC: Chlorinated polyvinyl chloride.

PART 2 -PRODUCTS

2.01 MANUFACTURERS

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

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

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

2.03 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Charlotte Pipe and Foundry Co.

C. Shielded Couplings: ASTM C 1277C or ASTM C 1540 Heavy Duty Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

1. Manufacturers:

a. ANACO-Husky.

b. Fernco, Inc.

c. Ideal Div.; Stant Corp.

d. Mission Rubber Co.

e. Tyler Pipe; Soil Pipe Div.

2.04 DWV PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, Schedule 40.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 and matched to pipe material and pipe schedule.

C. PVC Solvent Cement and Adhesive Primer:

1. ASTM D2564 solvent cement with VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2. Primer with VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.05 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:

a. Dallas Specialty & Mfg. Co.

b. Fernco, Inc.

c. Logan Clay Products Company (The).

d. Mission Rubber Co.

e. NDS, Inc.

f. Plastic Oddities, Inc.

2. Sleeve Materials:

a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.

b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

PART 3 -EXECUTION

3.01 PIPING APPLICATIONS

A. Do not locate cleanouts in and above:

1. Electrical and communications rooms.

2. Other locations indicated on drawings.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil, waste, and vent piping:

1. Hubless cast-iron soil pipe and fittings; heavy duty shielded, stainless-steel couplings; and hubless-coupling joints.

D. Underground, soil, waste, and vent piping:

1. Service class, cast-iron soil piping; and gasketed joints.

2. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

3. Dissimilar Pipe-Material Couplings: Flexible, shielded, nonpressure pipe couplings for joining dissimilar pipe materials with small difference in OD.

3.02 PIPING INSTALLATION

A. Sanitary waste piping outside the building are specified in Division 02.

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Mechanical."

C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

E. Install mechanical sleeve seal at every penetration through exterior foundation wall. Installation to be watertight.

F. 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. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

G. 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.

H. 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.

I. Install soil and waste drainage and vent piping at no less than the minimum slopes allowed by state or local plumbing code.

J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

K. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.03 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI`s "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI`s "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section “Hangers and Supports for Mechanical”. 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.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters. Support at every hub or every coupling within 18 inches of the hub or coupling. Installations that require multiple joints within a four-foot developed length may be supported at every other or alternating hub or coupling when approved.

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.

E. Install supports for vertical cast-iron soil piping every 15 feet and at each floor

F. Restrain joints and install sway bracing as needed to stabilize side movement and at changes in direction.

3.05 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.

3.06 FIELD QUALITY CONTROL

A. Prior to connecting a new structure sanitary sewer to a previous building's sewer, the original sewer must be flushed thoroughly with water and tested with an electronic video inspection performed in the presence of the Plumbing Inspector. The electronic inspection may be recorded and submitted for later review if approved by the Inspector.

B. 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.

C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

E. 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.

3.07 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.

3.08 PROTECTION

A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Miscellaneous sanitary drainage piping specialties.
4. Flashing materials.

1.02 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.

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

a. Drains.

B. Informational Submittals:

1. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.04 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.

PART 2 -PRODUCTS

2.01 CLEANOUTS

A. Exposed Metal Cleanouts:

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

   a. Josam Company; Josam Div.

   b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

   c. Tyler Pipe; Wade Div.

   d. Watts Drainage Products Inc.

   e. Zurn Plumbing Products Group; Specification Drainage Operation.

   f. Josam Company; Blucher-Josam Div.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.

3. Size: Same as connected drainage piping

4. Body Material: As required to match connected piping.

5. Closure: Raised-head, plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. 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. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

   e. Tyler Pipe; Wade Div.

   f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Light Commercial Operation.

h. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard and type: ASME A112.36.2M for threaded, adjustable housing cleanout.

3. Size: Same as connected branch.

4. Body or Ferrule: Cast iron.

5. Clamping Device: Required on all floors above base slab.

6. Outlet Connection: compatible with piping system.

7. Closure: Brass plug with threads and gasket.

8. Adjustable Housing Material: Cast iron with threads.

9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.

10. Frame and Cover Shape: Round.

11. Top Loading Classification: Extra Heavy Duty.

12. Riser: ASTM A 74, Extra-Heavy class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

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

a. Josam Company; Josam Div.

b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

c. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.

3. Size: Same as connected drainage piping.

4. Body: As required to match connected piping.

5. Closure: Countersunk or raised-head, plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

8. Wall Access: Round, wall-installation frame wall-installation frame and cover.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains:

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

    a. Josam Company; Josam Div.

    b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

    c. Zurn Plumbing Products Group; Specification Drainage Operation.

2.03 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.

B. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.

4. Outlet: Larger than inlet.

D. 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.

E. 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.

F. Expansion Joints:

1. Standard: ASME A112.21.2M.

2. Body: Cast iron with bronze sleeve, packing, and gland.

3. End Connections: Matching connected piping.

2.04 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. thickness.

2. Vent Pipe Flashing: 8 oz./sq. ft. 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

3.01 INSTALLATION

A. Coordinate all cleanout locations with Architect prior to installation. In hard floor finished areas, extend cleanout to adjacent service space. In tile carpeted areas, install cleanout under carpet tile with carpet marker.

B. Do not install cleanouts or sanitary specialties in electrical and communications rooms.

C. Refer to Division 22 Section "Common Work Results for Mechanical" for piping joining materials, joint construction, and basic installation requirements.

D. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

E. Install cleanouts in aboveground piping and building drain piping according to local code and to the following, and as indicated on plans:

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 40 feet.

4. Locate at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Refer to architectural plans for locations requiring floor sloping to drains.

3. Install drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for drains connected to sanitary building drain, unless otherwise indicated.

I. Install roof flashing on sanitary stack vents and vent stacks that extend through roof.

J. Assemble open drain fittings and install with top of hub 2 inches above floor.

K. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install blocking reinforcement for wall-mounting-type specialties.

N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical."

D. Connect wiring according to Division 26 Section "Conductors and Cables for Electrical."

3.03 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. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, 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 Division 07 Section "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.

3.04 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 223000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial electric water heaters.

B. Water softeners.

1.02 RELATED REQUIREMENTS

A. Section 220548 - Vibration and Seismic Controls for Plumbing Piping and Equipment.

B. Section 221123 - Domestic Water Pumps.

C. Section 251500 - Integrated Automation Software.

D. Section 260583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

B. ICC (IPC) - International Plumbing Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

D. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittals procedures.

B. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Provide electrical characteristics and connection requirements.

1.05 QUALITY ASSURANCE

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

B. Certifications:

1. Water Heaters: NSF approved.

2. Electric Water Heaters: UL listed and labeled to UL 174.

3. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

PART 2 PRODUCTS

2.01 WATER HEATERS

A. Manufacturers:

1. A.O. Smith Water Products Co: www.hotwater.com/#sle.

2. Rheem Manufacturing Company: www.rheem.com/#sle.

B. Commercial Electric Water Heaters:

1. Type: Factory-assembled and wired, electric, vertical storage.

2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.

3. Performance:

4. Electrical Characteristics:

5. Tank: Glass lined welded steel; 4 inch (100 mm) diameter inspection port, thermally insulated with minimum 2 inches (50 mm) glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.

6. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F (16 to 82 degrees C), flanged or screw-in nichrome elements, high temperature limit thermostat.

7. Accessories:

a. Water Connections: Brass.

b. Dip Tube: Brass.

c. Drain valve.

d. Anode: Magnesium.

e. Temperature and Pressure Relief Valve: ASME labeled.

8. Tank: Welded steel ASME labeled pressure vessel; glass lining, mounted on steel channel base with lifting lugs, insulated with 2 inch (50 mm) glass fiber; enclosed with 16 gauge, 0.0598 inch (1.52 mm) steel jacket; baked enamel finish.

9. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.

10. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in (11.6 W/sq m).

2.02 WATER SOFTENERS

A. Salt-Free Water Conditioner Using Catalytic Media Water Conditioner:

1. Manufacturers:

a. Culligan International Company: www.culligan.com/#sle.

b. US Water Systems, Inc: www.uswatersystems.com//#sle.

2. Throughput: Hardness under 3 grains/gallon or ppm (51.3 mg/L).

3. Capacity: Continuous duty, mineral-based cartridge type.

4. Glassfiber reinforced plastic self-standing vertical tank with bypass valve fitting.

5. Connections: manual tank inlet and outlet screwed on bypass fitting.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.

B. Electrical Work: Provide automatic control and protective devices with associated wiring to interconnect related interfaced devices required for specified operation.

C. Coordinate system, equipment, and piping work with applicable electrical, vent, drain, and waste support interconnections as included or provided by other trades.

D. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 251500.

3.02 FIELD QUALITY CONTROL

A. See Section 014000 - Quality Requirements for additional requirements.

B. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 25 1500.

END OF SECTION 223000

SECTION 224000 - PLUMBING FIXTURES

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes the plumbing fixtures and related components:

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

H. PMMA: Polymethyl methacrylate (acrylic) plastic.

I. PVC: Polyvinyl chloride plastic.

J. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

K. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

L. Tepid: Moderately warm.

1.03 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, roughing in drawings, wiring requirements, and flow-control rates.

B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

D. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" and Public Law 101-336, "Americans with Disabilities Act" for plumbing fixtures for people with disabilities.

E. Regulatory Requirements: Comply with requirements in Public Law 102-486 (Energy Policy Act), WaterSense, Energy Star, adopted plumbing code, and drawings regarding water flow and consumption rates for plumbing fixtures. Comply with most stringent requirement.

F. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.

2. Plastic Shower Enclosures: ANSI Z124.2.

3. Slip-Resistant Bathing Surfaces: ASTM F 462.

4. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.

5. Stainless-Steel Residential Sinks: ASME A112.19.3.

6. Vitreous-China Fixtures: ASME A112.19.2M.

7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.

I. 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.

J. Comply with the following applicable standards and other requirements specified for 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. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.

4. Faucets: ASME A112.18.1.

5. Hand-Held Showers: ASSE 1014.

6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.

7. Hose-Coupling Threads: ASME B1.20.7.

8. Manual-Control Antiscald Faucets: ASTM F 444.

9. Pipe Threads: ASME B1.20.1.

10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.

12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

K. 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.

L. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Dishwasher Air-Gap Fittings: ASSE 1021.
2. Flexible Water Connectors: ASME A112.18.6.
3. Floor Drains: ASME A112.6.3.
4. Grab Bars: ASTM F 446.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Off-Floor Fixture Supports: ASME A112.6.1M.
7. Pipe Threads: ASME B1.20.1.
8. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 -PRODUCTS

2.01 FAUCETS

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

1. Chicago Faucets.

2.02 SHOWER MIXING VALVES

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

1. Powers; a Watts Industries Co.
2. Symmons Industries, Inc.

2.03 FLUSHOMETERS

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

1. Sloan Valve Company.

2.04 TOILET SEATS

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

1. Bemis Manufacturing Company.
2. Church Seats.

2.05 ADA PROTECTIVE SHIELDING PIPE COVERS

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

1. TRUEBRO, Inc.

B. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supplies, cold-water supplies, trap, and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.06 FIXTURE SUPPORTS

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

1. Josam Company.

2. Smith, Jay R. Mfg. Co.

3. Zurn Plumbing Products Group; Specification Drainage Operation.

2.07 WATER CLOSETS

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

1. American Standard Companies, Inc.

2. Kohler Co.

2.08 URINALS

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

1. American Standard Companies, Inc.

2. Kohler Co.

2.09 LAVATORIES

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

1. American Standard Companies, Inc.

2. Kohler Co.

2.10 SINKS

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

1. Elkay Manufacturing Co.
2. Just Manufacturing Company.

2.11 INDIVIDUAL SHOWERS

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

1. Comfort Designs.

2.12 MOP SINK BASINS

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

1. Fiat Products.
2. Florestone Products Co., Inc.

2.13 EMERGENCY FIXTURES FOR SHOWERS, EYE WASH, EYE/FACE WASH, OR COMBINATION UNITS.

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

1. Bradley Corporation.
2. Guardian Equipment Co.
3. Haws Corporation.
4. Speakman Company.

2.14 WATER-TEMPERING EQUIPMENT FOR EMERGENCY FIXTURES.

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

1. Bradley Corporation.
2. Haws Corporation.
3. Lawler Manufacturing Co., Inc.
4. Powers, a Watts Industries Co.
5. Speakman Company.

2.15 CLINICAL SINKS

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

1. American Standard Companies, Inc.

2. Kohler Co.

2.16 SURGEONS` SCRUB SINKS

A. Stainless-Steel Surgeons` Scrub Sinks:

1. Refer to medical equipment plans and specifications.

2.17 PLUMBING FIXTURE SCHEDULE

A. See plumbing fixture schedule on drawings.

PART 3 -EXECUTION

3.01 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed. Maintain required rough in dimensions required to meet ADA.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers` written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

2. Use carrier supports without waste fitting for fixtures with tubular waste piping.

3. Use concealed arm type carrier supports with rectangular steel uprights for wall hung lavatories and sinks.

4. Use wide-chase chair-type carrier supports with multiple carrier bodies for fixture installations where the extension of the support bolts is greater than three (3) inches.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to manufacturer furnished roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valves if supply stops or integral stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Mechanical." Valves shall be lockable on emergency fixtures.

2. Exception: Omit shutoff valve on supply to emergency fixtures if prohibited by authorities having jurisdiction.

J. Install chrome plated brass supplies and p-traps on all new and relocated fixtures.

K. 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 Mechanical."

L. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 22 Section "Meters and Gages for Mechanical."

M. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.

N. 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."

O. Install trap and tubular waste piping on drain outlet of each fixture directly connected to sanitary drainage system.

P. Install tubular waste piping on drain outlet of each fixture indirectly connected to drainage system.

Q. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach. The top of the valve and the water supply shall be a minimum of 1-1/2 inches below the bottom of the grab bar for ADA accessible water closets.

R. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

S. Install toilet seats on water closets.

T. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

U. Install shower flow-control fittings with specified maximum flow rates in shower arms.

V. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.

2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

W. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Mechanical."

X. Set bathtubs, shower receptors, and individual showers in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Mechanical." Set fixtures on chlorinated polyethylene waterproof membrane sealed to drain and extended vertically no less than 12 inches along walls.

Y. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color.

1. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical."

D. Connect wiring according to Division 26 Section "Conductors and Cables for Electrical."

E. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

F. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.

G. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.

H. Provide direct or indirect drain piping from medical and kitchen equipment to sanitary waste and vent piping or nearest drain per equipment manufacturer and adopted plumbing code requirements.

3.04 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

F. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

G. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

H. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

I. Document and maintain test results in writing.

3.05 ADJUSTING

A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at fixtures to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

E. Adjust or replace fixture flow regulators for proper flow.

F. Adjust equipment temperature settings.

3.06 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers` recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.

2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

C. Do not allow disposal of any products used during construction into plumbing fixtures and other drains.

END OF SECTION 224000

SECTION 226113 - COMPRESSED-AIR, GAS, AND VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 -GENERAL

1.01 SUMMARY

A. This Section includes the following:

1. Medical air piping and specialties, designated "medical air".
2. Oxygen piping and specialties designated "medical oxygen" operating at 50 to 55 psig.
3. Medical surgical vacuum piping and specialties, designated "medical vacuum" operating at 20 inches mercury.
4. Waste anesthetic gas disposal piping and specialties, designated "WAGD evacuation" operating at 20 inches mercury.

1.02 DEFINITIONS

A. D.I.S.S.: Diameter-index safety system.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

C. Medical Compressed-Air Piping Systems: Include medical air and instrument air piping systems.

D. WAGD: Waste anesthetic gas disposal.

E. Medical vacuum piping systems include medical vacuum and WAGD evacuation piping systems.

F. CR: Chlorosulfonated polyethylene synthetic rubber.

G. Medical gas piping systems include nonflammable gas for healthcare facility patient care or for healthcare laboratory applications.

1.03 SUBMITTALS:

A. Action Submittals: Submit product data for the following:

1. Compressed-air, vacuum, and gas valves and valve boxes.
2. Medical compressed-air, vacuum, and gas service connections.
3. Medical gas alarm system components.

1.04 INFORMATIONAL SUBMITTALS:

A. Certifications: Submit documentation that the installers and testing agency meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: The project's testing agency shall prepare and submit a report on the adequacy of design for systems certification in accordance with the requirements of NFPA 99. The report shall include recommended changes and additions to systems to facilitate certification and compliance. The report shall also include recommended changes and additions to medical gas systems and general construction to allow access for certification.

1. Failure to submit testing agency's review of contract documents will be taken as acknowledgment that the contract documents illustrate a system that will be certified as compliant. Payment for modifications or relocations of components required for certification and not identified due to lack of testing agency review shall be the responsibility of the installing contractor.

C. Diagram power, signal, and control wiring.

D. Brazing certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For compressed-air, vacuum, and gas piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Compressed-Air, Vacuum, and Gas Piping Systems for Healthcare Facilities: Qualify installers according to ASSE Standard #6010.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for inspectors and ASSE Standard #6030 for verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for piping operating at more than 150 psig.

2. Comply with ASME B31.9, "Building Services Piping," for piping operating at 150 psig or less.

F. NFPA Compliance:

1. Comply with NFPA 99, "Health Care Facilities," for medical compressed-air system materials and installation in healthcare facilities.

G. UL Compliance:

1. Comply with UL 544, "Medical and Dental Equipment," for medical gas specialties.

1.06 COORDINATION

A. Confirm service connection types with Owner. Obtain Owner approval in writing prior to ordering materials.

PART 2 -PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Copper Medical Gas Tube: ASTM B 819, Types K and L, seamless, drawn temper, that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and in blue for Type L tube.

1. General Requirements for Copper Fittings: Manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

2. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, with dimensions for brazed joints.

3. Copper Unions: ASME B16.22 or MSS SP-123, wrought copper or cast-copper alloy.

2.02 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

C. Threaded-Joint Tape: PTFE.

D. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, full-face type.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

2.03 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

B. Ball Valves: MSS SP-110, 3-piece body, brass or bronze.

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

a. Amico Corporation.

b. BeaconMedaes.

2. Pressure Rating: 300 psig minimum.

3. Ball: Full-port, chrome-plated brass.

4. Seats: PTFE or TFE.

5. Handle: Lever type with locking device.

6. Stem: Blowout proof with PTFE or TFE seal.

7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

C. Check Valves: In-line pattern, bronze.

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

a. Amico Corporation.

b. BeaconMedaes.

2. Pressure Rating: 300 psig minimum.

3. Operation: Spring loaded.

4. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

D. Zone Valves: MSS SP-110, 3-piece-body, brass or bronze ball valve with gage.

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

a. Amico Corporation.

b. BeaconMedaes.

2. Pressure Rating: 300 psig minimum.

3. Ball: Full-port, chrome-plated brass.

4. Seats: PTFE or TFE.

5. Handle: Lever.

6. Stem: Blowout proof with PTFE or TFE seal.

7. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

8. Pressure Gage: Manufacturer installed on one copper-tube extension.

E. Zone Valve Boxes: Steel or aluminum with anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.

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

   a. Amico Corporation.

   b. BeaconMedaes.

2. Interior Finish: Factory-applied white enamel.

3. Cover Plate: Aluminum or extruded-anodized aluminum, Satin-chrome finish steel, or Stainless steel with NAAMM AMP 503, No. 4 finish with frangible or removable windows.

4. Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

F. Safety Valves: Bronze-body, ASME-construction, poppet, pressure-relief type with settings to match system requirements.

G. Pressure Regulators: Bronze or Stainless Steel body and trim; spring-loaded, diaphragm-operated relieving type; manual pressure-setting adjustment; rated for 250-psig minimum inlet pressure; and capable of controlling delivered pressure within 0.5 psig for each 10-psig inlet pressure.

H. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

2.04 MEDICAL SERVICE CONNECTIONS

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

1. Amico Corporation.

2. BeaconMedaes.

B. General Requirements for Medical Service Connections: For specific pressure and suction service listed. Include roughing-in assemblies, finishing assemblies, and cover plates. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate. Furnish recessed-type units made for concealed piping unless otherwise indicated.

1. Roughing-in Assembly:

   a. Steel outlet box for recessed mounting and concealed piping.

   b. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed. Suction inlets to be without secondary valve.

   c. Double seals that will prevent gas leakage.

   d. ASTM B 819, NPS 3/8 copper outlet tube brazed to valve with service marking and tube-end dust cap.

2. Finishing Assembly:

   a. Brass housing with primary check valve.

b. Double seals that will prevent gas leakage.

c. Cover plate with gas-service label.

3. Quick-Coupler Service Connections: Pressure outlet with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

4. Quick-Coupler Service Connections: Suction inlets for service outlets with noninterchangeable keyed indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment, and with positive-locking ring that retains equipment stem in valve during use.

5. D.I.S.S. Service Connections: Pressure outlets, complying with CGA V-5, with threaded indexing to prevent interchange between services, constructed to permit one-handed connection and removal of equipment.

6. Cover Plates: One piece, finished metal with permanent, color-coded, identifying label matching corresponding service. Plastic cover plates not allowed.

7. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

2.05 CEILING COLUMNS

A. General Requirements for Ceiling Columns: Ceiling-mounting units with medical gas service connections as specified in "Medical Gas Service Connections" Article and electrical service connections as specified in "Electrical Service Connections" Article. Include labels indicating services, and the following:

1. Ceiling-Mounting Plate: Manufacturer`s standard plate or roughing-in assembly.

2. Exposed Surfaces: Minimum 0.0375-inch- thick stainless steel with NAAMM AMP 503, No. 4 directional polish.

3. Servicing: Include access panels or means of removing shroud.

4. Blank cover plates for cutouts not having service connections.

5. ASTM B 819, NPS 3/8 copper-tube extensions for connection to medical gas systems.

6. Service Connections: Type and number indicated.

7. Dust Covers: For medical gas service connection.

B. Rigid Ceiling Columns: rectangular fixed column section with intravenous medication hooks. Include 0.078-inch- thick, stainless-steel bottom plate with the following service connections:

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

a. BeaconMedaes.

2.06 MEDICAL ALARM SYSTEMS

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

1. Amico Corporation.

2. BeaconMedaes.

B. Panels may be combined in single panels with medical compressed air, medical vacuum, and medical gas piping systems.

C. Components: Designed for continuous service and to operate on power supplied from 120-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.

D. Dew Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Alarm signals when pressure dew point rises above 39 deg F at 55 psig.

1. Operation: Chilled-mirror method or hygrometer moisture analyzer with sensor probe.

E. Pressure Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Low-Pressure Operating Range: 0- to 100-psig.

2. High-Pressure Operating Range: Up to 250-psig.

F. Vacuum Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Vacuum Operating Range: 0- to 30-on Hg.

G. Carbon Monoxide Monitors: Panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, and factory- or field-installed valved bypass. Alarm signals when carbon monoxide level rises above 10 ppm.

H. General Requirements for Medical Alarm Panels: Factory wired with audible and color-coded visible signals to indicate specified functions.

1. Mounting:

a. Mechanical rooms: Exposed, surface mounting.

b. Finished areas: Recessed installation.

2. Enclosures: Fabricated from minimum 0.047 thick steel or minimum 0.05-inch- thick aluminum, with knockouts for electrical and piping connections.

I. Master Alarm Panels: Separate trouble alarm signals, pressure gages, and indicators for medical compressed-air, vacuum, and gas piping systems.

1. Include alarm signals when the following conditions exist:

a. Medical Air: Pressure drops below 40 psig or rises above 60 psig, backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig, dew point rises above 39 deg F at 55 psig, carbon monoxide level rises above 10 ppm, high water level is reached in receiver, and high discharge air temperature.

b. Instrument Air, Compressed-Air Equipment: Pressure drops below 165 psig or rises above 185 psig, backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig, de point rises above 39 deg F at 55 psig, and high water level is in receiver.

c. Medical Oxygen: Pressure downstream from main shutoff valve drops below 40 psig or rises above 60 psig and changeover is made to alternate bank.

d. Medical Vacuum: Vacuum drops below 12-in. Hg, backup vacuum pump is in operation, and high water level in receiver.

J. Area Alarm Panels: Separate trouble alarm signals, pressure/vacuum gages, and indicators for medical piping systems.

1. Include alarm signals when the following condition exists:

a. Medical Air: Pressure drops below 40 psig or rises above 60 psig.

b. Medical Oxygen: Pressure drops below 40 psig or rises above 60 psig.

c. Medical Vacuum: Vacuum drops below 12-in Hg.

2.07 NITROGEN

A. Description: Comply with USP 28 - NF 23 for oil-free dry nitrogen.

2.08 WIRING/CABLING IDENTIFICATION

A. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with preprinted numbers and letter.

B. Colored Adhesive Marking Tape for banding Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mils thick by 1 inch to 2 inches in width.

PART 3 -EXECUTION

3.01 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing are not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.02 PIPING APPLICATIONS

A. Medical Air Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

B. Instrument Air Piping:

1. NPS 3 and Smaller: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

C. Medical Gas Piping: Use Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

D. Medical Vacuum Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

E. WAGD Evacuation Piping: Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

F. Drain Piping: Refer to Division 23 “Hydronic Piping” for condensate drain piping.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, equipment sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Comply with ASSE Standard #6010 for installation of piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install air, vacuum, and drain piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating unless otherwise indicated.

I. Install eccentric reducers where compressed-air and vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and pressure gage on discharge piping from each manifold, air compressor and on each receiver. Comply with requirements in Division 22 Section "Meters and Gages for Mechanical."

L. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator. Comply with requirements in Division 22 Section "Meters and Gages for Mechanical."

M. Install piping to permit valve servicing.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install medical piping to medical service connections specified in this Section, and to equipment specified in other Sections requiring medical service.

Q. Install interconnecting piping for field assembled equipment.

R. Install service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

S. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.

T. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

3.04 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from equipment and specialties.

B. Install check valves to maintain correct direction of flow from equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install safety valves on receivers where required by NFPA 99 and where recommended by specialty manufacturers.

F. Install pressure regulators on piping where reduced pressure is required.

G. Install automatic drain valves on equipment, specialties, and piping with drain connection. Run drain piping to floor drain so contents spill over or into it.

H. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor and suction inlet piping to each vacuum producer.

3.05 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings according to CDA`s "Copper Tube Handbook," "Brazed Joints" Chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

E. Flanged Joints:

1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

3.06 MEDICAL PIPING ALARM SYSTEM INSTALLATION

A. Alarm panels for medical piping systems may be combined in single panels.

B. Install alarm system components for medical gas piping according to and in locations required by NFPA 99.

C. Install area and master alarm panels for medical piping system where indicated.

3.07 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Mechanical" for seismic-restraint devices.

B. Comply with requirements in Division 22 Section "Hangers and Supports for Mechanical" for pipe hanger and support devices.

3.08 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for nonmedical laboratory piping, valves, wiring and specialties. Comply with requirements in Division 22 Section "Mechanical Identification."

B. Install identifying labels and devices for medical piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99.

C. Alarm Circuit Identification: Tag or label conductors as follows:

1. For control and communications/signal wiring, use colored marking tape and wire/cable designation tape markers at terminations in wiring boxes, troughs, and control cabinets. Use colors consistent with NFPA 99 and indicated above for system type and consistent letter/number conductor designations throughout on wire/cable marking tape.

2. Match identification markings with designations used in equipment shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

3. Identify Junction, Pull and Connection Boxes: Identification of systems and circuits shall indicate system and identity of contained circuits on outside of box cover. Labeling shall be 3/8-inch Kroy tape or Brother self-adhesive label color-coded same as conduits or permanent magic marker (color coded), neatly hand printed. In rooms that are painted out, provide labeling on inside of cover.

4. Provide typed legend of wire/cable wiring indicating tag, color, system, signal, starting room name and ending room name.

3.09 FIELD QUALITY CONTROL FOR MEDICAL PIPING IN HEALTHCARE FACILITIES

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections of medical compressed-air piping in healthcare facilities and prepare test reports.

B. Perform tests and inspections of medical compressed-air piping systems in healthcare facilities and prepare test reports.

C. Tests and Inspections:

1. Medical Testing Coordination: Perform tests, inspections, verifications, and certification concurrently for all medical systems.

2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:

a. Initial blowdown.

b. Initial pressure test.

c. Cross-connection test.

d. Piping purge test.

e. Standing pressure test for positive-pressure and vacuum piping.

f. Repair leaks and retest until no leaks exist.

3. System Verification: Comply with requirements in NFPA 99, ASSE Standard #6020, and ASSE Standard #6030 for verification of medical piping systems and perform the following tests and inspections:

a. Standing pressure test.

b. Cross-connection test.

c. Valve test.

d. Master and area alarm tests.

e. Piping purge test.

f. Piping particulate test.

g. Piping purity test.

h. Final tie-in test.

i. Operational pressure test.

j. Operational vacuum test.

k. Medical air purity test.

l. Medical gas concentration test.

m. Verify correct labeling of equipment and components.

n. Verify medical source equipment.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

a. Inspections performed.

b. Procedures, materials, and gases used.

c. Test methods used.

d. Results of tests.

D. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.10 DEMONSTRATION

A. Train Owner`s maintenance personnel to adjust, operate, and maintain equipment and alarm systems. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 226113

SECTION 226213 - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Medical-surgical vacuum piping, designated "medical vacuum."

1.03 DEFINITIONS

A. HVE: High-volume (oral) evacuation.

B. WAGD: Waste anesthetic gas disposal.

C. Medical vacuum piping systems include medical vacuum, WAGD, dental vacuum, HVE, and medical laboratory vacuum piping systems.

D. Nonmedical laboratory vacuum piping systems include laboratory low-vacuum and laboratory high-vacuum piping systems.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that medical vacuum piping materials comply with requirements in NFPA 99.

C. Brazing certificates.

D. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

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

1.07 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. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.

a. Medical Vacuum: Equal to 5 percent of amount installed, but no fewer than 3 units.

2. I.S.S. Service Connections: Furnish complete medical vacuum suction inlets complying with CGA V-5.

a. Medical Vacuum D.I.S.S. No. 1220: Equal to 5 percent of amount installed, but no fewer than 3 units.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Vacuum Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.

2. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.

3. Extruded-Tee Outlet Procedure: An authorized representative who is trained and approved by manufacturer.

4. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Medical vacuum operating at 20 in. Hg (510 mm Hg).

2.02 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical vacuum piping materials.

B. Copper Medical Gas Tube: ASTM B 819, Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in blue.

C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and sealed for medical gas service or according to CGA G-4.1 for oxygen service.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

F. Flexible Pipe Connectors:

1. Flex-Hose or equivalent

2. Description: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

a. Working-Pressure Rating: 200 psig (1380 kPa) minimum.

b. End Connections: Plain-end copper tube.

2.03 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.04 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

1. Exception: Factory cleaning and bagging are not required for valves for WAGD service.

B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:

a. Steel Box with Aluminum Cover:
1) Beacon Medaes or equal.

b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
1) Interior Finish: Factory-applied white enamel.
2) Cover Plate: Aluminum with frangible or removable windows.

3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Copper-Alloy Ball Valves:

1. Beacon Medaes or equal.

2. Standard: MSS SP-110.

3. Description: Three-piece body, brass or bronze.

4. Pressure Rating: 300 psig (2070 kPa) minimum.

5. Ball: Full-port, chrome-plated brass.

6. Seats: PTFE or TFE.

7. Handle: Lever type with locking device.

8. Stem: Blowout proof with PTFE or TFE seal.

9. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions and manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Beacon Medaes or equal.

2. Description: In-line pattern, bronze.

3. Pressure Rating: 300 psig (2070 kPa) minimum.

4. Operation: Spring loaded.

5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

2.05 MEDICAL VACUUM SERVICE CONNECTIONS

A. General Requirements for Medical Vacuum Service Connections:

1. Suitable for specific medical vacuum service listed.

2. Include roughing-in assemblies, finishing assemblies, and cover plates.

3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.

4. Recessed-type units made for concealed piping unless otherwise indicated.

B. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.

2. Brass-body inlet block.

3. Seals that will prevent vacuum leakage.

4. ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.

C. Finishing Assembly:

1. Brass housing with primary check valve.

2. Seals that will prevent vacuum leakage.

3. Cover plate with gas-service label.

D. Quick-Coupler Suction Service Connections:

1. Inlets for medical vacuum with noninterchangeable keyed indexing to prevent interchange between services.

2. Constructed to permit one-handed connection and removal of equipment.

3. With positive-locking ring that retains equipment stem in valve during use.

E. I.S.S. Suction Service Connections:

1. Inlets complying with CGA V-5.

2. Threaded indexing to prevent interchange between services.

3. Constructed to permit one-handed connection and removal of equipment.

4. Medical Vacuum: CGA V-5, D.I.S.S. No. 1220.

5. WAGD: CGA V-5, D.I.S.S. No. 2220.

F. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

G. Cover Plates:

1. One piece.

2. stainless steel.

3. Permanent, color-coded, identifying label matching corresponding service.

2.06 NITROGEN

A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

PART 3 EXECUTION

3.01 PREPARATION

A. All tubing and fittings shall be especially prepared and cleaned for the gas service intended and shall conform to NFPA 99.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of vacuum piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install vacuum piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.

O. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.

P. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Q. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

R. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.

S. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.

T. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.04 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Apply appropriate tape to external pipe threads.

E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

F. Soldered Joints: Apply ASTM B 813, water-flushable flux to tube end. Join copper tube and fittings according to ASTM B 828.

G. Flanged Joints:

1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.

2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.

7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.

8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.

J. Install supports for vertical copper tubing every 10 feet (3 m).

3.06 IDENTIFICATION

A. Install identifying labels and devices for laboratory vacuum piping, valves, and specialties. Comply with requirements in Section 200553 "Mechanical Identification”.

B. Install identifying labels and devices for medical vacuum piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:

1. Medical Vacuum: Black letters on white background.

2. WAGD: White letters on violet background.

3.07 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and to prepare test and inspection reports.

B. All new piping, valves and fittings installed under this section shall be tested as described under each individual gas section. These tests shall be made on the new work only. The contractor shall verify the presence of the desired gas in all outlets served by the new piping. This shall be done with an analyzer and a written certification of these tests (for each gas) shall be made to the Architect by the Plumbing Contractor and the company certifying the medical gas system.

C. A final test of the medical gas system (all gases and vacuum) shall be made prior to turning the building over to the Owner. This test shall be made by an independent testing company with three or more years experience in certification of medical gas systems. This independent company shall be certified by MGPHCO or NITC. A written certification from this testing company shall be turned over to the Owner and the Architect. The certification shall include only the medical gas system installed under this contract. These tests and certification shall comply with the requirements and recommendations of N.F.P.A. 99. The cost of this certification shall be included in the Plumbing Contract. The certification shall include a recertification of the existing system as required by N.F.P.A. and the health authorities having jurisdiction.

D. Tests and Inspections:

1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical gas piping systems.

2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:

   a. Initial blowdown.

   b. Initial pressure test.

   c. Cross-connection test.

   d. Piping purge test.

   e. Standing pressure test for vacuum systems.

   f. Repair leaks and retest until no leaks exist.

3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:

   a. Standing pressure test.

   b. Individual-pressurization or pressure-differential cross-connection test.

   c. Valve test.

   d. Master and area alarm tests.

   e. Piping purge test.

   f. Final tie-in test.

   g. Operational vacuum test.

   h. Verify correct labeling of equipment and components.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

   a. Inspections performed.

   b. Procedures, materials, and gases used.

   c. Test methods used.

   d. Results of tests.

E. Inspections shall be conducted by a person(s) competent and experienced in the field of medical gas and vacuum pipeline inspections and testing and meeting the requirements of ASSE 6020 or ASSE 6030.

F. The initial pressure test performed by the installing contractor shall be witnessed by an ASSE 6020 inspector an ASSE 6030 verifier, or the AHJ or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of test as required by NFPA 99.

G. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.08 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.09 PIPING SCHEDULE

A. Flanges may be used where connection to flanged equipment is required.

B. Medical Vacuum Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves:

   1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

B. Zone Valves: Copper-alloy ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 226213

SECTION 226313 - GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 -GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Oxygen piping, designated "medical oxygen."

B. Contractor-Furnished Material:

1. Ceiling column.

C. Related Requirements:

1. Section 226400 "Medical Gas Alarms" for combined medical air, vacuum, and gas alarms.

1.03 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. Medical gas piping systems include medical carbon dioxide, medical helium, medical nitrogen, , and medical oxygen for healthcare facility patient care.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that medical gas piping materials comply with requirements in NFPA 99 for positive-pressure medical gas systems.

C. Brazing certificates.

D. Certificates of Shop Inspection and Data Report for Bulk Gas Storage Tanks: As required by ASME Boiler and Pressure Vessel Code.

E. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For medical and specialty gas piping specialties to include in emergency, operation, and maintenance manuals.

1.07 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. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical gas pressure outlets and suction inlets.

a. Medical Carbon Dioxide: Equal to 5 percent of quantity installed, but no fewer than 5 units.

b. Medical Oxygen: Equal to 5 percent of quantity installed, but no fewer than 5 units.

2. I.S.S. Service Connections: Furnish complete medical gas pressure outlets and suction inlets complying with CGA V-5.

a. Medical Oxygen D.I.S.S. No. 1240: Equal to 5 percent of quantity installed, but no fewer than 5 units.

b. Medical Air D.I.S.S. No. 1160: Equal to 5 percent of quantity installed, but no fewer than 5 units.

1.08 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Gas Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for medical-gas-system installers.

2. Bulk Medical Gas Systems for Healthcare Facilities: According to ASSE Standard #6015 for bulk-medical-gas-system installers.

3. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for medical-gas-system inspectors and ASSE Standard #6030 for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Medical oxygen operating at 50 to 55 psig (345 to 380 kPa).

2.02 PIPES, TUBES, AND FITTINGS

A. Comply with NFPA 99 for medical gas piping materials.

B. Copper Medical Gas Tube: ASTM B 819, Type K and Type L, seamless, drawn temper that has been manufacturer cleaned, purged, and sealed for medical gas service; or according to CGA G-4.1 for oxygen service. Include standard color marking "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED" in green for Type K tube and blue for Type L tube.

C. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type that has been manufacturer cleaned, purged, and bagged for oxygen service according to CGA G-4.1.

D. Copper Unions: ASME B16.22 or MSS SP-123, wrought-copper or cast-copper alloy.

E. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150.

1. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness, full-face type.

2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel.

2.03 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

2.04 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to CGA G-4.1 for oxygen service.

B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:

a. Steel Box with Aluminum Cover:
1) Beacon Medaes or equal.

b. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
1) Interior Finish: Factory-applied white enamel.
2) Cover Plate: Aluminum with frangible or removable windows.
3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to NFPA 99.

C. Ball Valves:

1. Beacon Medaes or equal.
2. Standard: MSS SP-110.
3. Description: Three-piece body, brass or bronze.
4. Pressure Rating: 300 psig (2070 kPa) minimum.
5. Ball: Full-port, chrome-plated brass.
6. Seats: PTFE or TFE.
7. Handle: Lever[type with locking device].
8. Stem: Blowout proof with PTFE or TFE seal.
9. Ends: manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

D. Check Valves:

1. Beacon Medaes or equal.
2. Description: In-line pattern, bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Operation: Spring loaded.
5. Ends: Manufacturer-installed ASTM B 819, copper-tube extensions.

E. Safety Valves:

1. Bronze body.
2. ASME-construction, poppet, pressure-relief type.
3. Settings to match system requirements.

F. Pressure Regulators:

1. Bronze body and trim.
2. Spring-loaded, diaphragm-operated, relieving type.
3. Manual pressure-setting adjustment.
4. Rated for 250-psig (1725-kPa) minimum inlet pressure.
5. Capable of controlling delivered gas pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

2.05 NITROGEN

A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

PART 3 EXECUTION

3.01 PREPARATION

A. All tubing and fittings shall be especially prepared and cleaned for the gas service intended and shall conform to NFPA 99.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of medical gas piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

H. Install piping to permit valve servicing.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and for branch connections.

K. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.

L. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

M. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

N. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.

O. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.03 VALVE INSTALLATION

A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.

B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on gas piping where reduced pressure is required.

3.04 JOINT CONSTRUCTION

A. Ream ends of pipe and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Threaded Joints: Apply appropriate tape to external pipe threads.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free, dry nitrogen during brazing.

E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.05 GAS SERVICE COMPONENT INSTALLATION

A. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.

B. Install nitrogen pressure-control panels in walls. Attach to substrate.

C. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.

D. Assemble ceiling-hose assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.

3.06 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.

2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.

6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.

7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.

J. Install supports for vertical copper tubing every 10 feet (3 m).

3.07 IDENTIFICATION

A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Section 200553 "Mechanical Identification”

B. Install identifying labels and devices for healthcare medical gas piping systems according to NFPA 99. Use the following or similar captions and color-coding for piping products where required by NFPA 99:

1. Oxygen: White letters on green background or green letters on white background.

3.08 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL GAS

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Medical Gas Piping Testing Coordination: Perform tests, inspections, verifications, and certification of medical gas piping systems concurrently with tests, inspections, and certification of medical compressed-air piping and medical vacuum piping systems.

2. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:

a. Initial blowdown.

b. Initial pressure test.

c. Cross-connection test.

d. Piping purge test.

e. Standing pressure test for positive-pressure medical gas piping.

f. Standing pressure test for vacuum systems.

g. Repair leaks and retest until no leaks exist.

3. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:

a. Standing pressure test.

b. Individual-pressurization or pressure-differential cross-connection test.

c. Valve test.

d. Master and area alarm tests.

e. Piping purge test.

f. Piping particulate test.

g. Piping purity test.

h. Final tie-in test.

i. Operational pressure test.

j. Medical gas concentration test.

k. Medical air purity test.

l. Verify correct labeling of equipment and components.

m. Verify medical gas supply sources.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

   a. Inspections performed.

   b. Procedures, materials, and gases used.

   c. Test methods used.

   d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

D. Prepare test and inspection reports.

3.09 FIELD QUALITY CONTROL FOR LABORATORY FACILITY SPECIALTY GAS

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections medical gas piping systems in healthcare facilities and to prepare test and inspection reports.

B. All new piping, valves and fittings installed under this section shall be tested as described under each individual gas section. These tests shall be made on the new work only. The contractor shall verify the presence of the desired gas in all outlets served by the new piping. This shall be done with an analyzer and a written certification of these tests (for each gas) shall be made to the Architect by the Plumbing Contractor and the company certifying the medical gas system.

C. A final test of the medical gas system (all gases) shall be made prior to turning the building over to the Owner. This test shall be made by an independent testing company with three or more years experience in certification of medical gas systems. This independent company shall be certified by MGPHCO or NITC. A written certification from this testing company shall be turned over to the Owner and the Architect. The certification shall include only the medical gas system installed under this contract. These tests and certification shall comply with the requirements and recommendations of N.F.P.A. 99. The cost of this certification shall be included in the Plumbing Contract. The certification shall include a recertification of the existing system as required by N.F.P.A. and the health authorities having jurisdiction.

D. Tests and Inspections:

1. Piping Leak Tests for Specialty Gas Piping: Test new and modified parts of existing piping. Cap and fill specialty gas piping with oil-free, dry nitrogen to pressure of 50 psig (345 kPa) above system operating pressure, but not less than 150 psig (1035 kPa). Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

2. Repair leaks and retest until no leaks exist.

3. Inspect specialty gas regulators for proper operation.

4. System inspections shall be performed prior to concealing piping distribution systems in wall, ceilings, chases, trenches, underground, or otherwise hidden from view.

5. Inspections shall be conducted by a person(s) competent and experienced in the field of medical gas and vacuum pipeline inspections and testing and meeting the requirements of ASSE 6020 or ASSE 6030.

6. The initial pressure test performed by the installing contractor shall be witnessed by an ASSE 6020 inspector an ASSE 6030 verifier, or the AHJ or its designee. A form indicating that this test has been performed and witnessed shall be provided to the verifier at the start of test as required by NFPA 99.

E. Remove and replace components that do not pass tests and inspections and retest as specified above.

F. Prepare test and inspection reports.

3.10 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.11 DEMONSTRATION

A. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain bulk gas storage tanks.

3.12 PIPING SCHEDULE

A. Connect new tubing to existing tubing with memory-metal couplings.

B. Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper tube; wrought-copper fittings; and brazed joints.

3.13 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

END OF SECTION 226313