

SECTION 23 21 13

HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
 - 1. Hot-water heating piping.
 - 2. Chilled-water piping.
 - 3. Makeup-water piping.
 - 4. Condensate-drain piping.
 - 5. Blowdown-drain piping.
 - 6. Air-vent piping.
 - 7. Air control devices
 - 8. Strainers
 - 9. Vacuum Breakers
 - 10. Drain coolers
- B. Related Sections include the following:
 - 1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.3 DEFINITIONS

- A. PTFE: Polytetrafluoroethylene.

1.4 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the minimum working pressure and temperature of the systems listed in the PIPING APPLICATIONS section in Part 3 and as follows:
 - 1. Hot-Water Heating Piping: 150 psig at 200 deg F .
 - 2. Chilled-Water Piping: 150 psig at 200 deg F.
 - 3. Condensate-Drain Piping: 150 deg F .

4. Blowdown-Drain Piping: 200 deg F.
5. Air-Vent Piping: 200 deg F.
6. Make-up water piping: 80 psig at 150 deg. F.

1.5 SUBMITTALS

- A. Product Data: For each type of the following:
 1. Submit a schedule indicating the following:
 - a. System Service, Operating temperature, Operating pressure, Pipe material, Fittings, Methods of joining, Gaskets, Specialties, Test pressure, Flange gaskets, , Fittings., Unions, , Suction diffusers, Ring spacers and test blanks.
 2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
 3. Strainers
 4. Air control devices.
 5. Hydronic specialties.
- B. Shop Drawings: Detail, at 3/8 inch scale piping layout with fittings, valves and equipment, use single line for pipe sizes 3 inches and smaller, and double line for pipe sizes 4 inches and greater. fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops
 1. Minimum 3/8 inch scale double line layout and sections where required or coordination drawings
- C. Grooved joint couplings and fittings shall be shown on drawings and product submittals, and be specifically identified with the applicable Victaulic style or series number
- D. Welding certificates
- E. Qualification Data: For Installer
- F. Field quality-control test reports, Written reports of tests specified in Part 3 of this Section. Include the following:
 1. Test procedures used.
 2. Test results that comply with requirements
 3. Failed test results and corrective action taken to achieve requirements
- G. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals

1.6 QUALITY ASSURANCE

- A. Installer Qualifications:

- B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current
- D. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.
- F. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by Victaulic. Grooving tools shall be supplied by the same manufacturer as the grooved components.
- G. Steel Pipe Welding:
 - 1. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Welders shall be qualified for all required pipe sizes, material, wall thickness, and position in accordance with the American Society of Mechanical Engineering (ASME) Section IX, boiler and pressure Vessel Code
 - 3. Copies of the certified welder qualification reports shall be maintained by the responsible welding agency and the company performing the welding, and shall be submitted to the owner and/or Inspector upon request.
 - 4. All defective welds shall be chipped out and repaired at no cost to the Owner, based on procedure to be specified at the time.
 - 5. The contractor shall bear the cost of reinspection of the repaired welds and the inspection of two (2) additional welds, as selected by the owner, for each failed weld.
 - 6. Field Procedures:
 - a. Clean pipe free from rust, scale and oxide.
 - b. Bevel pipe on each end per acceptable procedures.
 - c. Contractor is responsible for preparation of pipe in accordance with ASME B 31.1, Chapter V and for visual inspection during the welding operation and for all required welding examinations with certified welding inspector(s), in accordance with ANSI/AWS B.1.10-86 or latest issue section 3.1, 3.1.1, 3.1.2, and 3.1.3.

H. Copper Tube Brazing

1. Qualify process and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"
2. Brazers shall be qualified for all required tube sizes, material, wall thickness, and position in accordance with the American Society of Mechanical Engineering (ASME), Section IX, boiler and Pressure Vessel Code.
3. Brazing qualification testing shall be performed an agency/laboratory certified by ASME.
4. Copies of the certified brazer qualification reports shall be maintained by the responsible brazing agency and the company performing the brazing, and shall be submitted to the owner and/or Inspector.
5. All defective brazements shall be chipped out and repaired at no cost to the Owner, based on procedure to be specified at the time.
6. The contractor shall bear the cost of re-inspection of the repaired brazements and the inspection of two (2) additional brazements, as selected by the owner, for each failed brazement.
7. Field Procedures:
 - a. Clean tubing free from surface oxidation on the O.D.
 - b. Ream all tubes and remove burrs created by the cutting operation, on each end per acceptable procedures.
 - c. Contractor is responsible for preparation of tubes and for visual inspection during the brazing operation in accordance with all applicable ASME, ANSI and AWS standards.

1.7 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, structure and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B)
- B. Annealed-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type A)
- C. Wrought-Copper Fittings: ASME B16.22
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic
 - 2. Grooved-End Copper Fittings: ASTM B 75 (ASTM B 75M), copper tube or ASTM B 152 wrought copper fittings with copper tubing sized grooved ends designed to accept Victaulic coupling. Flaring of tube and fitting ends to IPS dimensions is not permitted.
 - 3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F (110 deg C) for use with housing, and steel bolts and nuts.
 - a. NPS 2 through NPS 8: Standard rigid couplings with pressure-responsive, synthetic rubber gasket Grade "EHP" EPDM rated for temperatures up to 250 deg F, secured together with plated steel bolts and nuts. Victaulic Style 607.
 - 4. Grooved-End-Tube Flange Adapters: Cast ductile iron coated with copper-colored enamel, flat faced, for engaging into roll grooved copper tube and fittings and bolting directly to ANSI Class 125 and 150 bolt hole patterns. Victaulic Style 641.
 - 5. Grooved joints not allowed on hot water system
- D. Wrought-Copper Unions: ASME B16.22

2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

- F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Grooved Mechanical-Joint Fittings and Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company of America.
 - 2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; or ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel fittings with grooves or shoulders constructed to accept Victaulic standard and AGS "W" series grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - 3. Standard Couplings, 2" through 12": Ductile- iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 - a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9.
 - 1. 2" through 8" Sizes: Victaulic Style 107 installation ready rigid coupling, Grade "EHP" EPDM gasket with red color code for water services from -30 deg F (-34 deg C) to +250 deg F (+121 deg C).
 - 2. 10" through 12" Sizes: Victaulic Style 07 (Zero-Flex®) standard rigid coupling with Grade "E" EPDM gasket with green color code for water services from -30 deg F (-34 deg C) to +230 deg F (+110 deg C).
 - 3. Housings shall incorporate an angled-pattern bolt pad design to confirm joint rigidity upon visual confirmation of metal-to-metal bolt pad contact with no torque requirement. Designs that permit spaces at bolt pads or require a torque per written manufacturers installation instructions not permitted.
 - b. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors for vibration isolation at equipment connections. Three couplings, for each connector shall be placed in close proximity to the vibration source in accordance with published guidelines. Victaulic Style 177,77 or W77.
 - 4. AGS Couplings, 14" through 24": Two ductile iron housings cast with a wide key profile, lead-in chamfer and flat bolt pads for metal-to-metal contact,

pressure-responsive, synthetic rubber gasket of a FlushSeal® design, and plated steel bolts and nuts.

- a. Rigid Type: Provides a rigid joint that corresponds with support spacings as defined by ASME B31.1 and B31.9. Victaulic Style W07.
 - b. Flexible Type: Allows for linear and angular movement, vibration attenuation and stress relief. Victaulic Style W77.
5. Flange Adapters: ASTM A536 ductile iron casting, flat faced, for incorporating flanged components with ANSI Class 125, 150 and 300 bolt hole patterns to a grooved piping system, Victaulic Style 741, W741, or 743.
 6. Grooved joints not allowed on hot water system

I. Steel (Stainless) Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Victaulic Company of America.
2. Housing: Stainless Steel
3. O-Rings and Pipe Stop: EPDM.
4. Tools: Manufacturer's special tool.
5. Minimum 500-psig (2- 3450 kPa) working-pressure rating at 230 deg F (110 deg C).

J. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - c. For chilled water systems – Klinger suitable for glycol use.
 - d. For hot water – Klinger C4500
 - e. For joints of dissimilar metals, provide isolating gaskets, sleeves and washers between flanges, bolts and nuts. Gaskets shall be similar to Dupont Teflon

B. Flange Bolts, Studs, Nuts and Washers:

1. Bolts and studs shall be chrome-molybdenum bolt stud in accordance with ASTM A 193 grade B7 with full-length threads in accordance ANSI B 31.1. Length shall be sufficient to project beyond nuts three complete threads when joint is made.
2. Nuts shall be carbon-steel in accordance with ASTM A 194 Grade 2H. Nuts shall be hexagon heavy series type. Threads shall the same as for bolts.
3. Washers shall be flat, plain, stamped, in accordance with ANSI/ASME B18.22.1.

C. Ring Spacers and Test Blanks:

1. Provide between flanges where shown on drawing or where necessary to isolate equipment from the piping system, in accordance with B3.1.1, Chapter VI, section 137.2.4. Ring spacers to be replaced by test blanks during hydrostatic testing and/or during chemical cleaning for equipment isolation.
2. Size and rating to match companion flanges.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded

1. Comply with Section II, Part C of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded

2.4 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. In lieu of dielectric fittings, use brass unions to join piping of dissimilar materials.

2.5 VALVES

- A. Gate, Globe, Check, Ball, Butterfly, safety relief and balancing Valves,: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

2.6 AIR CONTROL DEVICES

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

- 1. Amtrol, Inc.
- 2. Bell & Gossett Domestic Pump; a division of ITT Industries

- B. Manual Air Vents:

- 1. Body: Bronze.
- 2. Internal Parts: Nonferrous.
- 3. Operator: Screwdriver or thumbscrew.
- 4. Inlet Connection: NPS 1/2 (DN 15).
- 5. Discharge Connection: NPS 1/8 (DN 6).
- 6. CWP Rating: 150 psig (1035 kPa).
- 7. Maximum Operating Temperature: 225 deg F (107 deg C)

- C. Automatic Air Vents:

- 1. Body: Bronze or cast iron.
- 2. Internal Parts: Nonferrous.
- 3. Operator: Noncorrosive metal float.
- 4. Inlet Connection: NPS 1/2 (DN 15).
- 5. Discharge Connection: NPS 1/4 (DN 8).
- 6. CWP Rating: 150 psig (1035 kPa).
- 7. Maximum Operating Temperature: 240 deg F (116 deg C)

- D. Expansion Tanks:

- 1. General:
 - a. Provide as shown on the drawings, a pressurization and air elimination system to accommodate the expanded water generated by the increase in temperature in the water system and to control the increase in pressure at all critical components in the system to the maximum allowable for those components.
 - b. The pressurization and air elimination system shall ensure that all entrained air bubbles in the system shall be eliminated. The only air in the system shall be the permanent sealed in air cushion contained in the pressurization controller component of the system, a diaphragm type extension tank, pre-charged to the minimum operating pressure at the location indicated on the drawing.
 - c. All free air originally contained in the system, and all entrained air bubbles carried by the system water shall be eliminated at all points in the piping system where the capability of water to hold air in solution is

lowest (the point of lowest solubility), and as indicated on the drawings. The air separating and elimination component shall separate entrained free air from flowing system water by the creation of a vortex which will allow free air to rise in the center, the point of lowest velocity, to an air elimination valve

2. Diaphragm or Bladder- Type Extension Tanks: .
 - a. Tank: Welded steel, rated for 125 psig (860-kPa_ working pressure and 375 deg F (191 deg c)maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
 - b. Diaphragm or Bladder: Securely sealed into tank to separate air change from system water to maintain required expansion capacity.
 - c. Air-Changed Fittings: Schrader valve, stainless steel with EPDM seats.
 - d. Orientation: Vertical
 - e. Size and capacity as scheduled on drawings
 - f. Features:
 1. Integral structural steel supports
 2. Base for vertical tanks
 3. Gasketed handhole
 4. Gasketed manhole
 5. All tappings for gauge glass, instrumentation, drain, fill and connections to system: Refer to detail on the drawing
 6. Pre-Charged with air to pressure scheduled on drawings

E. Air Separators:

1. Furnish and install air removal device of the size and type shown on the plans. Air and dirt separation devices shall be Taco 4900 series or approved equal, by Spirotherm or Armstrong
2. Air removal devices shall be constructed of steel. It shall be designed, fabricated and stamped per ASME Section VIII Division I with a maximum working pressure of 125 psi at 270 degrees F° Units up to three 3-inch in size shall be provided with threaded connections as standard. Units 4-inch and larger shall be provided with flanged system connections as standard.
3. Each air removal device shall be equipped with a brass conical shaped air venting chamber designed to minimize system fluid from fouling the venting assembly. A brass flushing cock shall be located on the side of each separator to facilitate system fast-fill and removal of the floating impurities fro the air system interface within the separator. A blown down valve shall be provided by the unit manufacture on the bottom of each unit to allow blow down and

cleaning. On units 2 ½" and smaller the valve and all of its fitting shall be 1". On units 3" and larger the valve and all openings shall be 2".

4. The air removal device shall remove air down to 18 microns. The unit manufacture shall provide owner and design engineer third party independent test data certifying that their unit perform to the above standards. Suppliers not providing these independent performance test results will not be acceptable.
5. The air separator shall employ the use of high surface area pall rings to achieve optimal separation of air with minimal pressure drop. The pall rings shall be made of stainless steel. Stainless steel will be there only acceptable material used for suppressing turbulence and increasing surface area for high efficiency air.
6. The unit shall be manufactured with a removable upper head to facilitate removal, inspection, and cleaning of the pall ring basket.

2.7 CHEMICAL TREATMENT

- A. The HVAC Contractor shall hire the services of the building water treatment contractor and provide all required labor and materials. Provide temporary metering and mixing devices as required. The HVAC contractor shall obtain and provide all requirements from the Owner/ water treatment vendor.

2.8 HYDRONIC PIPING SPECIALTIES

- A. Y-Pattern Strainers:

1. Chilled Water and Hot Water Systems of Steel Construction:

- a. Working pressure: To 250 psig, non-shock.

1. Sizes 1/4 inch to 2 inch: ANSI 250 lb. Class.

- a) Connections: Threaded.
- b) Body: Cast iron, ASTM A126, Class B. With machined seat for screen retention. Galvanized as required to match connecting piping.
- c) Cap: Bronze, gasketed.
- d) Screen: 20 mesh. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 times inlet area.
- e) Blowoff outlet: With female NPT tapping.
- f) Mueller model No. 11 MFCB.

2. Sizes 2-1/2 inch to 24 inch: Class 250.
 - a) Connections: Flanged.
 - b) Body: Cast iron, ASTM A126, Class B. With machined seat for screen retention. Galvanized as required to match connecting piping.
 - c) Cover flange: Cast iron, ASTM A126, Class B. With machined seat for screen retention. With female tapped NPT blowoff connection. With EPDM O-ring seal.
 - d) Screen to 8 inch: 1/8 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 times inlet area.
 - e) Screen 10 inch and larger: 5/32 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 times inlet area.
 - f) Magnets: Provide magnets for strainers. All 8 inch and larger. At each pump suction. With continuous magnetic field around entire circumference of screen. With removable cast Alnico No. 5 channel magnets with acceptable baskets constructed of magnetic alloy. Secured with stainless steel retaining lugs and threaded rods.
 - g) Blowoff outlet: With female NPT tapping.
 - h) Mueller model No. 752.
2. Chilled Water and Hot Water Systems of Copper Construction:
 - a. Working pressure: To 250 psig, non-shock.
 1. Sizes 1/4 inch to 2 inch: Class 250
 - a) Connections: Threaded.
 - b) Body: Bronze, ASTM B62. With machined seat for screen retention.
 - c) Cap: Bronze, ASTM B62. With machined seat for screen retention.
 - d) Screen: 20 mesh. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 time inlet area.
 - e) Blowoff outlet: With female NPT tapping.
 - f) Mueller model No. 352M.
 - b. Working pressure to 225 psig Class 150; to 400 psig Class 300:

1. Sizes 2-1/2 inch to 4 inch:
 - a) Connections: Flanged.
 - b) Body: Bronze, ASTM B62 (85-5-5-5) or bronze ASTM B61. Aluminum bronze ASTM A148-90 for sizes 8 inch and larger. With machined seat for screen retention.
 - c) Cover: Material to match body. With machined seat for screen retention.
 - d) Screen to 8 inch: 1/8 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 times inlet area.
 - e) Screen 10 inch and larger: 5/32 inch perforations. 304 stainless steel, ASTM 240. Free area not less than 2-1/2 times inlet area.
 - f) Blowoff outlet: With female NPT tapping.
 - g) Mueller model No. 851 or 851M for Class 150.
 - h) Mueller model. No. 852 for Class 300.

B. Vacuum Breakers

1. For service to 300 psig wsp, similar to Sarco VB 12:
 - a. Size: 1/2 inch.
 - b. Features:
 1. All internals renewable without disturbing piping.
 - c. Construction:
 1. Cap: Stainless steel, Type 303.
 2. Valve: VB 12 stainless steel, Type 303.
 3. Valve seat: VB 12 stainless steel, Type 303.
 4. Body: VB 12 stainless steel, Type 303.
 5. Gasket: VB 12 stainless steel, Type 304.
 6. Connections:
 - a) System: 1/2 inch screwed NPT.
 - b) Air inlet: 1/8 inch screwed NPT.

- C. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
- D. Drain Coolers:
 - 1. Provide, where indicated on drawings, drain coolers to cool hot blowdown water from humidifiers, using city water
 - 2. Drain coolers shall be equipped with temperature activated cold water valve, vacuum breaker and stainless steel mixing chamber.
 - 3. Provide with appropriate wall mount, floor mount or suspension mount assemblies as required.
 - 4. Drain coolers to be equal to Drane-Kooler by Dri-Steem.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Low Temperature Water System, IN EXCESS of 100 psig up to 300 PSIG, except as noted and 40 to 220 deg F supply temperature for hot water and chilled water systems:
 - 1. Material shall be steel in accordance with ASTM A 53, Grades A or B.
 - 2. Wall thickness shall be:
 - a. To 2 inch: Schedule 80 with threaded ends or Schedule 40 with socket weld ends.
 - b. 2-1/2 inch to 10 inch: Schedule 40, butt weld ends only.
 - 3. 4 inch and smaller up to 300 PSIG and 100 deg F or 150 PSIG and 250 deg F, Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints
 - 4. No threaded joints are allowed in glycol systems.
 - 5. Victaulic grooved joints may be used in lieu of welded, flanged or brazed joints on chilled water, and glycol systems (no hot water) for piping 2-1/2 inches and larger.
- B. Makeup-water piping installed aboveground shall be either of the following:
 - 1. Type L, drawn-temper copper tubing, wrought-copper fittings, and brazed joints.

- C. Condensate-Drain Piping: Type , L drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
- D. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- E. Air-Vent Piping:
 - 1. Inlet: Same as service where installed
 - 2. Outlet: Same as service where installed.
- F. Provide brass unions for connection of dissimilar metals. Use of bronze valves is not acceptable as a dielectric

3.2 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Install calibrated-orifice, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

3.3 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

- I. Install piping to allow application of insulation.
 - J. Select system components with pressure rating equal to or greater than system operating pressure.
 - K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
 - L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
 - M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.
 - N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
 - O. Install branch connections to mains using tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
 - P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."
 - Q. Install unions in piping, NPS 2 (DN 50) and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
 - R. Install flanges or grooved joints on applicable systems, in piping, NPS 2-1/2 (DN 65) and larger, at final connections of equipment and elsewhere as indicated. Slip-on flanges shall be back welded.
 - S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 (DN 20) nipple and ball valve in blowdown connection of strainers NPS 2 (DN 50) and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).
 - T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."
 - U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."
- 3.4 HANGERS AND SUPPORTS
- A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.
 - B. Seismic restraints are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

- C. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet (6 m) long.
 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet (6 m) or longer.
 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
 4. Spring hangers to support vertical runs.
 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
- D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 6 feet ; minimum rod size, 3/8 inch .
 2. NPS 1 (DN 25): Maximum span, 6 feet ; minimum rod size, 3/8 inch .
 3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
 4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
 5. NPS 2-1/2 (DN 65): Maximum span, 10 feet ; minimum rod size, 1/2 inch .
 6. NPS 3 (DN 80): Maximum span, 10 feet ; minimum rod size, 1/2inch .
 7. NPS 4 (DN 100): Maximum span, 10 feet ; minimum rod size, 5/8 inch .
 8. NPS 6 (DN 150): Maximum span, 10 feet ; minimum rod size, 3/4 inch .
- E. Victaulic Style 107, 07, and W07 rigid couplings may be used on IPS steel piping systems, which meet the support and hanging requirements of ASME B31.1 and B31.9. An adequate number of Victaulic Style 75, 77, or W77 flexible couplings shall also be used to compensate for thermal expansion/contraction of the pipe.
- F. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 3/8 inch .
 2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 3/8 inch .
 3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
 5. NPS 2-1/2 (DN 65): Maximum span, 9 feet (2.7 m); minimum rod size, 1/2 inch .
 6. NPS 3 (DN 80): Maximum span, 10 feet (3 m); minimum rod size, 1/2 inch .
- G. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.
- H. Provide additional support at changes in direction, branch piping and runouts over 5 feet and concentrated loads due to valves, strainers and other similar items.
- I. Vertical piping:

1. Base elbow support: Provide bearing plate on structural support, similar to F&S Manufacturing Co. Fig. 720 or 721.
2. Provide guides at every third floor but not exceed:
 - a. 25 ft for piping to 2 inch.
 - b. 36 ft for piping 2-1/2 inch to 12 inch.
 - c. 50 ft for piping 14 inch and larger.
3. Top support: Provide special hanger or saddle in horizontal connection and make provisions for expansion.
4. Intermediate supports: Steel pipe clamp at floor. Bolt and weld to pipe with extension ends bearing on structural steel or bearing plates.
5. For multiple pipes, coordinate guides, bearing plates and accessory steel.

3.5 PIPE JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel or groove (on applicable systems) plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Grooved Joints: Install in accordance with the manufacturer's Victaulic guidelines and recommendations. All grooved couplings, fittings, valves and specialties shall be supplied by a single manufacturer. Grooving tools shall be supplied by the

same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be developed and supplied by the manufacturer. Grooved end shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove. A factory trained field representative shall provide on-site training to contractor's field personnel in the installation of grooved piping products. Factory trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

1. Install the Victaulic AGS piping system in accordance with the latest Victaulic installation instructions. Use Victaulic grooving tools with AGS roll sets to groove the pipe. Follow Victaulic guidelines for tool selection and operation. Coupling installation shall be complete when visual metal-to-metal contact is reached. AGS products shall not be installed with standard grooved end pipe or components. Installing AGS products in combination with standard grooved end products could result in joint separation and/or leakage.

3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.7 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.
- D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

3.8 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
 1. Leave joints, including welds, uninsulated and exposed for examination during test.
 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
 2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
 3. Isolate expansion tanks and determine that hydronic system is full of water.
 4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping." Systems less than 100 psig, hydrostatically test to 150 psig.
 5. After hydrostatic test pressure has been applied for at least 4 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
 6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
 2. Inspect pumps for proper rotation.
 3. Set makeup pressure-reducing valves for required system pressure.
 4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.

END OF SECTION