SECTION 23 21 10 - 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 piping systems.

B. Water treatment work is part of the HVAC contact and shall be performed by Aqua-Treat Inc. located at, P.O. Box 462, Blackwood, NJ 08012, Contact John Mellon, Ph: (609) 315-1741.

1.3 SUBMITTALS

A. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves.
2. Air control devices.
3. Hydronic specialties.
4. Grooved joint pipe couplings and fitting.
5. Water Treatment provider. Provide verification of experience including a list of completed projects, similar to the size and scope of this project, and a list of references for those projects.

B. Refer to Division 01 Specification Section Coordination Drawings, for the work required by the HVAC Contractor in preparing Coordination Drawings.

C. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. The installation is to conform to the requirements of the 2018 International Mechanical Code and any applicable local codes. Verify local code requirements with the Authority Having Jurisdiction.

B. 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.

C. 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

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stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

D. All grooved joint couplings, fittings, valves and other specialties shall be provided from a single manufacturer. Grooving tools shall be from the same manufacturer as the grooved components. All castings used for coupling housings, valve bodies, fittings, etc. shall be date stamped for traceability and quality control.

E. Pressure seal piping systems: Installer shall be a qualified installer, licensed within the jurisdiction, and familiar with the installation of the copper press joint system. The copper press fittings shall be installed using the proper tool, actuator, jaws and rings as instructed by the press fitting manufacturer. The installation of copper tubing in Hydronic systems shall conform to the requirements of the ICC International Mechanical Code.

1.5 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 125 psig at 200 deg. F.
2. Chilled-Water Piping: 125 psig at 100 deg F.
3. Condensate-Drain Piping: 150 deg. F.
4. Air-Vent Piping: 200 deg. F.
5. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings and Unions: ASME B16.22.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

2.3 PRESSURE SEAL PIPING SYSTEMS

A. Subject to compliance with requirements, provide products manufactured by Veiga LLC or NIBCO Inc.

1. Copper tubing shall conform to ASTM B 75 or ASTM B88.
2. Copper fittings shall conform to ASME B16.18, ASME B16.22 or ASME B16.26.
3. Press Fitting: Copper and copper alloy press fittings shall conform to material requirements of ASME B16.18 or ASME B16.22. Sealing elements for press fittings shall be EPDM. Sealing elements shall be factory installed.

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4. System to have minimum 200-psig working-pressure rating at 250 deg F.

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53, 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 Piping Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by Victaulic Company of America or Anvil International.
2. Steel Pipe: ASTM A 53, carbon steel, schedule 40, roll or cut grooved ends.
3. Fittings: ASTM A 395, grade 65-45-12 ductile iron; ASTM A 536, grade 65-45-12 wrought steel conforming to ASTM A-235/A 53M, Type F, E, or S, Grade B factory fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, to secure grooved pipe and fittings.
4. Couplings: Ductile iron conforming to ASTM A-536, Grade 65-45-12.

a. NPS 2 through NPS 8; rigid coupling with high temperature range (-30 degrees F to 250 degrees F; Grade EP EPDM gasket.
b. NPS 10 through NPS 12; rigid coupling with Grade EP EPDM gasket (-30 degrees F to 230 degrees F).
c. NPS 2 through NPS 12: flexible coupling for use in locations where vibration attenuation and stress relief is required. Three flexible couplings may be used in lieu of a flexible connector.

I. Mechanical-Joint Piping Systems:

1. Manufacturers: Victaulic Company of America, Quick-Vic Systems.
2. Steel Pipe: ASTM A 53, schedule 40.
3. Couplings and Fittings: ASTM A 536, grade 65-45-12.
4. Gaskets: Grade EHP EPDM (-30 degrees F to +250 degrees F).

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2.5 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.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

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

D. 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.

E. Grooved Joint Lubricants: lubricate gaskets using a lubricant supplied by the coupling manufacturer. Lubricant shall be suitable for the gasket elastomer and fluid media.

1. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.6 EXPANSION FITTINGS AND COMPENSATORS

A. Grooved Mechanical-Joint Piping Systems:

1. Victaulic Style 150 Mover slip type expansion joint with 3” axial movement. Designed for service temperature to 230 degrees F and a working pressure of 350 psi maximum. Provide Grade “E” EPDM gaskets.
2. Victaulic Flexible Loop Series 159 with 4’ axial movement: Designed for service temperatures to 350 degrees F. maximum and working pressure of 150 psi. Schedule 40 carbon steel end connections and 321 stainless steel corrugated hose.

B. Welded or Soldered Joint Piping Systems: Provide in-line expansion compensators manufactured by Hyspan Precision Products or Metraflex Inc. Compensators to be rated for a maximum pressure of 175 psi and 230 degrees F. operating temperature.

2.7 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 Flanges:

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

a. Capitol Manufacturing Company.
b. Central Plastics Company.
c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

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

D. Dielectric Couplings:

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

a. Calpico, Inc.
b. Lochinvar Corporation.

2. Galvanized-steel coupling with inert and non-corrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg. F.

E. Dielectric Nipples:

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

a. Perfection Corporation; a subsidiary of American Meter Company.
b. Victaulic Company of America.

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

2.8 VALVES AND SPECIALTIES

A. Calibrated Balancing Valves:

1. Provide pressure independent and field adjustable venture type manual balancing valves.
2. Valves ½” to 2”: to have venturi type bronze body, chrome plated ball, EPDM seals. Provide pressure & temperature test ports across valve measurement area. Ports to be fitted with dual durometer EPDM cores, brass cap & O-ring seal. Valves to have drain/purge port. Provide valve with memory stop, memory lock & calibrated position indicator. Valves to be rated at 200 PSIG at 2500 F and be 100% positive shut-off. Measurement accuracy to be +/- 3%.
3. Valves 2-1/2” & Larger: to have venturi type cast carbon steel/ductile iron body, with SS steam, EPDM seat & Buna seals. Provide memory stop, memory lock & calibrated position indicator. Valves to be rated at 200 PSIG at 2250 F and be 100% positive shut-off. Measurement accuracy to be +/- 3%.

B. Coil hook-up kits

1. The contractor may provide coil hook-up kits for connections to coils. The kits shall be comprised of the following items:

a. Calibrated balancing valves as indicated in 2.9.A.
b. Shut-off valves.
c. Strainers.
d. Other components indicated on the drawings.

C. Flow Meters:

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

a. Bell & Gossett Domestic Pump; a division of ITT Industries or equal.

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2. Description: Differential-pressure-design wafer type orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid. Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
3. Construction: Cast-iron body, brass valves with integral EPT check valves and caps, and calibrated nameplate.
4. Temperature/Pressure Rating: 250 degrees F. at 250 psig.

D. System Fill Pressure-Reducing Valves:

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

   a. Amtrol, Inc.
   b. Bell & Gossett Domestic Pump; a division of ITT Industries.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Bronze body construction with NPT threaded inlet and outlet connections, a tight seating check valve, purge lever for manual purging, and built-in integral strainer. High-capacity performance suitable for use in hydronic heating and cooling systems. Maximum Pressure: 100psi.

E. Safety Relief Valves (Diaphragm-Operated):

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

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett Domestic Pump; a division of ITT Industries.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Body: for NPT ¾” and 1”, Bronze with 125 PSIG maximum working pressure and 250-degree F. maximum operating temperature.
3. Body: for NPT 1 ½” and 2”, Cast Iron with 50 PSIG maximum working pressure and 250-degree F. maximum operating temperature.
4. Diaphragm and Seat: EPDM.
5. Wetted, Internal Work Parts: Brass.
6. Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Water Meters:

1. Manufacturers: Subject to compliance with requirements provide water meters manufactured by Neptune Technology Group or equal.
2. All meters to be displacement type - magnetic drive 5/8” - 2” and shall be produced from an ISO 9001 manufacturing facility and conform to the “Standard Specifications for Cold Water Meters” C700, latest revision issued by AWWA or as otherwise stated. Only magnetic-driven, positive displacement meters of the flat disc type will be accepted because of enhanced low flow accuracy performance.
3. The size, capacity, and meter lengths shall be as specified in AWWA Standard C700 (latest revision). The maximum number of disc nutations is not to exceed those specified in AWWA C700 latest revision. All meter maincases shall be made of a no-lead high copper alloy containing a minimum of 85% copper that meets the ANSI/NSF 61 standard. The serial number should be stamped between the outlet port of the maincase and the register. Maincase markings shall be cast raised and shall indicate size, model, direction of flow, and NSF 61 certification. Plastic maincases are not acceptable. Maincases for 5/8”, 3/4” and 1” meters shall be of the removable bottom cap

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type with the bottom cap secured by four (4) bolts on 5/8" and 3/4" sizes and six (6) bolts on the 1" size. Intermediate meter maincases shall also be made of the same lead-free brass material in sizes 1-1/2" and 2" with a cover secured to the maincase with eight (8) bolts. Meters with a frost plug, a screw-on design or no bottom cap shall not be accepted in 5/8"-1" sizes. The 5/8" meters shall have a synthetic polymer or cast-iron bottom cap option. All no-lead maincases shall be guaranteed free from manufacturing defects in workmanship and material for the life of the meter. All meters must be adaptable to a field programmable absolute encoder register without interruption of the customer's service.

4. Direct Read Standard Register: The register shall be of the straight reading sealed magnetic drive type and shall contain six (6) numeral wheels. Registers must be roll sealed and dry. All direct reading register cups shall be copper to prevent corrosion and be covered with a high strength, impact resistant flat glass lens to prevent breakage. The lens shall be positioned above the register box to allow for run off of debris. The register lid shall overlap the register box to protect the lens. Register boxes and lids shall be of high-strength synthetic polymer or approved equivalent. All registers shall have the size, model and date of manufacture stamped on the dial face. The dial shall have a red center sweep hand and shall contain 100 equally divided graduations at its periphery. The register must contain a low flow indicator with a 1:1 ratio to disc nutations to provide leak detection. Registers shall be secured to the main case by means of a plastic tamper-proof seal to allow for inline service replacement. Register seal screws are only accepted when supplied with attached sealing wire to at least one bottom cap bolt with seal wire holes of not less than 3/32" in diameter.
5. Strainers: All meters shall contain a removable polypropylene plastic strainer screen. The strainer shall be located near the main case inlet port, before the measuring chamber. The strainer shall also function as the device that holds the measuring chamber in place within the main case.
6. Remote Transmitter Interface: Where indicated provide Neptune Tricon/E3 Transmitter or equal. The transmitter shall provide a digital pulse output with a 4-20mA signal.

G. Reduced-Pressure-Principle Backflow Preventers: Drawing Tag "RPB"

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

    a. Ames Co.
    b. Conbraco Industries, Inc.
    c. Watts Industries, Inc.; Water Products Div.
    d. 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. Temperature range: 210 degrees F.
6. Size: as indicated on the drawings.
7. Pressure Loss and Design Flow Rate: as indicated on the drawings.
8. Body: Lead free bronze construction for NPS 2 and smaller; epoxy coated cast iron complying with AWWA C550 and FDA approved for NPS 2-1/2 and larger.
9. Accessories: Ball type valves 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. Provide strainers on the inlet. Provide Air-Gap Fitting, ASME A112.1.2, matching backflow-preventer connection.

H. Backflow Preventers: Drawing Tag "BP"

1. Provide a Series 9D Dual Check Backflow Preventer manufactured by Watts Industries or equal as manufactured by one of the following:

    a. Ames Co.
    b. Conbraco Industries, Inc.

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c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1012.
3. Temperature range: 330 F to 2500 F.
4. Size: as indicated on the drawings.
5. Working Pressure: 25 to 175 psi.
6. Body: forged brass.

I. Mechanical Sleeve Seals:

1. Manufacturers: The Metraflex Co. of Flexcraft Industries.
2. Description: Pipe wall penetration seals to be of the modular link type. Seals shall consist of a series of interlocking, molded synthetic rubber links, with heavy-duty plastic pressure plates, and corrosion resistant nuts and bolts. Seals to be designed to provide a hydrostatic seal between the pipe and wall penetration. Seals shall be sized and selected per manufacturer recommendations. Mechanical pipe seals shall be fabricated of an EPDM elastomer for general service and a Nitrile/ Buna-N for hydrocarbon/petroleum based applications. Provide stainless steel hardware as required.
3. Steel wall sleeve: Cast in place concrete wall sleeves to be fabricated from galvanized heavy wall welded or seamless carbon steel pipe. All sleeves to have a 2" wide, full perimeter water stop, welded on both sides.

2.9 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.
3. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. CWP Rating: 150 psig (1035 kPa).
4. Maximum Operating Temperature: 225 deg. F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg. F.

D. Expansion Tanks/Diaphragm Bladder:

1. Tank: Welded steel, rated for 125-psig working pressure and 240 deg. F. maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Diaphragm/Bladder: Heavy duty Butyl Rubber, securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

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E. Centrifugal Type Air Separators:

1. The air separator must be designed, constructed and stamped for 125 psig @ 350ºF in accordance with Section VII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator(s) shall be painted with one shop coat of light gray air dry enamel.
2. The unit shall have flanged inlet and outlet connections tangential to the vessel shell. The unit shall have the capability to direct accumulated air to the compression tank (air control system) or air vent (air elimination system) via an NPT vent connection at top of unit. A blowdown connection shall be provided to facilitate routine cleaning.

F. In-Line Air Separators:

1. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
2. Maximum Working Pressure: Up to 175 psig.
3. Maximum Operating Temperature: Up to 300 deg. F.

G. Air Purgers:

1. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
2. Maximum Working Pressure: 150 psig.
3. Maximum Operating Temperature: 250 deg. F.

2.10 WATER TREATMENT

A. HVAC System water treatment shall be provided by the firm indicated in Paragraph 1.2.B

B. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for chilled water systems, hydronic heating systems, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from the date of Substantial Completion, and shall include the following:

1. Initial water analysis and HVAC water-treatment recommendations.
2. Startup assistance to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
3. Periodic field service and consultation consisting of a minimum of one site visit per month.
4. Provide reports indicating the type of treatment and date of the site visit.
5. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

2.11 CHEMICAL TREATMENT AND EQUIPMENT

A. Bypass Chemical Filter Feeder: Provide bypass filter/feeders where shown on the drawings, manufactured by Neptune Chemical Pump Company or equal. The bypass feeder shell shall be constructed of 11-gauge steel minimum for 2 gallon units and 10 gauge steel minimum for 5 gallon and larger units. Tank heads shall be a minimum of 11-gauge steel for 2 gallon units and a minimum 9 gauge steel for 5 gallon units. The bypass feeder shall be rated at 300 psi and to 200 degrees F. The tank shall have a wide mouth, 3-1/2” opening so that chemical addition can be performed without the need of a funnel. The bypass feeder shall have a continuous threaded closure requiring 2-1/2 turns to close and seal. Closures using partial threads or lugs shall not be considered. Closures rated less than 300 psi shall not be considered equal. The cap shall be constructed of cast iron with an epoxy-coated underside to prevent corrosion and shall

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use a square ring gasket seal. The ring gasket shall not be glued or restrained from movement. Closures using “o” rings or gaskets which are glued or restrained from free movement by snap rings shall not be considered equal. The bypass feeder shall be provided with legs to elevate the feeder off the floor. The legs shall have holes to allow mounting by anchor bolts. The bypass feeder shall be provided with a 5 micron cartridge filter for simultaneous side stream filtering.

B. Glycol Feeder: The Glycol Feeder is existing to remain. The Glycol Feeder will automatically maintain pressure via a factory supplied pressure switch with adjustable low and high set points.

C. Chemicals: Provide specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

D. Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in systems indicated to contain antifreeze or glycol solutions.

2.12 HYDRONIC PIPING SPECIALTIES

A. Suction Diffusers:

1. Angle pattern flow straightening fitting equipped with a combination diffuser strainer- orifice cylinder, flow straightening vanes, start-up strainer and filed supplied adjustable support foot. The combination diffuser-strainer-orifice cylinder shall be designed to withstand pressure differential equal to the system pump shutoff head and shall have a free area equal to five times the cross section area of the pump suction opening. The length of the flow straightening vanes shall be no less than 21/2 times the diameter of the system pump suction connection.
2. Provide cast iron NPT and flanged models rated for a maximum working pressure of 175 PSIG. The flow straightening fitting shall be of cast iron construction with Stainless steel combination diffuser-strainer-orifice cylinder with 3/16" diameter perforations to protect the system pump. Provide start-up strainer of 16 mesh bronze. All internal components shall be replaceable.

B. Y-Pattern Strainers: Subject to compliance with requirements, provide products by Metraflex, Hoffman Specialty, Armstrong or equal:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded or sweat for NPS 2 and smaller: grooved or flanged for NPS 2-1/2 and larger.
3. Strainer Screen: perforated stainless steel with 50 percent total free area.
4. CWP Rating: 150 psig.

C. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg. F.
6. Three Victaulic Style 77 couplings may be used in lieu of a flexible for vibration attenuation and stress relief at equipment connections. The couplings shall be in close proximity to the vibration source.

D. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.

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3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg. F.

2.13 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides: Where required provide alignment guides manufactured by Metraflex Inc or equal. Guides to be factory-fabricated alignment guides suitable for installation with insulated piping where applicable.

B. Anchors: Provide factory fabricated anchors manufactured by Metraflex or equal. In lieu of factory fabricated anchors provide field fabricated anchors fabricated from ASTM A36 / A36M steel shapes and plates.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating, chilled water piping and dual temperature system piping, aboveground, NPS 2 and smaller, shall be one of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 125, cast-iron fittings; cast-iron flanges and flange fittings; and threaded joints.
3. Pressure seal piping systems.
4. Victaulic Quick-Vic systems.

B. Hot-water heating, chilled water piping and dual temperature system piping, aboveground, NPS 2-1/2 and larger, shall be:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
3. Schedule 40 steel pipe; grooved, mechanical joint coupling and fittings; and grooved, mechanical joints.

a. Provide high temperature couplings at all connections to boilers and heat exchangers and on all heating system piping located within the boiler room.
b. Provide flexible couplings at connections to all pumps.

C. Makeup-water piping installed aboveground shall be:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Makeup-Water Piping Installed Belowground and within Slabs: Type K (A), annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

E. Condensate-Drain Piping:

1. Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Install condensate drain piping at a minimum slope of 1% in the direction of flow.

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F. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
2. Outlet: Type K (A), annealed-temper copper tubing with soldered or flared joints.

G. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

3.2 VALVE APPLICATIONS

A. Install shut off-duty valves at each branch connection to supply mains, and at supply and return connection to each piece of terminal equipment and at other locations indicated on the drawings. All valves are to be installed in an accessible location.

B. Install calibrated balancing valves in the return pipe of each heating or cooling terminal and elsewhere as shown on the drawings. Valves are to be installed with the test ports facing 40 degrees to vertical above the centerline of the pipe.

C. Install check valves at each pump discharge and elsewhere as required to control flow direction.

D. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

E. Where indicated, install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

F. Isolation valves for each boiler are to be labeled with warnings required by the PA Department of Labor and Industry. Verify requirement before installation begins.

3.3 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general routing, location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings. Provide offsets where required to clear steel, electrical conduit and / or other construction components.

B. Install cast-iron sleeve with water stop and provide Mechanical Sleeve Seal where HVAC piping penetrates a foundation wall or exterior. Select number of interlocking rubber links required to make installation watertight.

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

D. Install piping at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

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

F. Install piping to permit valve servicing.

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G. Install fittings for changes in direction and branch connections. Install piping to allow application of insulation.

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

I. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

J. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

K. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

L. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

M. 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.

N. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

O. Install unions or flanges at the inlet and outlet of all control valves.

P. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple, ball valve and hose connection in blowdown connection of strainers. Match size of strainer blow-off connection for strainers smaller than NPS 2.

Q. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

R. Provide Firestopping at all rated partitions. Provide a caulked and sealed installation at all non-rated partitions.

S. Provide expansion compensator joints or expansion loops for cooper and steel piping, where indicated on the drawings. Provide the quantity of pipe anchors and alignment guides as required by the expansion compensator manufacturer. Provide shut-off valves at the inlet and outlet of the expansion compensators and/or expansion loops. Install expansion joints, guides, and anchors per the manufacturer’s installation requirements. Install anchors per the following:

1. To Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. To Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

3.4 HANGERS AND SUPPORTS

A. Support all HVAC system piping to conform to ASME B31.9. Provide adjustable clevis hangers for all horizontal piping. Each hanger shall allow for adjustment, after installation, while supporting the pipe. Attach hangers to structural steel in accordance with MSS SP-69 and MSS SP-89. Install piping hangers and supports to provide the indicated pipe slopes.

B. Provide miscellaneous structural steel for support of HVAC equipment and piping. In areas with exposed construction, install miscellaneous supports prior to painting of ceiling and walls.

C. Provide a 12” long 18 gage protective saddle for all clevis hangers that support insulated piping.

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D. Use carbon-steel pipe hangers and supports and attachments for general service applications.

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

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Install hangers for steel piping with the following maximum spacing:

1. NPS 3/4 to NPS 2: 8 feet maximum horizontal spacing.
2. NPS 2 and larger: 12 feet maximum horizontal spacing.
3. Vertical supports at roof, at each floor, and at 10-foot maximum intervals.

H. Install hangers for drawn-temper copper tubing with the following maximum spacing: a

1. NPS 1-1/4 and smaller: 6 feet maximum horizontal spacing.
2. NPS 1-1/2 and larger: 10 feet maximum horizontal spacing.
3. Vertical supports at roof, at each floor, and at 10-foot maximum intervals.

3.5 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. 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.
4. 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:

a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
b. 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.

B. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

C. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

D. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts in accordance with the manufacturer’s written instructions. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings of the same manufacturer.

1. The grooved couplings factory trained representative shall provide on-site training for the contractor’s field personnel in the use of grooving tools and the installation of grooved joints.
2. The representative shall visit the job site periodically to review the installation and verify the system is being installed per the manufacturer’s recommendations.
3. A direct employee of the grooved piping system manufacturer must conduct the training and site visits. A distributor representative is not acceptable.

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3.6 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at all high points in all piping systems, at heat-transfer coils, where required for system air venting and at locations indicated on the drawings.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Where indicated, install air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Where indicated, install tangential air separator in pump suction piping.

F. Install bypass chemical filter/feeders in each hydronic system where indicated, in upright position with top of unit more than 48 inches above the floor. Install feeder with bypass line, full-size ball valve and balancing valve. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a ball valve. Verify installation details with the manufacturer to verify inlet and outlet connection locations.

G. Install expansion tanks on the floor or properly suspended from the structure. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system project requirements. Provide ASME relief valves and pressure gauges on all expansion tanks per PA Labor and Industry requirements. Connect piping from the system to the expansion tank and the side of the pipe main, not the top or bottom of the main.

H. BACKFLOW PREVENTERS:

1. Install Reduced-Pressure-Principal-Backflow-Preventers (noted as RPB on the drawings) in each water supply to HVAC equipment and systems.
2. In addition to installing the RPB, install Backflow Preventers (noted as BP on the drawings) in each water fill connection for boiler fill systems.
3. Install drain for all backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
4. Do not install bypass piping around backflow preventers. Locate backflow preventers in same room as connected equipment or system. Do not install bypass piping around backflow preventers.

3.7 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections. Install control valves in accessible locations close to connected equipment.

B. Provide shut-off valves on the supply and return connections to all terminal equipment. Where indicated, install bypass piping with ball or butterfly valve around control valve.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

D. Connections to any control valve, shut-off valve, strainer, balancing devices or other similar devices with bronze construction shall be made with an adapter fitting and/or nipple made of the same material.

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3.8 CHEMICAL TREATMENT

A. For the initial system fill perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep the chilled water and heating hot water system free of scale, corrosion, and fouling, and to sustain the proper water characteristics. Sample water at one-week intervals after equipment startup for a period of six weeks, and prepare test report. Sample water at four-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements.

B. At four-week intervals following Substantial Completion, perform separate water analyses on all hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements.

C. Fill system with fresh water, add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainers screens. Refill chilled water system with propylene glycol solution and refill heating water system with fresh water.

1. Contractor shall be responsible to maintain the existing glycol solution throughout project or maintain system to avoid freezing of chiller and chilled water coils.

D. Prior to start-up of any HVAC equipment, provide the required type of water treatment for all closed loop and open systems including but not limited to

1. Closed loop heating system.
2. Closed loop chilled water system.

E. Provide initial chemical treatment of all systems and maintain the required water quality within the proper ranges for a period of one year after the date of substantial completion. If the project has multiple construction phases, the date of substantial completion for the final phase of construction shall be used to begin the time period for water treatment.

F. Fill systems indicated to have glycol solutions with the following concentrations:

1. Chilled Water Piping System: Minimum 30 percent propylene glycol.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace all strainer screens. If the project has multiple construction phases provide the necessary labor and materials for flushing and cleaning of the hydronic system for each phase.
4. Utilize chiller bypass valve to isolate the chiller evaporator from the chilled water system during initial system flushing.
5. 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.
6. 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.

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B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Clean all new and existing to remain strainer screens installed throughout the building prior to hydronic system balancing. This includes strainer screens at system pumps and all air handling units and terminal equipment. All system screens shall be free of substantial dirt, debris, metal filings, and other contaminants at substantial completion.
2. Open manual valves fully.
3. Inspect pumps for proper rotation.
4. Set makeup pressure-reducing valves for required system pressure.
5. 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).
6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION 23 21 10

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