SECTION 232113

HYDRONIC PIPING

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**NOTE TO SPECIFIER**

*Use this Specification Section for Mail Processing Facilities.*

***This is a Type 2 Specification with primarily editable text; therefore, most of the text can be edited, but there is some required text which is noted within the Section with a “Note to Specifier.” Do not revise these paragraphs without an approved Deviation from USPS Headquarters, Facilities Program Management, through the USPS Project Manager.***

*For Design/Build projects, do not delete the Notes to Specifier in this Section so that they may be available to Design/Build entity when preparing the Construction Documents.*

*For the Design/Build entity, this specification is intended as a guide for the Architect/Engineer preparing the Construction Documents.*

*The MPF specifications may also be used for Design/Bid/Build projects. In either case, it is the responsibility of the design professional to edit the Specifications Sections as appropriate for the project.*

*Text shown in brackets must be modified as needed for project specific requirements.* *See the “Using the USPS Guide Specifications” document in Folder C for more information.*

*The last date that USPS revised this standard specification section occurs in two places, at the end of this section and in the Table of Contents. If the date in this section matches the date in the Table of Contents, then you are using the latest version. Do not delete or revise the “last revised” date at the end of the section during the development of the Project Manual.*

*The footer in this section should be edited to replace the text, “USPS MPF SPECIFICATION” with the project name, and the blank date in the center should be replaced with the submission date, for interim design reviews, or the issue date of the completed Project Manual.*

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1. GENERAL
   1. SUMMARY
      1. Water piping to connect HVAC equipment, including the following:
         1. Chilled water, condenser water, heating hot water and drain piping.
         2. Extension of domestic water make-up piping for HVAC systems.
         3. Glycol-water piping.
   2. references
      1. American Society of Mechanical Engineers (ASME):

B1.20.1-2013 Pipe Threads, General Purpose (Inch)

B16.3-2011 Malleable Iron Threaded Fittings: Classes 150 and 300

B16.4-2011 Gray Iron Threaded Fittings: (Classes 125 and 250)

B16.5-2013 Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard

B16.9-2012 Factory Made Wrought Buttwelding Fittings

B16.11-2011 Forged Fittings, Socket-Welding and Threaded

B16.18-2012 Cast Copper Alloy Solder Joint Pressure Fittings

B16.22-2013 Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

B16.24-2011 Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

B16.39-2014 Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300

B16.42-06 Ductile Iron Pipe Flanges and Flanged Fittings

B31.9-2014 Building Services Piping

B40.100-2013 Pressure Gauges and Gauge Attachments

* + 1. American Society for Testing and Materials (ASTM):

A47/A47M-1999 (R2014) Standard Specification for Ferritic Malleable Iron Castings

A53/A53M-2012 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

A106/A106M-2015 Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

A126-2004 (R2014) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

A183-2014 Standard Specification for Carbon Steel Track Bolts and Nuts

A216/A216M-2014e1 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A307-2014 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength

A536-1984 (R2014) Standard Specification for Ductile Iron Castings

B62-2015 Standard Specification for Composition Bronze or Ounce Metal Castings

B88-2014 Standard Specification for Seamless Copper Water Tube

F439-2013 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

F441/F441M-2015 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80

* + 1. American Welding Society (AWS):

B2.1/B2.1M-2014 Standard for Welding Procedure and Performance Specification

* + 1. Expansion Joint Manufacturer’s Association, Inc. (EJMA):

EJMA Expansion Joint Manufacturer’s Association Standards, Tenth Edition

* + 1. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:

SP-67-2011 Butterfly Valves

SP-70-2011 Gray Iron Gate Valves, Flanged and Threaded Ends

SP-71-2011 Gray Iron Swing Check Valves, Flanged and Threaded Ends

SP-80-2013 Bronze Gate, Globe, Angle, and Check Valves

SP-85-2011 Gray Iron Globe and Angle Valves, Flanged and Threaded Ends

SP-110-2010 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

SP-125-2010 Gray Iron and Ductile Iron In-line, Spring-Loaded, Center-Guided Check Valves

* + 1. Tubular Exchanger Manufacturers Association (TEMA):

TEMA Standards-2007 9th Edition

* 1. SUBMITTALS
     1. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
        1. Pipe and equipment supports.
        2. Pipe and tubing, with specification, class or type, and schedule.
        3. Pipe fittings, including miscellaneous adapters and special fittings.
        4. Flanges, gaskets and bolting.
        5. Couplings and fittings.
        6. Valves of all types.
        7. Strainers.
        8. Flexible connectors for water service.
        9. Pipe alignment guides.
        10. Expansion joints.
        11. Expansion compensators.
        12. All specified hydronic system components.
        13. Water flow measuring devices.
        14. Gauges.
        15. Thermometers and test wells.
     2. Submit the welder’s qualifications in the form of a current (less than one-year old) and formal certificate.
  2. QUALITY ASSURANCE
     1. Section 23 05 11, COMMON WORK RESULTS FOR HVAC, which includes welding qualifications.
     2. Submit prior to welding of steel piping a certificate of Welder’s certification. The certificate shall be current and not more than one-year old.
     3. All couplings, fittings, valves, and specialties shall be the products of a single manufacturer.
        1. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

1. PRODUCTS

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**NOTE TO SPECIFIER**

\*\*Required: Piping and fittings materials must comply with the chart in Section 220000 - Plumbing

Do not revise the materials below without an approved deviation; however, items may be removed to comply with local code requirements or for building requirements for MPF Repair & Alteration or Expansion projects; verify with the facility.

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* 1. PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES
     1. Provide in accordance with Section 230500, COMMON WORK RESULTS FOR HVAC.
  2. PIPE AND TUBING
     1. Chilled Water, Condenser Water, Heating Hot Water, and Glycol-Water, and Vent Piping:
        1. Steel: ASTM A53/A53M Grade B, seamless or ERW, Schedule 40.
        2. Copper water tube option: ASTM B88, Type K or L, hard drawn.
     2. Extension of Domestic Water Make-up Piping: ASTM B88, Type K or L, hard drawn copper tubing.
     3. Cooling Coil Condensate Drain Piping:
        1. From air handling units: Copper water tube, ASTM B88, Type M, or Schedule 40 PVC plastic piping.
        2. From fan coil or other terminal units: Copper water tube, ASTM B88, Type M for runouts and Type L for mains.
     4. Chemical Feed Piping for Condenser Water Treatment: CPVC, Schedule 80, ASTM F441/F441M.
  3. FITTINGS FOR STEEL PIPE
     1. 2 inches and Smaller: Screwed or welded joints.
        1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
        2. Forged steel, socket welding or threaded: ASME B16.11.
        3. Screwed: 150-pound malleable iron, ASME B16.3. 125-pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
        4. Unions: ASME B16.39.
        5. Water hose connection adapter: Brass, pipe thread to 3/4 inch garden hose thread, with hose cap nut.
     2. 2-1/2 inches and Larger: Welded or flanged joints.
        1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
        2. Welding flanges and bolting: ASME B16.5:
           1. Water service: Weld neck or slip-on, plain face, with 1/8 inch thick full-face neoprene gasket suitable for 220 degrees F.

Contractor's option: Convoluted, cold formed 150-pound steel flanges, with Teflon gaskets, may be used for water service.

* + - * 1. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade B.
    1. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gauge connections.
  1. FITTINGS FOR COPPER TUBING
     1. Joints:
        1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
        2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
        3. Piping under 4” diameter: Press-connect: Ensure the piping reveals no surface imperfection. Select the proper size and type of pressing jaw depending on the piping application.
     2. Bronze Flanges and Flanged Fittings: ASME B16.24.
     3. Fittings: ASME B16.18 cast copper or ASME B16.22 solder wrought copper.
  2. FITTINGS FOR PLASTIC PIPING
     1. Schedule 40, socket type for solvent welding.
     2. Schedule 40 PVC drain piping: Drainage pattern.
     3. Chemical feed piping for condenser water treatment: CPVC, Schedule 80, ASTM F439.
  3. DIELECTRIC FITTINGS
     1. Provide where copper tubing and ferrous metal pipe are joined.
     2. 2 inches and Smaller: Threaded dielectric union, ASME B16.39.
     3. 2-1/2 inches and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42. Dielectric gasket material shall be compatible with hydronic medium.
     4. Temperature Rating, 210 degrees F.
  4. SCREWED JOINTS
     1. Pipe Thread: ASME B1.20.1.
     2. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.
  5. VALVES
     1. Asbestos packing is not acceptable.
     2. All valves of the same type shall be products of a single manufacturer.
     3. Provide chain operators for valves 6 inches and larger when the centerline is located 8 feet or more above the floor or operating platform.
     4. Shut-Off Valves:
        1. Ball Valves (Pipe sizes 2 inch and smaller): MSS SP-110, screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat. Provide stem extension to allow operation without interfering with pipe insulation.
        2. Butterfly Valves (Pipe Sizes 2-1/2 inch and larger): Provide stem extension to allow 2 inches of pipe insulation without interfering with valve operation. MSS SP-67, flange lug type rated 175 psig working pressure at 200 degrees F. Valves shall be ANSI Leakage Class VI and rated for bubble tight shut-off to full valve pressure rating. Valve shall be rated for dead end service and bi-directional flow capability to full rated pressure. Butterfly valves are prohibited for direct buried pipe applications.
           1. Body: Cast iron, ASTM A126, Class B. Malleable iron, ASTM A47/A47M electro-plated, or ductile iron, ASTM A536, Grade 65‑45‑12 electro-plated.
           2. Trim: Bronze, aluminum bronze, or 300 series stainless steel disc, bronze bearings, 316 stainless steel shaft and manufacturer's recommended resilient seat. Resilient seat shall be field replaceable, and fully line the body to completely isolate the body from the product. A phosphate coated steel shaft or stem is acceptable, if the stem is completely isolated from the product.
           3. Actuators: Field interchangeable. Valves for balancing service shall have adjustable memory stop to limit open position.

Valves 6 inches and smaller: Lever actuator with minimum of seven locking positions, except where chain wheel is required.

Valves 8 inches and larger: Enclosed worm gear with handwheel, and where required, chain-wheel operator.

Gate Valves:

2 inches and smaller: MSS SP-80, Bronze, 150 psig, wedge disc, rising stem, union bonnet.

2-1/2 inches and larger: Flanged, outside screw and yoke. MSS SP-70, iron body, bronze mounted, 125 psig wedge disc.

* + 1. Globe and Angle Valves:
       1. Globe Valves:
          1. 2 inches and smaller: MSS SP-80, bronze, 150 psig. Globe valves shall be union bonnet with metal plug type disc.
          2. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for globe valves.
       2. Angle Valves:
          1. 2 inches and smaller: MSS SP-80, bronze, 150 psig. Angle valves shall be union bonnet with metal plug type disc.
          2. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-85 for angle.
    2. Check Valves:
       1. Swing Check Valves:
          1. 2 inches and smaller: MSS SP-80, bronze, 150 psig, 45-degree swing disc.
          2. 2-1/2 inches and larger: 125 psig, flanged, iron body, bronze trim, MSS SP-71 for check valves.
       2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
          1. Body: MSS SP-125 cast iron, ASTM A126, Class B, or steel, ASTM A216/A216M, Class WCB, or ductile iron, ASTM 536, flanged or wafer type.
          2. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
    3. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
       1. A dual-purpose flow balancing valve and adjustable flow meter, with bronze or cast-iron body, calibrated position pointer, valved pressure taps or quick disconnects with integral check valves and preformed polyurethane insulating enclosure.
       2. Provide a readout kit including flow meter, readout probes, hoses, flow charts or calculator, and carrying case.
    4. Automatic Balancing Control Valves: Factory calibrated to maintain constant flow (plus or minus five percent) over system pressure fluctuations of 4 to 57 psig. Provide standard pressure taps and four sets of capacity charts. Valves shall be line size and be one of the following designs:
       1. Gray iron ASTM A126 or brass body rated 175 psig at 200 degrees F, with stainless steel piston and spring.
       2. Brass or ferrous body designed for 300 psig service at 250 degrees F, with corrosion resistant, tamper proof, self-cleaning piston/spring assembly that is easily removable for inspection or replacement.
       3. Combination assemblies containing ball type shut-off valves, unions, flow regulators, strainers with blowdown valves and pressure temperature ports shall be acceptable.
       4. Provide a readout kit including flow meter, probes, hoses, flow charts and carrying case.
    5. Manual Radiator/Convector Valves: Brass, packless, with position indicator.
  1. WATER FLOW MEASURING DEVICES
     1. Minimum overall accuracy plus or minus three percent over a range of 70 to 110 percent of design flow. Select devices for not less than 110 percent of design flow rate.
     2. Venturi Type: Bronze, steel, or cast iron with bronze throat, with valved pressure sensing taps upstream and at the throat.
     3. Wafer Type Circuit Sensor: Cast iron wafer-type flow meter equipped with readout valves to facilitate the connecting of a differential pressure meter. Each readout valve shall be fitted with an integral check valve designed to minimize system fluid loss during the monitoring process.
     4. Self-Averaging Annular Sensor Type: Brass or stainless-steel metering tube, shutoff valves and quick-coupling pressure connections. Metering tube shall be rotatable, so all sensing ports may be pointed down-stream when unit is not in use.
     5. Flow Measuring Device Identification:
        1. Metal tag attached by chain to the device.
        2. Include meter or equipment number, manufacturer's name, meter model, flow rate factor and design flow rate.
     6. Portable Water Flow Indicating Meters:
        1. Minimum 6 inch diameter dial, forged brass body, beryllium-copper bellows, designed for 175 psig working pressure at 250 degrees F.
        2. Bleed and equalizing valves.
        3. Vent and drain hose and two 10 feet lengths of hose with quick disconnect connections.
        4. Factory-fabricated carrying case with hose compartment and a bound set of capacity curves showing flow rate versus pressure differential.
        5. Provide one portable meter for each range of differential pressure required for the installed flow devices.
     7. Permanently Mounted Water Flow Indicating Meters: Minimum 6 inch diameter, or 18 inch long scale, for 120 percent of design flow rate, direct reading, with three valve manifold and two shut-off valves.
  2. STRAINERS
     1. Screens: Bronze, Monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 0.045 inch diameter perforations for 4 inches and larger: 1/8 inch diameter perforations.
  3. FLEXIBLE CONNECTORS FOR WATER SERVICE
     1. Flanged Spool Connector:
        1. Single arch or multiple arch type. Tube and cover shall be constructed of chlorobutyl elastomer with full faced integral flanges to provide a tight seal without gaskets. Connectors shall be internally reinforced with high strength synthetic fibers impregnated with rubber or synthetic compounds as recommended by connector manufacturer, and steel reinforcing rings.
        2. Working pressures and temperatures shall be as follows:
           1. Connector sizes 2 inches to 4 inches, 165 psig at 250 degrees F.
           2. Connector sizes 5 inches to 12 inches, 140 psig at 250 degrees F.
        3. Provide ductile iron retaining rings and control units.
  4. EXPANSION JOINTS
     1. Factory built devices, inserted in the pipe lines, designed to absorb axial cyclical pipe movement which results from thermal expansion and contraction. This includes factory-built or field-fabricated guides located along the pipe lines to restrain lateral pipe motion and direct the axial pipe movement into the expansion joints.
     2. Manufacturing Quality Assurance: Conform to Expansion Joints Manufacturers Association (EJMA) Standards.
     3. Bellows ‑ Internally Pressurized Type:
        1. Multiple corrugations of Type 304 or Type A240-321 stainless steel.
        2. Internal stainless-steel sleeve entire length of bellows.
        3. External cast iron equalizing rings for services exceeding 50 psig.
        4. Welded ends.
        5. Design shall conform to standards of EJMA and ASME B31.9.
        6. External tie rods designed to withstand pressure thrust force upon anchor failure if one or both anchors for the joint are at change in direction of pipeline.
        7. Integral external cover.
     4. Bellows ‑ Externally Pressurized Type:
        1. Multiple corrugations of Type 304 stainless steel.
        2. Internal and external guide integral with joint.
        3. Design for external pressurization of bellows to eliminate squirm.
        4. Welded ends.
        5. Conform to the standards of EJMA and ASME B31.9.
        6. Threaded connection at bottom, 1 inch minimum, for drain or drip point.
        7. Integral external cover and internal sleeve.
     5. Expansion Compensators:
        1. Corrugated bellows, externally pressurized, stainless steel or bronze.
        2. Internal guides and anti-torque devices.
        3. Threaded ends.
        4. External shroud.
        5. Conform to standards of EJMA.
     6. Expansion Joint: 350 psig maximum working pressure, steel pipe fitting consisting of telescoping body and slip-pipe sections, PTFE modified polyphenylene sulfide coated slide section, with welded or flanged ends, suitable for axial end movement to 3 inch.
     7. Expansion Joint Identification: Provide stamped brass or stainless-steel nameplate on each expansion joint listing the manufacturer, the allowable movement, flow direction, design pressure and temperature, date of manufacture, and identifying the expansion joint by the identification number on the contract drawings.
     8. Guides: Provide factory-built guides along the pipe line to permit axial movement only and to restrain lateral and angular movement. Guides must be designed to withstand a minimum of 15 percent of the axial force which will be imposed on the expansion joints and anchors. Field-built guides may be used if detailed on the contract drawings.
     9. Supports: Provide saddle supports and frame or hangers for heat exchanger. Mounting height shall be adjusted to facilitate gravity return of steam condensate. Construct supports from steel, weld joints.
  5. HYDRONIC SYSTEM COMPONENTS
     1. Heat Exchanger (Water to Water): Shell and tube type, U-bend removable tube bundle, heating fluid in shell, heated fluid in tubes, equipped with support cradles.
        1. Maximum tube velocity: 7.5 f/s.
        2. Tube fouling factor: TEMA Standards, but not less than 0.001.
        3. Materials:
           1. Shell: Steel.
           2. Tube sheet and tube supports: Steel or brass.
           3. Tubes: 3/4 inch OD copper.
           4. Head or bonnet: Cast iron or steel.
        4. Construction: In accordance with ASME BPVC Section VIII for 125 psig working pressure for shell and tubes. Provide manufacturer's certified data report, Form No. U-1.
     2. Plate and Frame Heat Exchanger:
        1. Fixed frame with bolted removable corrugated channel plate assembly, ASME code stamped for 150 psig working pressure.
        2. Corrugated channel plates shall be type 316 or 304 stainless steel.
        3. Channel plate carrying bars to be carbon steel with zinc yellow chromate finish.
        4. Fixed frame plates and moveable pressure plates to be corrosion resistant epoxy painted carbon steel.
        5. Piping connections 2 inch and smaller to be carbon steel NPT tappings. Piping connections 4 inch and larger to be studded port design to accept ANSI flange connections. Connection ports to be integral to the frame or pressure plate.
        6. Finished units to be provided with OSHA required, formed aluminum splash guards to enclose exterior channel plate and gasket surfaces.
        7. Provide two sets of replacement gaskets and provide one set of wrenches for disassembly of plate type heat exchangers.
        8. Performance: As scheduled on drawings.
     3. Air Purger: Cast iron or fabricated steel, 125 psig water working pressure, for in-line installation.
     4. Tangential Air Separator: ASME BPVC Section VIII construction for 125 psig working pressure, flanged tangential inlet and outlet connection, internal perforated stainless-steel air collector tube designed to direct released air into expansion tank, bottom blowdown connection. If scheduled on the drawings, provide a removable stainless-steel strainer element having 3/16 inch perforations and free area of not less than five times the cross-sectional area of connecting piping.
     5. Diaphragm Type Pre-Pressurized Expansion Tank: ASME BPVC Section VIII construction for 125 psig working pressure, welded steel shell, rustproof coated, with a flexible elastomeric diaphragm suitable for a maximum operating temperature of 240 degrees F. Tank shall be equipped with system connection, drain connection, standard air fill valve and be factory pre-charged to a minimum of 12 psig.
     6. Closed Expansion (Compression) Tank: ASME BPVC Section VIII construction for 125 psig working pressure, steel, rustproof coated. Provide gauge glass, with protection guard, and angle valves with tapped openings for drain (bottom) and plugged vent (top).
        1. Horizontal tank: Provide cradle supports and following accessories:
           1. Air control tank fittings: Provide in each expansion tank to facilitate air transfer from air separator, or purger, into tank while restricting gravity circulation. Fitting shall include an integral or separate air vent tube, cut to length of about 2/3 of tank diameter, to allow venting air from the tank when establishing the initial water level in the tank.
           2. Tank drainer-air charger: Shall incorporate a vent tube, cut to above 2/3 of tank diameter, and drain valve with hose connection draining and recharging with air.
        2. Vertical floor-mounted expansion tank: Provide gauge glass, system or drain connection (bottom) and air charging (top) tappings. Provide gate valve and necessary adapters for charging system. Tank support shall consist of floor mounted base ring with drain access opening or four angle iron legs with base plates.
     7. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 4 psig above and below set point. Bronze, brass or iron body and bronze, brass or stainless-steel trim, rated 125 psig working pressure at 225 degrees F.
     8. Pressure Relief Valve: Bronze or iron body and bronze or stainless-steel trim, with testing lever. Comply with ASME BPVC Section VIII and bear ASME stamp.
     9. Automatic Air Vent Valves (where shown on drawings): Cast iron or semi-steel body, 150 psig working pressure, stainless steel float, valve, valve seat and mechanism, minimum 1/2 inch water connection and 1/4 inch air outlet. Air outlet shall be piped to the nearest floor drain.
     10. Buffer Tank: Buffer tank shall be constructed with a built-in baffle to allow mixing of the fluid inside the tank. Tank shall be constructed in accordance with ASME BPVC Section VIII requirements and stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors. Tank shall have a working pressure of 125 psig and shall come equipped with a base ring for installing the buffer tank directly on a level surface. The tank shall be furnished with two connections, tappings for air vent, relief valve and drain. Buffer tank shall have a capacity as indicated on the drawings.
  6. GAUGES, PRESSURE AND COMPOUND
     1. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 4-1/2 inches in diameter, 1/4 inch NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
     2. Provide brass lever handle union cock. Provide brass/bronze pressure snubber for gauges in water service.
     3. Range of Gauges: Provide range equal to at least 130 percent of normal operating range.
        1. For condenser water suction (compound): 30 inches Hg to 100 psig.
  7. PRESSURE/TEMPERATURE TEST PROVISIONS
     1. Pete's Plug: 1/4 inch MPT by 3 inches long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gauge test connections shown on the drawings.
     2. Provide one each of the following test items:
        1. 1/4 inch FPT by 1/8 inch diameter stainless steel pressure gauge adapter probe for extra-long test plug.
        2. 3-1/2 inch diameter, one percent accuracy, compound gauge, 30 inches Hg to 100 psig range.
        3. 32 to 220 degrees F pocket thermometer one-half degree accuracy, 1 inch dial, 5 inch long stainless-steel stem, plastic case.
  8. THERMOMETERS
     1. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 6 inch brass stem, straight, fixed or adjustable angle as required for each in reading.
     2. Case: Chrome plated brass or aluminum with enamel finish.
     3. Scale: Not less than 9 inches, range as described below, two-degree graduations.
     4. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
     5. Scale ranges:
        1. Chilled Water and Glycol-Water: 32 to 100 degrees F.
        2. Hot Water and Glycol-Water: 100 to 200 degrees F.

1. EXECUTION
   1. GENERAL
      1. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost or time to USPS. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
      2. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
      3. Support piping securely. Install heat exchangers at height sufficient to provide gravity flow of condensate to the flash tank and condensate pump.
      4. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide 1 inch minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than 1 inch in 40 feet. Provide eccentric reducers to keep bottom of sloped piping flat.
      5. Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally, locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
      6. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs with 3-elbow swing joints where noted on the drawings.
      7. Tee water piping runouts or branches into the side of mains or other branches. Avoid bull-head tees, which are two return lines entering opposite ends of a tee and exiting out the common side.
      8. Provide manual or automatic air vent at all piping system high points and drain valves at all low points. Install piping to floor drains from all automatic air vents.
      9. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
         1. Water treatment pot feeders and condenser water treatment systems.
         2. Flow elements (orifice unions), control valve bodies, flow switches, pressure taps with valve, and wells for sensors.
      10. Thermometer Wells: In pipes 2-1/2 inches and smaller increase the pipe size to provide free area equal to the upstream pipe area.
      11. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.
      12. Where copper piping is connected to steel piping, provide dielectric connections.
   2. PIPE JOINTS
      1. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1/B2.1M.
      2. Screwed: Threads shall conform to ASME B1.20.1; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
      3. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
      4. Solvent Welded Joints: As recommended by the manufacturer.
   3. EXPANSION JOINTS (BELLOWS AND SLIP TYPE)
      1. Anchors and Guides: Provide type, quantity and spacing as recommended by manufacturer of expansion joint and as shown. A professional engineer shall verify in writing that anchors and guides are properly designed for forces and moments which will be imposed.
      2. Cold Set: Provide setting of joint travel at installation as recommended by the manufacturer for the ambient temperature during the installation.
      3. Preparation for Service: Remove all apparatus provided to restrain joint during shipping or installation. Representative of manufacturer shall visit the site and verify that installation is proper.
      4. Access: Expansion joints must be located in readily accessible space. Locate joints to permit access without removing piping or other devices. Allow clear space to permit replacement of joints and to permit access to devices for inspection of all surfaces and for adding.
   4. LEAK TESTING ABOVEGROUND PIPING
      1. Inspect all joints and connections for leaks and workmanship and make corrections as necessary.
      2. An operating test at design pressure, and for hot systems, design maximum temperature.
      3. A hydrostatic test at 1.5 times design pressure. For water systems, the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.
   5. FLUSHING AND CLEANING PIPING SYSTEMS
      1. Initial Flushing: Remove loose dirt, mill scale, metal chips, weld beads, rust, and like deleterious substances without damage to any system components. Provide temporary piping or hose to bypass coils, control valves, exchangers and other factory cleaned equipment unless acceptable means of protection are provided and subsequent inspection of hide-out areas takes place. Isolate or protect clean system components, including pumps and pressure vessels, and remove any component which may be damaged. Open all valves, drains, vents and strainers at all system levels. Remove plugs, caps, spool pieces, and components to facilitate early debris discharge from system. Sectionalize system to obtain debris carrying velocity of 5.9 f/s, if possible. Connect dead-end supply and return headers as necessary. Flush bottoms of risers. Install temporary strainers where necessary to protect down-stream equipment. Supply and remove flushing water and drainage by various type hose, temporary and permanent piping and Contractor's booster pumps.
      2. Cleaning: Circulate systems at normal temperature to remove adherent organic soil, hydrocarbons, flux, pipe mill varnish, pipe joint compounds, iron oxide, and like deleterious substances not removed by flushing, without chemical or mechanical damage to any system component. Removal of tightly adherent mill scale is not required. Keep isolated equipment which is "clean" and where dead-end debris accumulation cannot occur. Sectionalize system if possible, to circulate at velocities not less than 5.9 f/s. Circulate each section for not less than 4 hours. Blow-down all strainers or remove and clean as frequently as necessary. Drain and prepare for final flushing.
      3. Final Flushing: Return systems to conditions required by initial flushing after all cleaning solution has been displaced by clean make-up. Flush all dead ends and isolated clean equipment. Gently operate all valves to dislodge any debris in valve body by throttling velocity. Flush for not less than one hour.
   6. WATER TREATMENT
      1. Install water treatment equipment and provide water treatment system piping.
      2. Close and fill system as soon as possible after final flushing to minimize corrosion.
   7. STARTUP AND TESTING
      1. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
      2. When any defects are detected, correct defects and repeat test at no additional cost or time to the USPS.
      3. Adjust red set hand on pressure gauges to normal working pressure.
   8. DEMONSTRATION AND TRAINING
      1. Provide services of manufacturer’s technical representative to instruct each USPS personnel responsible in operation and maintenance of the system.

END OF SECTION

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