SECTION 23 05 15

PIPING SPECIALTIES

**BASED ON DFD MASTER SPECIFICATION DATED 12/20/2023**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

P A R T 1 - G E N E R A L

SCOPE

This section contains specifications for HVAC piping specialties for all piping systems. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference

Quality Assurance

Shop Drawings

Operation and Maintenance Data

Design Criteria

PART 2 - PRODUCTS

Thermometers

Thermometer Sockets

Test Wells

P/T (Pressure/Temperature) Test Plugs

Hose Connection Caps

Pressure Gauges

Expansion Loops

Expansion Compensators

Expansion Joints (Bellows type)

Expansion Joints (Slip type)

Strainers

Water Filters

Centrifugal Separators

Steam Traps

Steam Traps (Distribution)

Condensate Mixer

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Air Separators

Coalescing Air and Dirt Separators

Air Vents

Suction Diffusers

Vacuum Breakers

Flow Sensing Devices

Differential Pressure Gauge

Cold Water Meters

PART 3 - EXECUTION

Thermometers

Thermometer Sockets

Test Wells

P/T (Pressure/Temperature) Test Plugs

Pressure Gauges

Expansion Loops

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Air Vents

Suction Diffusers

Vacuum Breakers

Flow Sensing Devices

Differential Pressure Gauge

Cold Water Meters

Steam Condensate Water Meters

Construction Verification Items

RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 23 08 00 – Commissioning of HVAC

Section 23 11 00 - Facility Fuel Piping

Section 23 21 13 - Hydronic Piping

Section 23 22 13 - Steam and Condensate Heating Piping

Section 23 24 00 - Internal-Combustion Engine Piping

Section 23 83 16 - Radiant-Heating Hydronic Piping

Section 23 05 23 - General-Duty Valves for HVAC Piping

Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

Section 23 07 00 - HVAC Insulation

REFERENCE

Applicable provisions of Division 1 govern work under this section.

QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Required for all items in this section; Include materials of construction, dimensional data, ratings/capacities/ranges, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

Delete the following if there are no additional requirements.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

 [A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]

DESIGN CRITERIA

All piping specialties are to be rated for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

P A R T 2 - P R O D U C T S

THERMOMETERS

Manufacturers: Ashcroft, Marsh, Taylor, H. O. Trerice, U. S. Gauge, Weiss, Weksler.

Stem Type, cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red or blue indicating fluid, black lettering against a white background, with scale ranges as follows:

|  |  |  |
| --- | --- | --- |
| **Service** | **Scale Range, °F** | **Min. Increment, °F** |
| Hot Water | 30 - 240 | 2 |
| Chilled Water | 0 - 120 | 1 |
| Glycol Water | 30-130 | 2 |
| Condenser Water | 0 - 120 or 30 - 130 | 1 |
| Steam Condensate | 30 - 300 | 1 |

Select a scale range such that the normally measured average fluid temperature is near the midpoint of the scale, the minimum increment number is as low as possible, and the range is appropriate to the temperatures that will be measured during normal operation as well as when the system is not operating. Verify scale range and divisions for glycol water. Use compound gauges at the inlet of condenser water pumps drawing from open sumps.

THERMOMETER SOCKETS

Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

TEST WELLS

Similar to thermometer sockets except with a brass cap that thread into the inside of the test well to prevent dirt from accumulating. Secure cap to body with a short chain. Furnish with extension necks, where appropriate, to accommodate the pipeline insulation.

P/T (PRESSURE/TEMPERATURE) TEST PLUGS

Brass plug with 1/4" NPT threads, EPDM or neoprene valve core, knurled cap with cap strap. Use extended length plugs to clear insulated piping. Adaptors shall have 1/4" FPT connection for standard pressure gauges.

HOSE CONNECTION CAPS

Hose connection caps shall be pressure rated for 150 psig at 180 deg F.

PRESSURE GAUGES

Manufacturers: Ametek/U. S. Gauge Division, Ashcroft, Marsh, Taylor, H. O. Trerice, Weiss, Weksler.

Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

|  |  |  |
| --- | --- | --- |
| **Service** | **Scale Range, psig** | **Min. Increment, psig** |
| Hot Water |  |  |
| Chilled Water |  |  |
| Glycol Water |  |  |
| Condenser Water |  |  |
| Low Pressure Steam | 0 - 30 | 0.5 |
| High Pressure Steam | 0 - 100 | 1 |
| High Pressure Steam | 0 - 300 | 5 |
| Fuel Oil Suction |  |  |
| Fuel Oil Discharge |  |  |

Select pressure ranges appropriate to the system being designed and so that the variable being measured is near the midpoint of the scale under normal conditions. Enter scale range and minimum increment in the blank spaces in the above table for the specific project requirements. Even though components in any system must be rated at not less than 125 psig,, it is appropriate to select gauges with scale ranges less than this rating. Compound gauges may be needed on fuel oil systems.

Pressure Snubbers:

Bronze construction, suitable for system working pressure, 1/4" size.

Coil Syphons:

Bronze or steel construction, suitable for system working pressure, 1/4" size.

Gauge Valves:

Use valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping. For water systems, use 1/4" ball valves. For steam systems, use 1/4" gate valves suitable for system working pressure.

The following subheadings indicate various methods of accommodating thermal pipe expansion/contraction and stresses within the pipe. Consultant must indicate anchor locations on the drawings, calculate the forces on these anchors, and verify with the building structural consultant that the forces can be restrained by the structural system.

EXPANSION LOOPS

Provide expansion loops indicated on the drawings and details.

The consultant is required to size each loop so that the stress levels due to expansion and/or contraction do not exceed those allowed by ASME Codes. Always use expansion loops in lieu of expansion compensators or expansion joints unless absolutely necessary. Do not install compensators/joints in inaccessible locations.

EXPANSION COMPENSATORS

Verify working pressure requirements when expansion compensators are used on systems connected to existing central chilled and/or hot water plants.

Manufacturers: MetraFlex HP series, Vibrations Mountings and Controls, Hyspan, or Flexonics model H or HP.

Constructed of two ply stainless steel bellows with carbon steel shrouds, carbon steel threaded or flanged end fittings or copper solder joint fittings, internal guides for the full length of the bellows travel, and positive internal anti-torque device to prevent twist or torque during installation. Units to be rated at 150 psi at not less than 400°F.

Use only on water systems. Not for use on steam unless specifically approved by DFD-engineering staff. Expansion compensators will not be approved for high pressure steam applications.

EXPANSION JOINTS (Bellows type)

Verify working pressure requirements when expansion joints are used on systems connected to existing central chilled and/or hot water plants.

Manufacturers: Adsco Corruflex, Flexonics High Corr, Hyspan, MetraFlex.

Flanged, packless, self-equalizing type constructed of type 304 stainless steel bellows and carbon steel fittings. Construct control rings of cast steel or nickel iron. Include limit stops and tie rods to prevent over traversing and to constrain pressure thrust forces on the joints. Units to be rated at 150 psi at not less than 400°F.

Include an external sheet metal shroud on all joints that will be insulated. Shroud to be removable for field inspection of the joint.

Include an internal sleeve of 304 stainless steel with sufficient clearance between the bellows and the sleeve to permit full rated rotational and lateral movement. Inside diameter of sleeve is not to be less than that of the adjoining pipe.

Specify a pressure balanced type expansion joint when the application requires that external loads on equipment or pressure vessels must be minimized. Not for use on steam.

EXPANSION JOINTS (Slip type)

This specification is good for 150 psig steam at temperatures to 500 deg. F. Above these conditions, contact the specific manufacturers.

Manufacturers: Adsco Type RJ, Advanced Thermal Systems Type TP2, Hyspan 6500 series, precompression amounts, and presence or absence of bases as indicated on the drawings.

Slip type with integral internal and external guides designed for the injection of self-lubricating packing under full line pressure. Provide [Single end] [Double end with integral anchor base] expansion joints, suitable for use with 150 psig steam of sizes and traverse noted on plans.

Single end type should be located adjacent to a pipe anchor at one end of the pipe run rather than in the middle of the run. Fabricate anchors for piping in the field. Specify the anchor base only on double joints. Modify the pressure/temperature requirements upward when needed for the specific project.

Traverse chamber and stuffing box:

ASTM A53, Grade B, seamless steel pipe and concentric reducer of same or greater wall thickness as connected piping system.

Slip:

ASTM A53, Grade B, Type S, black steel pipe. Use schedule 80 material for sizes through 16 inch and schedule 60 for sizes 18 inch through 24 inch, but not lighter weight material than used on the connected piping system. Slip to be ground, polished, and plated with not less than 1 mil of hard chrome applied over 1 mil of crack-free hard chrome, in accordance with ASTM B650.

End Connections:

Beveled to match connected piping for field welding.

Flanges are specifically not wanted due to dimensional problems when/if the joint is replaced.

Guides:

Internal and external integral with the stuffing box with aluminum bronze, Bronzalon, or other non-ferrous, low friction inserts.

Outward limit stops:

T-303 stainless steel pins welded to slip to prevent disengagement of the slip in the event of anchor failure.

Packing/Packing Cylinder:

Injectable packing to be self-lubricating, asbestos free, flake graphite/Teflon packing suitable for 150 psig at not less than 600°F, injectable under full line pressure, backed by self-lubricating, asbestos free reinforced graphite braided ring packing. The area of the packing in contact with the sliding slip shall be a minimum of 15 times the nominal pipe size of the joint. Provide multiple packing cylinders with integral stainless steel safety valve and internal acme thread and plungers to inject packing into the expansion joint without blowback. Furnish one clean-out tool to loosen impacted packing prior to adding injectable packing. Provide three extra packing plugs for each packing cylinder for each joint.

Locate expansion joint with sufficient clearance from wall or other obstruction to allow access to and removal of all packing ram plungers and use of clean-out tool.

Pressure/Temperature Rating:

150 psig at temperatures to 500°F.

Coordinate the following paragraph with the execution portion of this section and Section 23 07 00.

Insulation Blanket:

Expansion joint manufacturer to supply a reusable, removable insulation blanket utilizing T-304 stainless steel wire twist fasteners for the body and silicon fiberglass belting with stainless buckles for the sliding slip, designed to allow access to the packing cylinder plungers for repacking without removal of the blanket. Thermal resistance to be not less than that of the insulation covering the adjoining piping.

STRAINERS

Verify working pressure requirements when strainers are used on systems connected to existing central chilled and/or hot water plants.

Manufacturers: Armstrong, Hoffman, Illinois, Keckley, Metraflex, Mueller Steam, or Sarco.

WATER SYSTEMS:

Y type; cast iron body; stainless steel screens; bolted or threaded screen retainer tapped for a blow off valve; threaded body in sizes through 2 inch and rated at not less than 175 psi WOG; flanged body in sizes over 2 inch and rated at not less than 125 psi WOG at 240°F. Screen to be 20 mesh for line sizes 2 inch and less, 0.125 inch perforations for line sizes 2-1/2 inch through 4 inch, and 0.25 inch perforations for line sizes 5 inch and larger.

Use basket strainers with clamped covers on cooling tower pumps pumping from open sumps or tower basins. Verify that maximum cover working pressure exceeds the static pressure at the pump suction.

Basket type: Cast iron body with clamped cover; stainless steel screens; body tapped for a blow off valve; 125 psig flanged body for 2 1/2" and larger; 0.125 inch perforations for line sizes 2-1/2 inch through 4 inch, and 0.25 inch perforations for line sizes 5 inch and larger.

WATER SYSTEMS WITH DESIGN PRESSURES OVER 150 PSIG:

Y type; cast iron or cast steel body; stainless steel screens; bolted or threaded screen retainer tapped for a blow off valve; threaded or socket weld body in sizes through 2 inch and rated at not less than 300 psi WOG at 150°F; flanged or butt weld body in sizes over 2 inch and rated at not less than 300 psi WOG at 150°F. Screen perforations to be 0.057 inch for line sizes 2 inch and less, 0.125 inch for line sizes 2-1/2 inch through 4 inch, and 0.25 inch for line sizes 5 inch and larger.

STEAM SYSTEMS (15 PSIG AND LOWER):

Y type; cast iron body; stainless steel screens; bolted or threaded screen retainer tapped for a blow off valve; threaded in sizes through 2 inch and rated at not less than 250 psi at 400°F; flanged in sizes over 2 inch and rated at not less than 125 psi at 350°F. Screen to be 20 mesh for line sizes 2 inch and less, 0.050 inch perforations for line sizes over 2 inch.

STEAM SYSTEMS (15 PSIG TO 100 PSIG):

Y type; steel body; stainless steel screens; bolted or threaded screen retainer tapped for a blow off valve; threaded or flanged in sizes through 2 inch; flanged in sizes over 2 inch; rated at not less than 250 psi at 400°F. Screen perforations to be 0.050 inch for all line sizes.

The preceding paragraph is intended to be used on high pressure steam systems that are not exposed to superheated steam. Those systems that are connected to central plants that generate superheated steam or that can be exposed to superheated steam under some circumstances are to use the cast steel strainers from the following paragraph. Note, however, that the following strainer specification may not be suitable for all work within central heating plants; contact the DFD engineering for direction. Note that the following paragraph calls for service at 600 psig which does not necessarily mean a Class 600 strainer is required. Some Class 300 strainers are rated at 600psig up to 500°F. Verify the actual system requirements prior to specifying either strainer class.

STEAM SYSTEMS (100 PSIG to 300 PSIG):

Y type; cast steel or forges steel body; stainless steel screen; bolted or threaded screen retainer tapped for a blow off valve; threaded, socket weld, butt weld, or flanged end connections in all sizes; suitable for steam service at 300 psig and 800 deg F. Screen perforations to be 0.050 inch for all line sizes.

STEAM SYSTEMS (OVER 300 PSIG)

AE should consult with DFD for service over 300 PSIG

WATER FILTERS

For use on closed water systems (do not use on individual buildings connected to campus or district chilled water systems). Size filter to handle approximately 10% of the system flow rate, note that the pump will then need to be selected for 110% of the required design flow. Pressure drop through the clean filter must be significantly less than the pressure drop through the remainder of the system, otherwise, as the filter begins to load, the system could receive most of the flow with little going through the filter.

Verify working pressure requirements when filters are used on new or existing central chilled and/or hot water plants.

Manufacturers: Commercial Filters (Carborundum), Pall Trinity Micro Corporation, Dover Corp./Ronningen-Petter Division or equal.

Construct housing of carbon steel rated at 125 psig at 250°F. Finished product to bear the ASME unfired pressure vessel stamp. Use a gasketed clamped cover of cast iron or steel to provide filter access. Use threaded pipe connections for nominal pipe sizes 2 inch and smaller, flanged pipe connections for nominal pipe sizes 2-1/2 inch and larger; mechanical grooved pipe connections may be substituted for all sizes when allowed by Section 23 21 13. Include a floor mounting support.

For very small size filter, the floor support can be deleted and pipeline mounting or wall mounting can be used if acceptable to the manufacturer. If this method is used, revise the installation requirements in Part 3.

Furnish 4 sets of cleanable nylon bag filters, two capable of removing 95% of solids that are 10 microns or large and two cable of removing 95% of solids that are 50 microns or larger

Assembly to function properly with pressure differentials to 75 psi.

Verify with the agency whether a differential pressure alarm is needed and if it should be connected to a building automation system.

CENTRIFUGAL SEPARATORS

Use on water systems that are dirty or on closed water systems that are frequently opened.

Verify working pressure requirements when separators are used on systems connected to existing central chilled and/or hot water plants.

Centrifugal vortex type separator constructed of carbon steel and furnished with flanged inlet and outlet, collection chamber that is openable for inspection or cleaning, flanged separator section to allow interior inspection or cleaning, flanged collection chamber outlet for removing collected material, a relief line from the venturi chamber to the collection chamber to improve solids collection, 1/2 inch gauge connections in the main inlet and outlet connections, and suitable for an operating pressure of not less than 125 psig. Assembly to be capable of removing 98% by weight of all particles 75 microns or larger and having a specific gravity of at least 1.8.

Furnish with a purge assembly consisting of a motorized ball valve and a controller suitable for 120 volt operation and mounting independently near the valve. Ball valve to be suitable for 125 psig operation at 100°F. Controller to allow setting of purge time between 15 seconds and 30 minutes with frequencies between one minute and 16 hours. Include controls to allow automatic operation, manual operation, or de-energizing the controller.

STEAM TRAPS

Select only the trap types that are needed for the project. Most projects will use float and thermostatic traps and/or inverted bucket traps. The list of manufacturers may have to be edited, depending on the type of traps needed and the pressure ratings required.

Additional comments may have to be made with respect to the safety factor by the consultant for instances when a factor of three or four may be required.

Some traps are specified below with options for the pressure ratings. The Engineer is responsible for making sure the proper pressure range is specified for the project.

Do not use float and thermostatic traps on systems carrying superheated steam; use inverted bucket traps. Since the air vent on float and thermostatic traps opens a few degrees below saturation temperature, inadequate air venting and inadequate condensate drainage will occur if used on superheated steam systems.

The consultant is expected to schedule steam trap capacities required for each application or series of applications. These scheduled capacities are to include the effect of safety factors. Schedule required trap capacities not the capacity of the item being trapped.

Notes that specific revisions may be needed for some traps if operating pressures exceed 125 psig.

Consultant should consider whether each application should have standby traps. DFD personnel are available for consultation if needed.

F&T traps on LPS are not to be used in steam distribution systems. check with DFD PM before using any other trap for steam distribution systems.

Manufacturers: Armstrong, Dunham-Bush, Hoffman, Illinois, Nicholson, Spirax Sarco, TLV and Yarway. Manufacturers must meet the material specifications below.

Minimum trap size is 3/4 inch for all types.

Traps with brass/bronze internal parts will not be accepted.

This requirement is due to costly repairs we have experienced in the past due to incorrect chemical treatment resulting in too high a pH.

FLOAT AND THERMOSTATIC TRAPS:

Cast iron or semi-steel body and bolted cover, non-asbestos cover gasket, stainless steel bellows type air vent, stainless steel float, stainless steel lever and valve assembly, and rated at not less than [125 psig saturated steam][15 psig saturated steam]. Traps used on low pressure steam, 15 psig or less, are to be SHEMA rated.

INVERTED BUCKET TRAPS - CAST IRON:

Cast iron or semi-steel body and bolted cover, non-asbestos cover gasket, stainless steel bucket, stainless steel or heat treated chrome steel seat and plunger, integral inlet strainer with stainless steel screen and tapped and plugged blowdown connection, rated at not less than 150 psig saturated steam. Sealed stainless steel traps may be substituted for cast iron traps if the pressure/temperature and other construction limitations are met.

INVERTED BUCKET TRAPS - FORGED STEEL:

Forged carbon steel body with bolted cover, non-asbestos cover gasket, stainless steel bucket, stainless steel or heat treated chrome steel seat and plunger, rated at not less than 175 psig steam at 430°F.

**STEAM TRAPS (DISTRIBUTION)**

Manufacturers: Velan TS-300, Gestra BK, or approved equal. Manufacturers must meet the material specifications below.

Minimum trap size is 3/4 inch for all types.

Traps with brass/bronze internal parts will not be accepted.

INVERTED BUCKET TRAPS - CAST IRON:

Cast iron or semi-steel body and bolted cover, non-asbestos cover gasket, stainless steel bucket, stainless steel or heat treated chrome steel seat and plunger, integral inlet strainer with stainless steel screen and tapped and plugged blowdown connection, rated at not less than 150 psig saturated steam. Sealed stainless steel traps may be substituted for cast iron traps if the pressure/temperature and other construction limitations are met.

BIMETALLIC TRAPS:

Forged steel body and bolted cover, non-asbestos cover gasket, stainless steel trim, stainless steel or heat treated chrome steel seat, integral inlet strainer with stainless steel screen and tapped and valved blowdown connection, Blowdown port shall have cap and retainer. Trap shall be rated for not less than 175 psig and 430°F.

**CONDENSATE MIXER**

Condensate mixers shall be manufactured by Advanced Steam Technology, Maxi-Therm or approved equal. Mixers shall be rated for 150 PSIG. Mixers shall be schedule 80 carbon steel. Mixer shall be butt weld. Mixers shall require no maintenance and have no internal moving parts.

Coordinate with PM and Facility on end type. Butt weld is preferred

EXPANSION TANKS

Where equipment room space is not critical, standard type tanks may be used. Use bladder tanks when space or weight factors are more critical.

Verify working pressure requirements when expansion tanks are used on systems connected to existing central chilled and/or hot water plants.

Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, John Wood, Taco, Wessels.

STANDARD TYPE:

Steel construction, tested and stamped in accordance with Section 8D of the ANSI/ASME Code and furnished with the National Board Form U-1, red line gauge glass with guard and cocks, drain valve with hose adapter, air charging device, system connection, rated for not less than 125 psi working pressure, prime coated, mounting saddles for horizontal installation or base for vertical installation, size/capacity as indicated on the drawings.

BLADDER TYPE:

Steel construction, tested and stamped in accordance with Section 8D of the ANSI/ASME Code and furnished with the National Board Form U-1, rated for not less than 125 psig working pressure, precharged with air to the initial fill pressure indicated on the drawings, butyl replaceable bladder suitable for fluid temperatures to 220°F, and furnished with a tank drain connection, system connection, mounting saddles for horizontal installation or base for vertical installation, prime coated, size/capacity as indicated on the drawings. Tank and bladder construction must allow field replacement of the bladder on its failure.

On systems using an antifreeze solution, verify that the bladder material usually butyl is suitable for the application.

AIR SEPARATORS

Verify working pressure requirements when air separators are used on systems connected to existing central chilled and/or hot water plants.

Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, John Wood, Taco.

1-1/2 inch and smaller: Cast iron construction, suitable for in-line installation, top and bottom connections for use with expansion tanks specified above, rated at not less than 125 psig at 220°F.

2 inch and larger: Welded steel construction, ASME constructed and stamped for a working pressure not less than 125 psig at 220°F, threaded or flanged connections for 2 inch size, flanged or grooved connections if grooved piping is allowed for all sizes over 2 inch, suitable for use with expansion tanks specified above, drain connection at the bottom of unit, vent/tank connection at the top of unit, suitable for the system flow rates as indicated on the drawings.

Include a galvanized or stainless steel strainer with provisions in the unit shell for strainer removal. Provide a blowdown connection located so that the inside surface of the strainer can be cleaned by draining the system fluid through the blowdown connection.

COALESCING AIR AND DIRT SEPARATORS

Verify working pressure requirements when separators are used on systems connected to existing central chilled and/or hot water plants.

Manufacturers: Bell & Gossett, Spirotherm, Inc., Wessels

2 inch and larger: Welded steel construction, ASME Section VIII, Division 1 constructed and stamped for a working pressure not less than 150 psig at 250°F, threaded or flanged connections for 2 inch size, flanged or grooved connections if grooved piping is allowed for all sizes over 2 inch. Provide unit with factory installed automatic air vent on the top, blow down connection at the bottom of the unit, and a skimming connection to remove floating dirt. Unit size shall be suitable for the system flow rates as indicated on the drawings.

Internal coalescing material shall be constructed of copper or 304 stainless steel. Unit shall include internal structured elements filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100% entrained air, and 99% dissolved air at the installed location. Dirt separation efficiency shall be a minimum of 80% of all particles 30 micron and larger within 100 passes

Provide the following on units installed on condenser water systems.

Provide removable head to access material for inspection and cleaning.

AIR VENTS

Verify working pressure requirements when air vents are used on systems connected to existing central chilled and/or hot water plants. If there is a working pressure problem, one solution would be to install a shutoff valve between the system and each air vent.

MANUAL KEY TYPE VENTS:

Bell and Gossett Model 4V; Eaton/Dole Model 9, 9B, or 14A.

Bronze body with nonferrous internal parts, screwdriver operated, designed to relieve air from the system when vent is opened, rated at not less than 125 psig at 220°F.

MANUAL BALL VALVE VENTS:

Provide 1/4" ball valves for manual venting of air handling unit coils and where indicated elsewhere on drawings and details. Reference specifications section 23 05 23.

AUTOMATIC VENTS:

Thrush Model 720, Bell and Gossett Model 107, Watson McDaniel Model AV813W

Cast iron body with nonferrous internal parts, designed to vent air automatically with float principle without allowing air to enter the system, rated at not less than 125 psig at 220°F.

SUCTION DIFFUSERS

Manufacturers: Amtrol/Thrush, Armstrong Pumps, Bell and Gossett, Taco.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Amtrol | Armstrong | B&G | Taco |
| Body | CI/steel | CI | CI | CI |
| Straightening Vanes |  | c:CI/steel o:SS/CI | steel | CI |
| Strainer | Galv. Steel | SS | c:Steel o:SS | SS |
| Startup Strainer |  | Brass | c:Bronze o:None | Bronze |
| Max. psi | 175 | 175 | 175 | 175 |
| Max deg. F | 250 | 300 | 250 | 250 |

"c" indicates manufacturer’s standard construction for closed systems; "o" indicates manufacturer’s standard construction for open systems, Jul 89

Verify working pressure requirements when suction diffusers are used on systems connected to existing central chilled and/or hot water plants.

Designed to replace the suction line strainer and the long entrance pipe at a pump suction; constructed with a strainer blowdown connection, provisions for a field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250°F.

CLOSED SYSTEMS:

Body constructed of cast iron, ductile iron or carbon steel; cast iron or steel straightening vanes; steel, galvanized steel or stainless steel strainer; brass or bronze fine mesh startup strainer, strainer blowdown connection, inlet pressure gauge connection, provisions for a field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250°F.

OPEN SYSTEMS:

Body constructed of cast iron, ductile iron or carbon steel; cast iron, steel or stainless steel straightening vanes; galvanized steel or stainless steel strainer; strainer blowdown connection, inlet pressure gauge connection, provisions for a field supplied support foot, and bolted flange for strainer removal and cleaning; rated at not less than 125 psi working pressure at not less than 250°F.

VACUUM BREAKERS

Where vacuum breakers are not furnished integral with equipment by the equipment manufacturer, provide 15 degree swing check valve. Reference specification section 23 05 23.

FLOW SENSING DEVICES

Consultant must indicate location of each flow sensing device on the drawings, the flow rate that is to be sensed, the type of flow sensing device, and the permanent pressure loss at the design flow rate.

For water flow sensing devices 2 inch and smaller, use balance valves as specified in Section 23 05 23 - General-Duty Valves for HVAC Piping.

PITOT TUBE FLOW SENSORS - TYPE 1:

1. This is a standard duty flow sensor for use where the system can be shutdown, it is not a hot-tap type of sensor.
2. Do not use the Type 1 sensor on any campus type chilled water or steam systems, extensions of the systems, or within any central plants.
3. Include the meter paragraph on when directed.
4. Taco is not included in this specification due to inadequate published information that has not yet been researched through the supplier.
5. This specification is not intended to limit the type of sensor used by the consultant; if another type is desired, review with DFD engineering personnel.

Dieterich Standard/Annubar, Preso, or approved equal.

Multi-port averaging type flow sensor designed to sense the velocity of a fluid flowing in a pipe and produce a pressure output that is proportional to the fluid velocity. Sensor to consist of a type 316 stainless steel probe with a diamond or elliptical shape of sufficient length to sense flow completely across the pipe section and to accommodate the insulation specified for the pipeline; brass body gate, needle, or ball instrument connection valves with appropriate fitting for connection to a meter; single forged steel weld type installation fitting for pipe sizes through 6 inch, double forged steel weld type installation fittings for use on opposite ends of the sensor for larger pipe sizes if recommended by the manufacturer for the application; accurate within 2% of the actual flow with a turndown ratio of 10:1 or better; permanently stamped nameplate attached to the sensor indicating the flow/differential pressure characteristics of the sensor; suitable for use on systems to 150 psig at 250°F.

PITOT TYPE FLOW SENSORS - TYPE 2:

1. This is a "hot-tap" sensor that can be installed without shutting down the system.
2. Use on all campus steam and chilled water systems where this type of sensor is acceptable and other applications where it is impractical to shut down the system.
3. Include the meter paragraph only when directed.
4. The pressure/temperature rating is based on the operating condition of most distribution systems, this should be verified, however when work within central plant systems is being done.
5. Depending on the conditions of the flowing fluid, it may be necessary to specify pressure and temperature sensing at the same point where flow sensing is done. The consultant should investigate this with the specific agency.

Dieterich Standard/Annubar, Preso, or approved equal.

Multi-port averaging type flow sensor designed to sense the velocity of a fluid flowing in a pipe and produce a pressure output that is proportional to the fluid velocity. Sensor to consist of a type 316 stainless steel probe with a diamond or elliptical shape; brass body gate, needle, or ball instrument connection valves with appropriate fitting for connection to a meter; single forged steel weld type installation fitting for pipe sizes through 6 inch, double forged steel weld type installation fittings for use on opposite ends of the sensor for larger pipe sizes if recommended by the manufacturer for the application; non-asbestos packing in a type 316 stainless steel packing gland; carbon steel mounting hardware; ball or gate type isolation valve extended from the system pipe to accommodate pipeline insulation; accurate within 2% of the actual flow with a turndown ratio of 10:1 or better; permanently stamped nameplate attached to the sensor indicating the flow/differential pressure characteristics of the sensor; suitable for use on systems to 150 psig at 366°F and 200 psig at 100°F.

Include one differential pressure meter kit that includes a six inch diameter gauge having an accuracy of 3% of full scale or better and suitable for the differential pressures of the valves supplied for this project, color coded hoses not less than ten feet in length with brass connectors suitable for connection to the low and high pressure connections on the balance valves, instrument valving so meter can be vented and drained, pressure and temperature rating at least equal to that of the valves. Provide meter and all accessories in a durable case with carrying handle.

DIFFERENTIAL PRESSURE GAUGE

Barton 247A, Midwest 809, or approved equal.

Bellows type differential pressure meter kit that includes a six inch diameter gauge with a 270° arc having an accuracy of ±1% of full scale or better and suitable for the differential pressures of the flow meters supplied for this project, over range protection on the meter, color coded hoses not less than ten feet in length with brass connectors suitable for connection to the low and high pressure connections on the balance valves, inline strainers, instrument valving so meter can be vented and drained, pressure and temperature rating at least equal to that of the valves. Provide meter and all accessories in a durable case with carrying handle.

COLD WATER METERS:

Bronze body, minimum 3/4" NPT ends, positive displacement disc type meter with built-in strainer, magnetic drive and thermoplastic disc/register gearing. Meters shall meet ANSI/AWWA Standard C700. Sealed register shall be odometer type totalization display having 10,000,000 gallon capacity. Register shall also have 360 degree sweep hand with 10 gallon range and 0.1 per gallon increments. Meters shall be suitable for 150 psig pressure at 80 degrees F. Badger Recordall Disc Meter, Carlon Meter Co., Neptune, Hersey, Venture Measurement Niagara.

P A R T 3 - E X E C U T I O N

THERMOMETERS

STEM TYPE:

Install in piping systems as indicated on the drawings and/or details using a separable socket in each location.

DIAL TYPE FOR AIR TEMPERATURE MEASUREMENT:

Install in ductwork where detailed or specified. Support capillary inside duct so it measures a uniform sample of air. Mount readout so it is readily visible on a portion of ductwork that is not externally insulated or on a sheet metal angle support secured to a nearby structural element.

THERMOMETER SOCKETS

Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

TEST WELLS

Install in piping systems as indicated on the drawings and/or details wherever provisions are needed for inserting a thermometer at a later date.

P/T (PRESSURE/TEMPERATURE) TEST PLUGS

Install in piping systems as indicated on the drawings and/or details. Do not insulate over test plugs.

PRESSURE GAUGES

Install in locations where indicated on the drawings and/or details, including any gauge piping, with scale range appropriate to the system operating pressures.

PRESSURE SNUBBERS:

Install in gauge piping for all gauges used on water services.

COIL SYPHONS:

Install in gauge piping for all gauges used on steam services.

GAUGE VALVES

Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

Regardless of the method used to control expansion and contraction, the consultant must indicate the anchor and guide requirements on the drawings.

EXPANSION LOOPS

Install where indicated on the drawings or details, locating anchors and guides as detailed.

EXPANSION COMPENSATORS

Install where indicated on the drawings or details, locating anchors and guides as detailed.

Show locations on the drawings or details so that the contractor knows exactly where expansion compensators are needed. See comments in Part 2 under Expansion Loops for one method of determining where they are required.

EXPANSION JOINTS (Bellows type)

Install where indicated on the drawings or details, locating anchors and guides as detailed. Do not stretch joint to accommodate pipe misalignment or end-to-end spacing. Remove all shipping rods and spacers and clean inside of joint before placing in service.

EXPANSION JOINTS (Slip type)

Verify that the joint has been precompressed the proper amount for the application, including the temperature difference between the installation condition and the operating condition; adjust precompression as required. Provide protection for the chrome plated slip during the entire installation process. Replace packing if it has become imbedded with dirt, gravel, or other foreign material. Install alignment guides as indicated on the drawings or in accordance with the joint manufacturer's instructions, whichever is more restrictive. For joints furnished with bases, use the proper size bolts in all bolt holes to obtain the maximum anchor strength. Install a drip trap or drain plug, in accordance with the project details, on joints furnished with a drain connection.

On lines specified to be insulated, install the insulation blanket, furnished by the expansion joint supplier, in accordance with the manufacturer's instructions.

Expansion joints shall be oriented to have the slip ram connect to the length of pipe that is intended to grow with thermal expansion. The tail end without the ram is to be nearest the pipe anchor.

STRAINERS

Install all strainers where indicated on the project details, allowing sufficient space for the screens to be removed. Rotate screen retainer where required by the installation so blowdown can remove accumulated dirt from the strainer body.

For steam distribution projects the contractor shall comeback 4 months after start up and clean out all the new strainer baskets installed as part of the project without additional cost to the owner.

WATER SYSTEMS:

Install a ball valve for blowdown in the tapped screen retainer; valve to be the same size as the tapping.

Steam system strainers are to be installed in the following locations:

1. Major takeoffs to equipment on user floors.
2. In mechanical equipment rooms.
3. At individual pieces of equipment on a user floor where the strainer can be maintained in the user space; i.e. at sterilizers.

Do not install strainers at each steam consuming device above suspended ceilings.

STEAM SYSTEMS - LOW PRESSURE (15 PSIG AND LOWER):

Install a gate valve for blowdown in the tapped screen retainer; valve to be the same size as the tapping, suitable for system pressure (reference section 23 05 23).

Use the following paragraph only on steam systems connected to central heating plants.

STEAM SYSTEMS - HIGH PRESSURE (ABOVE 15 PSIG):

Install a forged steel gate valve for blowdown in the tapped screen retainer; valve to be the same size as the tapping, suitable for system pressure (reference section 23 05 23).

WATER FILTERS

Install water filter in a bypass arrangement around system pump where indicated on the drawings. Allow sufficient clearance at the top of the unit for filter removal and replacement. Anchor filter support stand to a housekeeping pad. Install a shutoff valve upstream and downstream of the filter. Install a pressure gauge with gauge valves, piped so the pressure differential across the filter can be read.

Coordinate the pad location with the architectural drawings so the HVAC contractor is not required to pour the pad.

Install the 50 micron filters after the piping system has been cleaned and flushed. Install one set of 10 micron filters when the 50 micron filters need replacing. Give the other set of 10 micron filters and the other set of 50 micron filters to the Owner.

CENTRIFUGAL SEPARATORS

Install centrifugal separator in a bypass arrangement around secondary chilled water system pumps where indicated on the drawings. Allow sufficient clearance at the top of the unit for head removal and cleaning. Support stand with angle iron and other structural support members. Install a shutoff valve upstream and downstream of the separator. Install a pressure gauge with gauge valves, piped so the pressure differential across the separator can be read. Install the motorized drain valve in the collection chamber outlet downstream of a manual shutoff valve; extend piping to the adjacent floor drain. Controller will be installed under the temperature control specification section.

STEAM TRAPS

It is the responsibility of the A/E to assure proper equipment mounting heights so traps can be installed and maintained in accordance with the manufacturer's instructions and good operating practice.

Where scheduled trap capacity exceeds the capacity of a single trap, contractor may, at his option, use multiple traps or a single "ultra-capacity" trap.

Install on the discharge side of all steam terminals, at the end of mains, at the end of long branches, at points where mains must rise to a new elevation, and elsewhere as indicated on the drawings and in the manner indicated on the details. Do not lift condensate from the discharge of any trap without the written permission of the Architect/Engineer.

Install a valved test tee on the discharge of all traps, as detailed. Install a strainer upstream of all drip traps and all terminal equipment where a strainer is not present upstream of the control valve at the terminal. Install a shutoff valve upstream of each drip trap; shutoff valves are not required when the trap is at a piece of equipment which has a shutoff valve in the steam line serving it.

Install a line size dirt leg at each trap. Trap elevation to be not less than one foot below the equipment outlet connection. Provide a separate trap for each equipment outlet connection.

Install a steam shutoff valve at the blowdown connection of each trap containing a strainer; terminate the blowdown connection with a nipple and an end cap.

Install trap stations to allow for easy maintenance of the station. Trap station shall not be under or behind obstacles.

**CONDENSATE MIXERS**

Install mixers as indicated on the drawings. Install condensate in location as to not interfere with other pipe and equipment. Mixer shall be installed per the manufacturers recommendations.

EXPANSION TANKS

Install tanks where indicated on the drawings, coordinating concrete base installation with the General Contractor or fabricating steel supports to suit the application. Install all specified tank accessories.

STANDARD TANKS:

Charge tank with the proper amount of air and water during the initial fill after the system has been flushed and cleaned.

BLADDER TANKS:

Verify proper air charge; recharge as necessary. Install an isolation valve in the piping connecting the tank to the system. In the piping between the tank and the isolation valve, install a pressure gauge and a drain valve with a hose adapter. Install a drain valve with hose adapter in the drain connection of the tank. Make sure that all drains are accessible and a hose can be attached.

AIR SEPARATORS

Most separators have inlet and outlet connections at different elevations. If it is the intent that the mains run at a constant elevation, show the offsets and elbows at the separator on the drawings.

Mount in hot and/or chilled water lines as indicated on the drawings/details. Install ball valve with hose adapter in bottom blowdown connection.

Use the following paragraph only when the air separator is specified to be furnished with a system strainer.

Open the drain valve and blowdown the strainer after system cleaning and again after 30 days of operation.

COALESCING AIR AND DIRT SEPARATORS

Mount in hot and/or chilled water lines as indicated on the drawings/details. Install ball valve with hose adapter in bottom blowdown connection and skimming connection.

Open the drain/blowdown valve after system cleaning and again after 30 days of operation.

AIR VENTS

MANUAL KEY TYPE VENTS:

Install at all high points where air may collect and not be carried by the system fluid. Use a soft Type L copper "pigtail" so the vent can be positioned for venting and collecting any water that might escape.

MANUAL BALL VALVE VENTS:

Install on air handling coils and where indicated elsewhere as shown on drawings and details.

AUTOMATIC VENTS:

Install on the top of air separators on systems using bladder type expansion tanks. Install at other locations as indicated on the drawings or details. All locations to have a ball valve installed upstream of the vent for maintenance purposes.

SUCTION DIFFUSERS

Install at each pump suction connection for end suction pumps where shown. Provide sufficient space for removal of the strainer. Install a capped drain valve in the blowdown connection. Install support below the suction diffuser so the weight of the suction piping does not rest on the pump suction connection.

Install a pressure gauge across the suction diffuser, valved so that a single gauge can be used to read the inlet pressure and the outlet pressure across the strainer. Use gauge valves as specified with the gauges. This gauge can be the same one used to read pressures across the pump. Select gauge range appropriate to the system pressures.

Open the drain valve and blowdown the strainer after system cleaning and again after 30 days of operation. If the unit is furnished with a fine mesh startup strainer, remove this strainer after the system has been flushed and cleaned.

On applications involving open systems, such as but not limited to cooling towers, remove the fine mesh startup strainer prior to pump operation if the suction diffuser includes such a strainer.

VACUUM BREAKERS

Install on steam heating coils, steam-to-water heat exchangers, and elsewhere as indicated on the drawings and/or details.

FLOW SENSING DEVICES

The A/E is responsible for selecting and showing on the drawings or specifying the location for each sensing device so that proper sensing can be accomplished. Proper pipe lengths and downsizing of piping to provide for velocities required for accurate measurement and maximum turndown need to be shown on the plans.

Give portable meter to user agency at the completion of all balancing work.

Delete if contractor's meter or owner's existing meter is being used.

PITOT TUBE FLOW SENSORS:

Install where indicated on the drawings and details for flow sensing in hydronic and/or steam piping systems. Butterfly valves installed at the location of a flow sensing device are to have a memory stop.

DIFFERENTIAL PRESSURE GAUGE

Handle as a loose and detachable part as outlined in the General Requirements.

COLD WATER METERS

Install water meters on makeup water line to hot water and chilled water systems ahead of water pressure reducing valve.

CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

END OF SECTION