SECTION 23 21 13

HYDRONIC PIPING

BASED ON DFD MASTER SPECIFICATION DATED 9/28/2021

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 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 all HVAC hydronic pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL

Scope

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## RELATED WORK

Section 01 91 01 or 01 91 02 - Commissioning Process

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

Section 23 05 15 - Piping Specialties

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

Section 23 07 00 - HVAC Insulation

Section 23 08 00 - Commissioning of HVAC

Section 23 25 00 - HVAC Water Treatment.

## REFERENCE

Applicable provisions of Division 1 govern work under this section.

## REFERENCE STANDARDS

Edit the following list so only the standards that are needed in your spec are included in it.

ANSI B16.3 Malleable Iron Threaded Fittings

ANSI B16.4 Cast Iron Threaded Fittings

ANSI B16.5 Pipe Flanges and Flanged Fittings

ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

ASTM A74 Cast Iron Soil Pipe and Fittings

ASTM A105 Forgings, Carbon Steel, for Piping Components

ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A181 Forgings, Carbon Steel for General Purpose Piping

ASTM A197 Cupola Malleable Iron

ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

ASTM A380 Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems

ASTM B75 Seamless Copper Tube

ASTM B88 Seamless Copper Water Tube

## SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

### TYPE F STEEL PIPE:

Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

### TYPE E OR S STEEL PIPE:

Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

### COPPER TUBE:

Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

## QUALITY ASSURANCE

Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

## DELIVERY, STORAGE, AND HANDLING

Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

Offsite storage agreements will not relieve the contractor from using proper storage techniques.

Storage and protection methods must allow inspection to verify products.

## DESIGN CRITERIA

Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

Construct all piping 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.

Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

Where ASTM A53 type F pipe is specified, ASTM A53 grade A type E or S, or ASTM A53 grade B type E or S may be substituted at Contractor's option. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

## WELDER QUALIFICATIONS

Before any metallic welding is performed, the Contractor shall submit his Standard Welding Procedure Specifications, Procedure Qualification Records and Qualification Test Records for each Welder along with associated continuity records to demonstrate compliance with ASME Section IX, paragraph QW-322.

The Contractor shall maintain a complete set of welder qualification documents at the jobsite, including Test Records and Continuity Records for each welder.

The A/E or DFD reserves the right to test the work of any welder employed on the project, at the Contractor's expense. Testing will include a visual examination of the pipe and weld and may include radiography of any suspect welds. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project. Any welds deemed unacceptable will be repaired at the contractor’s expense.

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

## HEATING HOT WATER

2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

Contractor may use ASTM B88 seamless, type L, hard temper copper tube with ANSI B16.22 wrought copper solder-joint fittings in lieu of steel pipe for all sizes. Mechanically formed tee fittings may be used in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) the diameter of the main.

## CHILLED WATER

2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

Contractor may use ASTM B88 seamless, type L, hard temper copper tube with ANSI B16.22 wrought copper solder-joint fittings in lieu of steel pipe for all sizes. Mechanically formed tee fittings may be used in lieu of wrought copper solder-joint tee fittings for branch takeoff up to one-half (1/2) the diameter of the main.

## CONDENSER WATER

2" and Smaller: ASTM A53, type F, standard weight (schedule 40) black steel pipe with ASTM A126/ANSI B16.4, class 125, standard weight cast iron threaded fittings.

2-1/2" and Larger: ASTM A53, standard weight (schedule 40) black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

In some cases, condenser water piping specifications may be needed for a closed circuit, air-cooled fluid cooler similar to what might be used on a computer room cooling system that is intended to be used year-round. If such is the case, verify that any antifreeze material used is compatible with the piping material, pipe joining material, gaskets, and valves specified. The title of the pipe material specification may be changed to an appropriate designation.

## RECLAIM WATER

Use pipe and fittings as specified for heating hot water systems.

This system designation is to be used with or without an antifreeze material in the system water. If antifreeze material is used in the system water, verify that the material is compatible with the copper tube option, delete it from the specification, or modify the specification so that copper tube is not allowed with the antifreeze material being specified.

## MAKEUP WATER

Extend from where left by the Plumbing Contractor with the same materials.

Coordinate with the Plumbing design consultant so that both plumbing and HVAC drawings show the same size line and in the same location.

## CHEMICAL TREATMENT

Use pipe and pipe fittings as specified for the system to which the chemical treatment piping is connected. Plastic pipe furnished with the chemical treatment materials may also be used if its pressure/temperature rating is acceptable for the service.

## VENTS AND RELIEF VALVES

Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

## COOLING COIL CONDENSATE

ASTM B88, type L hard temper copper tubing with ASTM B145/ANSI B16.23 cast red bronze or ASTM B75/ANSI B16.29 wrought solder-type drainage fittings.

Galvanized steel pipe with cast iron drainage fittings may also be specified. Note that drainage pattern fittings are not the same as pressure fittings.

## STAINLESS STEEL PIPING

2" and Smaller: ASTM A312 or A376, Schedule 40, seamless stainless steel, type 304 pipe with ASTM A182, Gr. F304, 3000 lb socket-weld fittings.

2-1/2" and Larger: ASTM A312 or A376, Schedule 40, seamless stainless steel, type 304 pipe with ASTM A403, Gr. WP304, butt-weld fittings.

Use 3000 lb socket-weld, stainless steel ground joint unions.

Use ASTM A182, Gr. F304, Class 150 flanges with 1/16" raised face, serrated face finish and weld neck pattern.

## UNIONS AND FLANGES

2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use ANSI B16.18 cast copper alloy unions on copper piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.

2-1/2" and Larger: ASTM A181 grade I or A105, grade III hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

Provide ASTM A 193 B7 grade bolts and A 194 2H grade nuts & hardened washers for connections (Star washers for grounding.)

## GASKETS

Water and Glycol Systems: Branded, compressed, non-asbestos sheet gaskets. Klingersil C4401, Garlock 3000, JM Clipper 978-C or approved equal.

## MECHANICAL GROOVED PIPE CONNECTIONS

Mechanical grooved piping is not intended for use for most projects. Obtain prior approval of the DFD Project Manager/Reviewer before including this section.

Manufacturers:

Victaulic, Anvil Corp., or Star Pipe Products, Inc.

Mechanical grooved pipe couplings and fittings may be used with steel pipe on the systems indicated below. Either cut-groove or equivalent roll-groove products are acceptable providing the system temperature and pressure requirements are met. Where malleable iron fittings are indicated, they shall conform to ASTM A47. Where ductile iron fittings are indicated, they shall conform to ASTM A 536. Where forged steel fittings are indicated, they shall conform to ASTM A106, Grade B. Where fabricated steel fittings are indicated, they shall conform to ASTM A53, type F in sizes 3/4" through 1-1/2" and type E or S, grade B in sizes 2" through 20". Do not use fabricated fittings where malleable or ductile iron or forged steel fittings are available. Gaskets in all cases shall be EPDM suitable for temperatures to 230 degrees F.

The following services may use mechanical grooved pipe connections within the building in mechanical spaces and above accessible ceilings. Mechanical chases are not considered accessible.

* Heating Hot Water
* Chilled Water

Mechanical grooved pipe connections shall not be used in heating plants or below grade utility distribution systems.

Mechanical grooved pipe connections shall not be used in chilled water piping between the cooling coil and the isolation valve for that cooling coil.

Fittings and couplings must be suitable for the temperature and pressure involved. In no case is the final system to have a pressure rating of less than 125 psig at the design temperature of the fluid.

Acceptable fittings and couplings are listed below, based on Victaulic. When used on galvanized piping, fittings and couplings shall be galvanized. When used on black steel piping, fittings and couplings shall have an enamel coating.

Couplings: Ductile iron standard couplings, Style 77; lightweight couplings, Style 75; and rigid couplings. Reducing couplings are not acceptable.

Flanges: Ductile iron Style 741 or 742 except at lug type butterfly valves where standard welding flanges shall be used.

Standard flanges are necessary so that the butterfly valve can be properly bolted to the flange and retain its place in the pipe when piping on one side is removed.

Fittings: Ductile iron elbows and tees of the manufacturer's standard line may be used in all sizes except bullhead tees will not be accepted. Fabricated steel fittings may be used in all sizes where fitting wall thickness conforms to standard weight pipe. Mechanical-T Style 920 fittings with malleable iron housings may be used for up to 2" outlet size.

Mechanical grooved pipe couplings are not allowed as a substitute for expansion compensation specified in section 23 05 48.

Mechanical grooved flexible couplings are not allowed as a substitute for the flexible connectors specified in 23 05 48 at pump connections.

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

## ERECTION

Carefully inspect all pipe, fittings, valves, equipment and accessories before installation. Any items that are unsuitable, cracked or otherwise defective shall be rejected and removed from the job site immediately. Excluding minor surface rust, piping that exhibits significant oxidation or corrosion will be rejected.

Exercise care at every stage of storage, handling, laying and erecting to prevent entry of foreign matter into piping, fittings, valves, equipment and accessories. Do not erect or install any item that is not clean.

Remove all lose dirt, scale, oil, chips, burrs and other foreign material from the internal and external surfaces of all pipe and piping components prior to assembly, including debris associated with cutting, threading and welding.

During fabrication and assembly, remove slag and weld spatter from internal pipe surfaces at all joints by peening, chipping and wire brushing.

During construction, until system is fully operational, keep all openings in piping and equipment closed except when actual work is being performed on that item of the system. Use plugs, caps, blind flanges or other items designed for this purpose.

Furnish and install all flanges, caps, bypasses, drains, valves, etc. required to facilitate flushing and draining all heating and cooling system piping.

Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

See comment on expansion provisions in Section 23 05 15. Show all needed expansion loops, anchors and guides on the drawings.

Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

"Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

Install drains throughout the systems to permit complete drainage.

Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

This requirement is based on NFPA 70-1987, 384-4 and 450-47.

Install all valves, control valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

## WELDED PIPE JOINTS

Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable.

All pipe welding shall be completed by Qualified Welders in accordance with the Contractor’s Procedure Specifications.

Contractor will ensure that these steps are followed where pipe sections will be joined by welding:

1. Cleaning – Welding surfaces will be clean and free of defects.
2. Alignment – Inside diameter of piping components will be aligned as accurately as possible. Internal misalignment shall not exceed 1/16”.
3. Spacing – Pipe sections will be spaced to allow deposition of weld filler material through the entire weld joint thickness.
4. Girth Butt Welds:
	1. Girth butt welds shall be complete penetration welds.
	2. Concavity will not exceed 1/32”
	3. Under cuts will not exceed 1/32”
	4. As welded surfaces are permitted however surfaces will be free from coarse ripples, grooves, abrupt ridges and valleys.

Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

## THREADED PIPE JOINTS

Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

## COPPER PIPE JOINTS

Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux, and assemble joint. Use 95-5 solder or brazing to secure joint as specified for the specific piping service.

Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. Use an adjustable collaring device. Notch and dimple the branch tube. Remove all debris created by the forming process from the inside of the pipe. Braze the joint, applying heat properly so that pipe and tee do not distort; remove distorted connections.

## WATER SYSTEM

Run water mains level or pitch horizontal mains up 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.

Main branches and runouts to terminal equipment may be made at the top, top 45 degree, side, and/or bottom 45 degree of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located at all top and top 45 degree connections. Bottom connections are not acceptable unless approved by the DFD Mechanical Inspector.

Use top or top 45 degree connection to main for upfeed risers and bottom 45 degree connection to main for downfeed risers. Bottom connections are not acceptable unless approved by the DFD Mechanical Inspector.

Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping systems. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.

Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

## MAKEUP WATER

Install where indicated and/or specified, including all valves, piping specialties and dielectric unions required for a functional system.

## CHEMICAL TREATMENT

Install chemical treatment piping as indicated on the drawings, as detailed, and as recommended by the supplier of the chemical treatment equipment.

## VENTS AND RELIEF VALVES

Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

## COOLING COIL CONDENSATE

Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain location. Construct trap with plugged tee for cleanout purposes as detailed.

Design ahu layout with sufficient height above the floor to accommodate the needed cooling coil trap depth. Cleary show the ahu elevated if it needs to be elevated. Traps should be located on above the floor that the ahu is located.

## UNIONS AND FLANGES

Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

## GASKETS

Store horizontally in cool, dry location and protect from sunlight, water and chemicals. Inspect flange surfaces for warping, radial scoring or heavy tool marks. Inspect fasteners, nuts and washers for burrs or cracks. Replace defective materials.

Align flanges parallel and perpendicular with bolt holes centered without using excessive force. Center gasket in opening. Lubricate fastener threads, nuts and washers with lubricant formulated for application.

Draw flanges together evenly to avoid pinching gasket. Tighten fasteners in cross pattern sequence (12 – 6 o’clock, 3 – 9 o’clock, etc.), one pass by hand and four passes by torque wrench at 30% full torque, 60% full torque and two passes at full torque per ASME B16.5.

## MECHANICAL GROOVED PIPE CONNECTIONS

Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application.

Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

Support pipe as indicated in Section 23 05 29 of these specifications except as modified below. Support each horizontal pipe section at least once between couplings and whenever a change in direction of line flow takes place. Support vertical pipe at every other floor or every other pipe length, whichever is most frequent. Set the base of the riser or the base fitting on a pedestal or foundation.

Follow coupling manufacturer's installation recommendations if they are more stringent that the above requirements.

## PIPING SYSTEM LEAK TESTS

Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.

Provide all piping, fittings, blind flanges, and equipment to perform the testing.

Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

Do not insulate pipe until it has been successfully tested.

For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.

Revise the following test pressure upward if necessary for the specific project. Test pressure for chilled water piping connected to the UW-Madison underground distribution system to be 200 psig.

Consultant must verify that all system components have been designed for these test pressures; contact DFD engineering personnel if there are questions.

|  |  |  |  |
| --- | --- | --- | --- |
| System | Pressure | Medium | Duration |
| Heating hot water | 100 psig | Water | 8 hr |
| Chilled water \*\* | 100 psig | Water | 8 hr |
| Condenser water | 100 psig | Water | 8 hr |
| Reclaim water | 100 psig | Water | 8 hr |

\*\*Verify operating system pressure with DFD and specify test pressure accordingly. Several state agencies have systems that operate at higher pressures and require test pressures in excess of that scheduled above.

All pressure tests are to be documented on a Division of Facilities Development form included in this specification.

On piping that cannot be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

## HYDRONIC PIPING SYSTEM FLUSHING

All new chilled water and heating hot water system piping shall be flushed thoroughly before the systems are put in to operation. Subsequent to executing the chemical cleaning processes specified in Section 23 25 00 – HVAC WATER TREATMENT, and prior to adding scale and corrosion inhibitors, flush all piping and components with a clean source of water until the discharge from the system is clean. Discharge shall be from drains provided at all low points in the piping, ends of headers and as otherwise necessary to flush and drain the entire system.

Project specific procedures shall be established prior to flushing. Before beginning flushing operations, submit proposed flushing procedures to the A/E and DFD’s Project Representative for review and approval. Provide sufficient notice to the A/E and/or DFD to allow the flushing operations to be observed.

A clean water source shall be tapped into the system downstream of the main circulation pump(s). Provide minimum 2” connection between water source and hot water/chilled water systems including taps with ball valves (or line size tap and ball valve for piping systems smaller than 2”). Provide minimum 2” taps (or line size if mains are smaller than 2”) at the ends of headers, the low pint of each of the mains on each floor and as otherwise necessary to flush and drain the entire system. Provide minimum 2” bypass with shut off valve (or line size if mains are smaller than 2”) between the supply and return mains on each floor as where directed by the A/E and DFD Project Representative or where shown on the drawings. Contractor shall identify proposed clean water source along with the method/location of drain discharge and review with the A/E and DFD Project Representative prior to installing flushing connections to water source and drain outlets. Provide code required temporary backflow prevention for the clean water source if needed. Provide all temporary taps, valves, piping, bypasses and hoses as needed to accomplish flushing procedures. The Agency’s district chilled water system shall NOT be used as a source of water for flushing any piping.

AE should show locations of bypasses on each floor. Location should be near the ends of mains but such that the piping is still relatively large so sufficient water will be bypassed to flush mains.

Flush piping systems using the following procedure:

Flushing sequence for hot water and chilled water systems is as follows:

1. Close isolation valves at all coils and wall fin.
2. Open the temporary bypasses that connect the ends of supply and return mains.
3. Flush mains by turning on flushing water source and sequentially opening drains on mains on each floor until the discharge is clean. This will flush the mains without forcing water/debris into the branches and run out pipes.
4. Close isolation valves located downstream of coils/wall fin.
5. Open isolation valves located upstream of coils/wall fin.
6. Open individual drain valves upstream of coils/wall fin until the discharge is clean. This will flush the supply branch and run out lines between the mains and the coils/wall fin without running water/debris through the TCV or coils/wall fin.
7. Close the individual drain valves upstream of coils/wall fin.
8. Open drain valves at low points in the return piping mains.
9. Open the individual isolation valves located downstream of the coils/wall fin. This will flush the return branch and run out lines located between the coils/wall fin and the mains back into the mains and out the drains on the return mains. The water going through the coil/wall fin should be already be clean since this section was flushed previously.
10. Repeat steps 1-3 to clean debris from the mains.

Isolate all coils while flushing risers and mains. Flush the mains on each floor individually, starting at the top of the building and working down towards the basement level. After risers and mains have been flushed clean, individually open the drain valves in each branch circuit to discharge any debris that may have accumulated in the branch piping.

As directed by DFD, the Contractor will be required to open drain valves at selected locations in the system to verify the effectiveness of flushing procedures. If sediment or debris is identified in the system, it will be flushed again and reinspected at no expense to the State.

After flushing operations are complete, drain and/or blow out any residual water, clean and replace all strainers, and add scale and corrosion inhibitors as specified in Section 23 25 00. Leave flushing connections/valves in place and cap.

All flushing procedures shall be documented by completing and submitting the report form included at the end of this Section.

## INITIAL FILL AND VENT

Fill hydronic systems with appropriate working fluids as specified. All system fluids shall be chemically treated as specified in Section 23 25 00 – HVAC WATER TREATMENT.

For closed piping systems, all air trapped at high points shall be relieved through the manual air vents prior to notifying DFD that the systems are ready to be tested and balanced.

## 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

# PIPING SYSTEM LEAKAGE TEST REPORT

**State of Wisconsin**

**Department of Administration Date**

**Division of Facilities Development Submitted:**

**Project Name:**

**Location: DFD Project No:**

**Contractor:**

 **□ HVAC □ Refrigeration □ Controls**

□ **Power Plant** □ **Plumbing** □ **Sprinkler**

 **Test Medium:** □ **Air** □ **Water** □ **Other**

**Test performed per specification section No.**

**Specified Test Duration \_\_\_\_\_ Hours Specified Test Pressure PSIG**

**System Identification:**

**Describe Location:**

 **Test Date:**

**Start Test Time: Initial Pressure: PSIG**

**Stop Test Time: Final Pressure: PSIG**

**Tested By: Witnessed By:**

**Title: Title:**

**Signed: Signed:**

**Date: Date:**

**Comments:**

# PIPING SYSTEM FLUSHING REPORT (revised 10/21/2016)

**State of Wisconsin**

**Department of Administration Date**

**Division of Facilities Development Submitted**:

**Project Name:**

**Location: DFD Project No:**

**Contractor:**

**System Identification (check one):**

**❒ Chilled Water ❒ Process Chilled Water ❒ Heat Reclaim**

**❒ Heating Hot Water ❒ Other**

**Describe procedure:**

**Flush Date:**   **Start Time:**   **Stop Time:**

**Pressure of Water Source:**  **PSIG**

**Describe water source and method of connection to source:**

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**PIPING SYSTEM FLUSHING REPORT (page 2**)

**Flushed By:**   **Witnessed By:**

**Title:**   **Title:**

**Company:**   **Agency:**

**Signed:**   **Signed:**

**Date:**   **Date:**

**Describe results:**