232000 HVAC PIPING AND PUMPS

Part 1 – GENERAL

1.1 Description

A. This section details the guidelines and expectations for the design and installation of HVAC piping and pumps on Johns Hopkins University Homewood Campus. Project conditions and requirements vary, thus precluding the absolute adherence to the items identified herein in all cases. However, unless there is adequate written justification and approval from the JHFRE Engineering and Energy Department, it is expected that these guidelines will govern the design and specifications.

1.2 Submittals

A. Piping layouts shall be designed to provide organized distribution systems which permit isolation of distinct sections without disruption of the entire building. Provide isolation valves at every major branch and at all unit connections. Provide manual air vents at all high points in the system and drain valves at all low points of the piping system.

B. Locate expansion loops and anchors on drawings. Expansion loops shall be used unless compensation devices are reviewed and accepted by JHFRE.

C. Primary chilled or condenser water pumps shall be piped in parallel configurations to allow flexibility in case of failure so any condenser or primary pump can be operated with any chiller. This concept requires that chillers and cooling towers shall also be piped in parallel configurations. Secondary Pumps shall be equipped with Variable Frequency Drives (VFD) and associated controls to work in conjunction with terminal equipment two-way modulating valves.

D. Provide consideration for future extensions to building systems. Provide temperature and pressure gauges on the supply and return of all new equipment.

1.3 Quality Assurance

A. In all cases, a water treatment contractor shall be consulted during design and specified during construction to recommend the proper course of action and proper chemistry requirements based upon the system metallurgy on hand. The industry standard definition of clean is a surface free of mill scale, slag, grease, oil, dirt, and corrosion products. All new piping systems shall be specified to be chemically pre-treated using an agent in compliance with the University's water treatment contractor standards. The water treatment contractor shall test the water to ensure that the contaminant levels coming out of the system in the effluent are identical to that of the makeup water source, in accordance with AWWA-C651.

B. Any new/old system shall be specified to be flushed with clean fresh makeup water until the water coming out of the system is identical in content to the water going into the system. This ensures that any chemical agents used are completely rinsed out of the system and any corrosion products, oils, greases, etc. are removed from the system.

C. All new piping shall be specified to be cleaned, flushed, treated and hydrostatically tested to ensure clean, flushed, treated and leak-free construction prior to University acceptance.

1.4 Delivery and storage

A. Material deliveries and storage areas to be approved by Owner.

B. Material storage to comply with manufacturer's recommendations.

C. All piping shall be stored in a clean and dry place, with ends capped, before installation.

Part 2 – PRODUCTS

2.1 Heating/Chilled/Condenser water piping

A. 2-1/2" and smaller shall be type "L" copper

1. 2-1/2" shall be brazed fittings with material consisting of 80% Copper, 5% Phosphorus, and 15% Silver.

2. 2" and smaller shall be soldered fittings with material consisting of 95% Tin, 4-5% Copper, 0.04-0.20 % Selenium.

B. 3" to 10" shall be schedule 40 black steel with welded joints.

C. 12" and larger shall be standard weight Electric Resistance Welded pipe.

2.2 Air conditioning condensate shall be type "L" copper with soldered joints.

2.3 For steel piping applications, flanges shall only be installed for joining valves with flanges. All other pipe shall be butt-welded.

2.4 For underground piping installations, specify corrosion resistant pre-insulated piping to eliminate the need for cathodic protection. Pre-insulated piping systems consist of a carrier pipe that is factory insulated and wrapped in a non- ferrous (FRP, PVC, or HDPE) jacket. Leak detection shall be provided within the outer jacket to identify the relative location of leaks along the entire length of buried pipe.

2.5 Specialized piping restrictions for Data Center applications

A. Chilled water piping 6" and larger shall be black steel with welded fittings.

B. Chilled water piping 2-1/2" to 4" shall be copper Type L with brazed fittings. Flanges shall only be installed for joining valves with flanges.

C. Use of oxy-acetylene tank/torch is required for brazing in lieu of acetylene tank/torch. Brazing material chemical composition shall be 80% Copper, 5% Phosphorus, and 15% Silver.

D. In applications with 2-1/2" to 4" copper situations where a brass/bronze flange is required, soldering in lieu of brazing is acceptable but requires using the soldering material chemical composition

of 96% tin and 4% silver. For copper piping 2" and smaller, soldering material chemical composition shall be 95% Tin, 4-5% Copper and 0.04-0.20% Selenium.

2.6 Pipe Jacketing & Insulation

A. All pipe jacketing and insulation shall comply with ASHRAE 90.1 without exception.

B. Provide full color-coded PVC jacket for all exposed piping within the mechanical rooms. Jacket shall be cut and curled for the appropriate pipe size (snap-on). PVC jackets for piping, fittings, valves and specialty devices shall be 20mils thick and shall meet 25/50 fire/smoke spread ratings. The color-coding shall be as follows:

1. Primary Chilled Water – Blue.
2. Secondary Chilled Water – Light Blue.
3. Condenser Water – Green.
4. Hot Water – Pepto Pink.
5. High Pressure Steam – Red.
6. Medium Pressure Steam – Orange.
7. Steam Condensate – Green.
8. Process Chilled Water – Light Green.

C. For piping installed outdoors provide exterior jacketing of 0.016" thick, smooth finish aluminum jacket factory cut and rolled for the appropriate pipe size. For elbows, fittings, valves and specialties factory prefabricated fittings shall be used. No field fabricated fittings will be accepted. For joining sections of jacketing, 3/4" wide type 304 stainless steel bands shall be used.

Part 3 – EXECUTION

3.1 All new piping must be treated and cleaned prior to connection to commons systems on the university utility distribution.

3.2 All piping take offs shall be from the sides of the main piping where possible. Avoid taking off on the bottom of pipes to avoid debris from being supplied via the take-off.

3.3 Filler sections of welded piping shall not be less than 18" in length. Provide piping identification and directional flow arrows at intervals not greater than 20'.

3.4 Mechanical joints of any kind will not be acceptable. Provide electrolysis control between dissimilar materials through the use of dielectric nipples and a non-dielectric union. Dielectric unions are not acceptable.

3.5 Pro-press shall not be used unless there is adequate written justification and approval from the JHFRE Engineering and Energy Department.

3.6 Coils shall be piped with strainers, flow meters, balancing valves and isolation valves as individual components.

3.7 All condenser water piping to the cooling tower shall be run as symmetrically as possible to ensure flow is evenly distributed to all cooling tower cells. The supply header shall be located below the cold-water basin level to prevent flooding of the cooling tower basin upon pump shutdown. For the distribution piping leading from the water supply main to the hot water basin inlet, the upper section (from the automated control valve to the hot water basin) shall be constructed of Schedule 80 PVC to avoid any unwanted corrosion. Provide tower fill bypasses for winter operations (either at the tower or within condenser water mains).

A. All chilled water piping shall be run as symmetrically as possible as well.

3.8 In areas of heavy cooling loads (i.e., data centers, watch centers, etc.), provide two chilled water pathways in the following distribution piping configurations:

A. Loop – a circumferential distribution which provides for equalization of pressure through the system and has branch taps for equipment support.

B. Grid – a branching network allowing for full reach of service to potential equipment loads.

3.9 The following are requirements of typical chilled water distribution systems.

A. Risers shall be located in room corners or adjacent to walls and have the clearances as stated in this standard below.

B. Terminal equipment shall be equipped with Two-Way Modulating Control Valves to work in conjunction with the secondary pump variable frequency drive system and associated controls.

C. Manual Air Vents (no automatic air vents) shall be installed, without disruption to other systems service or operation, in all high points in the chilled/condenser water system, in pipe segments (with isolation valves) of loop or grid systems, at heat transfer coils and elsewhere as required to vent all air out of the chilled water system (including reverse traps due to pipe jogging).

D. Piping penetrating through walls and floors shall have black steel pipe sleeves with fire retardant in compliance with NFPA. Floor sleeves shall have a "sealed lip" pipe sleeve 2” above and flush below to prevent flooding from draining through the piping penetration. Wall penetrations shall be flush on both sides of wall. Exterior wall penetrations shall have a “Dry-Link” type of expanding sleeve fill.

E. Drains shall be provided, without disruption to other systems service or operation, at all chilled/condenser water system low points, in pipe segments (with isolation valves) of loop or grid systems and at all heat transfer coils for draining system (including reverse traps due to pipe jogging).

3.10 New overhead piping containing water shall be prohibited to be designed to pass within or through electrical rooms/closets and telecommunication rooms/closets. Every effort shall be made to separate electrical/IT equipment and piping containing water. Fittings, valves, meters, and any other non-welded, non-soldered, non- brazed joints or penetrations in the pipe are not permitted above equipment and, to the maximum extent practical, should be located completely out of any electrical

rooms/closets and telecommunication rooms/closets. Investigate and design protection schemes to ensure risks to electrical/IT equipment is minimized for any scenarios where water piping is not practical to be located outside of the room/closet.

A. For existing, overhead piping containing water within electrical rooms/closets and telecommunication rooms/closets, evaluate the feasibility of relocating the pipe with the Project Manager/JHFRE. The feasibility evaluation shall include the following, at a minimum:

1. Potential pathways for relocating the pipe. Define the technical and operational reasons which eliminate any possible alternate paths.

2. Potential risk mitigation strategies such as providing drip pans with drains

3. Potential outages required to provide potential pathways for relocating the pipe.

4. Cost of alternative pathways for relocating the pipe vs. risk mitigation strategies.

5. Impacts to the construction schedule for installation of any alternative pathways and/or risk mitigation strategies.

6. Drawings, sketches or slides to convey options, paths and impacts

B. If JHU agrees the conditions do not allow for separating the pipes, the A/E must provide the best mitigation possible given the restrictions of the site. The following methods for mitigation shall be considered when preparing the design:

1. Water piping shall not pass over medium voltage electrical equipment (>600v).

2. Piping, located above electrical equipment (<600v), shall pass by the shortest route possible, preferably perpendicular to the long side of the equipment.

3. Fittings, valves, meters, and any other non-welded, non-soldered, non-brazed joints or penetrations in the pipe are not permitted above equipment and, if possible, should be located completely out of the electrical room. Ultrasonic flow meters may be considered as alternatives to in-pipe meters if the flow meter cannot be moved.

4. Drip pans are required for any existing pipe that passes above equipment. The pan shall be equipped with a drain which is sized to one inch minimum for easy cleaning and routed to the nearest drain. Leak detectors shall be installed in all drip pans and be connected to an alarm to the building BAS.

5. The following are options to provide shielding for electrical equipment. Each option requires that the product shall be installed on areas that are within 6’ horizontal distance of any electrical equipment.

a. Install a clear poly-carbon shield to deflect potential water leaks away from the electrical equipment. The shield shall extend a minimum 6” below the lowest level of the pipe on the equipment side of the pipe. The shield shall be transparent and shall not impeded access to the pipe

by maintenance personnel with tools. This may result in the shield being located 12”-18” from the side of the pipe.

b. Install Teflon-coated fiberglass at all connection in the piping system. Shielding shall meet the minimum temperature and pressure ratings of the system. The shield shall be attached to the pipe with boot clamps under the insulation. Pipe connections being protected will not be readily apparent nor visible as a result of the coverage with the insulation. Install a drain hose from each shield terminal at the leak detection cabling. Each drain line shall include a clear pigtail which shall be located as close as reasonably possible to the shield.

6. Any utilized piping shield shall be rated as Class A for interior wall and ceiling finish (flame spread 0-25, and smoke developed 0-50 when tested per NFPA 255, Standard Method of Test of Surface Burning Characteristics of Building Materials)

7. The A/E, on a drawing, shall show all dimensions/clearances from the equipment to the pipe or walls/ceiling, whichever is less to show all critical dimensions within the space. Minimum clearances shall be 6’ vertical and 6’ horizontal clearance from the equipment. If these minimum clearances cannot be achieved, consideration shall be given to moving equipment, or downsizing it, as approved by the JHU.

8. Risers shall be located in room corners or adjacent to walls and have the clearances as stated herein.

3.11 Contractor shall flush the system to remove any debris that either existed before or was caused by construction. Stainless steel construction strainers (minimum 3/32” mesh) shall be installed to protect all pumps during the procedure. The Contractor will be responsible for all costs (parts and labor) to repair pumps damaged as a result of this required work. Piping shall meet the following velocity requirements while not exceeding a piping friction loss 4.5 ft per 100 feet of piping.

Pipe Sizes	Maximum Water Velocity
1”	4 ft/sec
2”	4 ft/sec
3”	5 ft/sec
4”	6 ft/sec
5”	7 ft/sec
6”	8 ft/sec
8”	9 ft/sec

10” or larger	10 ft/sec