DIVISION 23 – HVAC
23 21 13 – Hydronic Piping Systems

	General Information	Programming/ Design	Bidding/ Preconstruction	Installation/ Construction	Closeout/ Warranty
01 General					
1. Verify that piping does not pass exposed through electrical rooms or is erected over or near and switchboard or other electrical gear.	☐	☒	☐	☒	☐
2. Verify that no piping passes through elevator machine rooms.	☐	☒	☐	☒	☐
3. Section 1022.4 Penetrations of the 2009 edition of the International Building Code prohibits any penetrations through an exit enclosure (stairwell, vestibule, etc.) except for exit doors, equipment and ductwork necessary for independent ventilation/pressurization, sprinkler piping, standpipes, electrical raceways for fire department communication systems, and electrical raceways serving the exit enclosure. Verify that the only HVAC piping penetrations into an exit enclosure directly connect to equipment (cabinet heaters, convectors, etc.) serving the exit enclosure.	☐	☒	☐	☒	☐
4. Verify that pipe penetrations through fire-rated walls, partitions, ceilings, and floors are adequately sealed and maintained.	☐	☒	☐	☒	☐
5. During demolition, verify that dead legs are removed to the fullest extent possible and that abandoned piping is capped and labeled.	☐	☒	☐	☒	☐
6. Verify that piping located above drop ceilings is installed to allow sufficient space for ceiling panel removal.	☐	☒	☐	☒	☐
7. Verify that piping is installed to permit servicing of valves.	☐	☒	☐	☒	☐
8. Verify that piping labels are in place and are easily viewed. Labels may be adhesive-backed vinyl cloth labels or stencils. Label lettering shall identify both the medium being conveyed and the direction of flow. Labels shall be spaced a maximum 15' on centers. Labels on piping 2" and smaller shall be ¾" wide; labels on piping greater than 2" shall be 2' wide. Piping/label colors shall comply with those listed on the OPP Design and Construction Standards webpage under item 23 05 01.05C of the Mechanical General Requirements section.	☐	☒	☐	☐	☒
02 Piping/Fittings					
1. All hydronic water piping shall be black steel pipe, ASTM A-53, Grade B; or copper, Type 'L', hard drawn. Verify that the pipe thickness/schedule shall meet the pressure requirements.	☐	☒	☐	☒	☐
3. Pipe fittings two inches and smaller shall be screwed or soldered as applicable; 2-1/2 inches and larger shall be soldered, welded, flanged, or grooved couplings, as applicable. The use of the Ridgid ProPress system is permitted for pressed copper piping connections.	☐	☒	☐	☒	☐

4. There should be NO dielectric unions used on projects. Dielectric unions perform adequately for a number of years, but as heating systems are cycled on and off during summer shutoffs and winter startups, the gaskets in the unions shrink and the connections begin to leak. Instead, use a combination of dielectric nipples and couplings to connect dissimilar piping materials. Dielectric nipples are plastic/PVC lined galvanized steel.	☐	☒	☐	☒	☐
5. Unions shall be installed adjacent to all equipment in order to facilitate repair and replacement of that equipment.	☐	☒	☐	☒	☐
6. Standard Victaulic gaskets are rated at 230F, but they are now making gaskets rated to 250F. Gaskets will fail when overheated. It is advisable to include a high temperature sensor alarm (tied back to CCS) on the heating water discharge line.	☐	☒	☐	☒	☐

03 Valves

1. Multipurpose/triple duty valves shall not be used. With the predominance of speed drives on pump systems, the balancing portion (and corresponding pressure drop) becomes unnecessary. In addition, the check valve portion cannot be repaired without draining the entire system.	☐	☒	☐	☒	☐
2. Three valve bypasses around control valves and pressure-reducing stations IN CRITICAL AREAS shall be used. Work with the Project Manager, Engineering Services, Central Services, and/or Area Services if the criticality is in question.	☐	☒	☐	☒	☐
3. Ball valves may be used in lieu of globe valves for throttling purposes; however, the ball valve must be equipped with a "characterizing disc" to correct for low-flow conditions.	☐	☒	☐	☒	☐
4. Verify that drain valves are installed at all low points in piping system mains, bases of risers (downstream of isolation valves), and elsewhere as required for drainage of all or isolated portions of piping systems.	☐	☒	☐	☒	☐
5. Verify that valve tags are in place. Valve tags shall be 1" x 2" laminated, black micarta attached by a 10 gauge brass "S" hook. Valve numbers shall be white lettering/numerals and engraved as large as possible.	☐	☒	☐	☐	☒
6. Verify that valve charts have been installed. Valve charts shall be typewritten on white bond paper and mounted in a glass-front frame. Charts shall indicate service, number and location.	☐	☒	☐	☐	☒

04 Specialties

1. Verify that manual air vets are installed at system high points, at heat transfer coils, and elsewhere as required for system air venting.	☐	☒	☐	☒	☐
2. Verify that reduced pressure principal back flow preventers are installed on all makeup water lines to equipment.	☐	☒	☐	☒	☐
3. Verify that pressure reducing/regulating valves are installed on makeup water lines to equipment.	☐	☒	☐	☒	☐
4. On bladder-type expansion tanks, verify that the fill pressure and expansion tank air bladder is set to the actual project specifications. Most expansion tanks are shipped from the manufacturer set at 12 psig.	☐	☒	☐	☒	☐
5. Verify that safety valves are installed on hot water generators, boilers, and any pressure vessel. Verify that drip pan elbows are installed under the safety valves, discharge piping (without any other type of shutoff valve) is routed to	☐	☒	☐	☒	☐

the outdoors, and/or drain lines (without any other type of shutoff valve) are routed to the nearest floor drain.					

05 Unfired Pressure Vessels

1. PA Labor & Industry requires that unfired pressure vessels that meet certain criteria must be installed with a minimum clearance of 18" around the unfired pressure vessel or an assembly of water heaters (as long as there is 6" clearance between each water heater). There must also be a minimum of 30" clearance in front of manholes. Chapter 3a.36 of Title 34 of the PA Code that references L&I describes these clearances.	☐	☒	☐	☒	☐
2. Specific criteria for unfired pressure vessels that must comply with the L&I requirements are found in Chapter 3a.3 of Title 34 of the PA Code. Unfired pressure vessels that exceed ONE of the following must comply: • 5 cubic feet in volume and 250 psi design pressure. • 3 cubic feet in volume and 350 psi design pressure. • 1.5 cubic feet in volume and 600 psi design pressure. • Vessels having an inside diameter, width, height or cross section diagonal exceeding 6 inches with no limitation on length of vessel or pressure. Storage and instantaneous water heaters that exceed ANY of the following must comply: • A heat input of 200,000 BTUs /hr. • A water temperature of 210° F. • A nominal water-containing capacity of 120 gallons. In addition, unfired pressure vessels with a nominal water-containing capacity over 120 gallons containing water under pressure must comply. These vessels include unfired pressure vessels that contain air, which is trapped in the system and where the compression air serves only as a cushion. Also, unfired pressure vessels having an internal or external operating pressure greater than 15 psig with no limitation on size must comply (unless they are equipped with approved safety devices). In most cases heat exchangers, large air separators, expansion tanks, water heaters, steam generators, instantaneous water heaters, sterilizers, and autoclaves must comply with the requires published by PA L&I.	☐	☒	☐	☒	☐
3. For those unfired pressure vessels that meet the conditions above, verify that they contain an ASME label and National Board registration number.	☐	☒	☐	☒	☐
4. For projects that contain an unfired pressure vessel that meets the criteria listed above and must comply with PA L&I requirements, Tom Haupt (teh9@psu.edu, (814) 777-8198), OPP Planner/Estimator. Tom will meet with the contractor PRIOR to installation to review the installation for conformance with PA L&I requirements. Tom will also submit the necessary paperwork to L&I to arrange for inspection and tagging of the unfired pressure vessel(s).	☐	☐	☐	☒	☒
5. If the project includes the REMOVAL of a boiler or unfired pressure vessel (heat exchangers, expansion tanks, air separators, air tanks, water heaters, chillers, autoclaves, etc.) contact Tom Haupt (teh9@psu.edu, (814) 777-8198), OPP Planner/Estimator. Tom maintains a list of pressure vessels and must be	☐	☐	☐	☒	☒

updated any time a pressure vessel is removed or installed.					

06 Testing of Hydronic Piping Systems

1. Hydronic piping systems shall be prepared for testing in accordance with ASME B31.9 and as follows: • Joints, including welds, shall remain uninsulated and exposed for examination during testing. • Temporary restraints for expansion joints that cannot sustain reactions due to test pressure shall be installed. If temporary restraints are impractical, the expansion joints shall be isolated from testing. • The hydronic piping systems shall be flushed with clean water; then strainer screens shall be removed and cleaned or replaced. • Equipment shall be isolated from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against the test pressure without damage to valve. Blind flanges shall be installed to isolate equipment. • Safety valves shall be set at a pressure no more than one-third higher than the test pressure to protect against damage by expanding liquid or other source of overpressure during test.	☐	☒	☐	☒	☐
2. The following tests shall be performed on hydronic piping systems: • Ambient temperature water shall be used as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used if necessary. • While filling system, vents installed at high points of system to release air shall be used. Drains installed at low points for complete draining of test liquid shall be installed. • Expansion tanks shall be isolated from the system. • Verify that hydronic system is full of water before starting the test. • The hydronic piping system shall be subjected to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. The test pressure shall not exceed the maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of the specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping." • After hydrostatic test pressure has been applied for at least 10 minutes, the piping, joints, and connections shall be examined for leakage. Leaks shall be eliminated by tightening, repairing, or replacing components. The hydrostatic test shall be repeated until there are no leaks.	☐	☒	☐	☒	☐
3. A written report of testing shall be prepared and submitted to the University.	☐	☒	☐	☐	☒

07 Cleaning and Start Up

1. All hydronic piping systems shall be chemically cleaned after all equipment has been connected to the system and all piping has been completed. Cleaning shall be done prior to introducing chemical treatment or glycol, and prior to acceptance by the University.	☐	☒	☐	☒	☐
2. The University shall be notified at least one week in advance of the date and	☐	☒	☐	☐	☒

time that system cleaning is to take place. The University shall observe the system cleaning process. Contact Mark Gephart (mpg4@psu.edu, (814) 777-5070), OPP Lead Water Analyst, to arrange for oversight and review.					
3. Verify that the following have been completed before full operation of the system: • Manual valves are fully opened. • Pumps are set for the proper rotation. • Makeup water pressure reducing valves are set for the required system pressure. • Air vents at high points of system are inspected and verified that all are installed and operating freely (automatic type), or bleed air completely (manual type). • Temperature controls are set so all coils are calling for full flow. • Operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, are set to specified values. • Motors and bearings have been properly lubricated.	☐	☒	☐	☒	☐