Modify *Section 23 21 13* per the following (deletions are shown struck through and additions are double underlined).
Delete existing Subsection .01 and .02 and replace with new .01-.04 in their entirety.
Relocate text from existing Subsection .03 to new .05
Delete remaining existing Subsections

23 21 13 Hydronic Piping

~~**.01 Piping**~~

~~A. Piping shall be pitched and valves installed to facilitate complete drainage of the system.~~

~~B. All piping run within the building shall be run concealed in the finished portions of building in pipe spaces, ceilings or furred chases and exposed only in mechanical rooms and where shown on the drawings.~~

~~C. No pipe shall pass in front of or interfere with any openings, door or window. Head room in front of openings and doors shall in no case be less than the top of the opening.~~

~~D. Piping shall not pass exposed through electrical rooms or be erected over any switchboard or other electrical gear.~~

~~E. Pipe sizes shall be indicated on the plans at each change in direction and at all branch take off locations.~~

~~F. Provide 2-inch clearance between insulated piping and other obstructions.~~

~~G. Unions:~~

~~1. No union shall be placed in a location which will be inaccessible.~~

~~2. Unions shall be installed adjacent to all equipment for repair and replacement.~~

~~H. Electrolysis Control:~~

~~1. Electrolysis control between dissimilar materials shall be achieved through the use of dielectric nipples and a non-dielectric union. Dielectric unions shall be avoided whenever possible.~~

~~I. Bypasses:~~

~~1. Three valve bypasses shall be installed around control valves and pressure-reducing stations serving critical areas. Areas deemed to be critical shall be reviewed with the Project Manager.~~

2. In all applications, use ball valves for shut-off purposes and globe valves for throttling purposes in the bypass line.

    a. Gate valves may be used for shut-off purposes in large line sizes.

    b. Ball valves equipped with "characterizing discs" may be used for throttling purposes in lieu of globe valves.

3. In water applications, ball valves may be used for throttling and shut-off service.

4. No other equipment is to be provided with a bypass unless approved by the Project Manager.

J. Sleeves:

1. All pipes passing through wall or floor construction shall be fitted with sleeves. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise specified. Sleeves shall be two pipe sizes larger than the pipe when un-insulated and of sufficient size to allow for the insulation without binding. Floor sleeves in mechanical rooms shall extend 4 inches above finished floor, all other spaces minimum one inch above finished floor.

2. Sleeves in bearing walls, masonry walls, masonry partitions, and floors shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 USG galvanized steel.

3. Where pipes pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.

4. Sleeves through exterior walls below grade shall have the space between pipes and sleeves caulked watertight.

5. Install one-piece chrome-plated escutcheon plates with set screw at sleeves for all pipes exposed in finished areas.

6. The annular space between sleeves and pipe shall be filled with fiberglass insulation and caulked in non-fire rated situations.

7. Where pipes pass through fire-rated floors, walls, or partitions, the use of a UL approved system for through penetrations is required. The annular space around the pipes shall be packed with mineral wool or other noncombustible material and sealed at each exposed edge to maintain the rating of the system in accordance with the through penetration sealant manufacturer's recommendations.

K. System and Equipment Drains:

1. All piping shall be arranged to completely drain the system. Drain locations shall be located at all system low points.

2. Where sectionalizing valves are installed, a drain shall be installed on downstream side of valve to drain that section of the system.

3. All cooling tower drains and overflow are to be piped to sanitary system (not onto roof).

4. All system and equipment drains are to be piped to a floor drain.

L. Welding:

1. All welding shall be done in accordance with the AWS.

2. All boiler, pressure vessel, and gas piping welding must be done by certified welders as required by applicable codes.

3. All welding must be done with portable welding machines.

M. Pressure Tests:

1. All piping must be tested prior to receiving insulation.

2. Test pressures shall be minimum 1 1/2 times system operating pressure or as specified by the Professional.

3. Pressure tests must be witnessed and acknowledged in writing by a University representative.

.02 Hot Water, Chilled Water, Vent Piping

A. All supply water piping shall be graded up and return graded down in the direction of flow. At all high points in the piping system, manual air vents shall be installed to eliminate air pockets at initial fill. Drains shall be installed at all system low points.

B. All water piping shall be black steel pipe, ASTM A-53, Grade B or copper, Type 'L', hard drawn. Schedule to meet pressure requirements

C. 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.

D. The use of the Ridgid ProPress system is permitted for pressed copper piping connections.

E. Grooved Coupling Piping Systems are permitted, subject to the following requirements:

1. All grooved piping shall be installed and supported in strict adherence to the grooved manufactures latest written installation and pipe supporting instructions. No exceptions.

~~2. Select proper gasket material that is compatible with fluid requirements. Gasket Lubricant shall be from the same manufacture as the couplings.~~

~~3. Pipe shall be grooved to manufactures recommended specifications. Grooving tools shall be from the same manufacture as the couplings.~~

~~4. All couplings, fittings, flanges, valves and accessories shall be from the same manufacture.~~

~~5. All grooved piping products (ie. Couplings, fittings, valves and accessories) used on hot water systems shall have a temperature rating of at least 250 degrees F.~~

~~6. All couplings used up to and including 24" shall have a minimum pressure rating of 350 PSI.~~

~~7. All couplings shall be the rigid design except as needed or required.~~

~~8. All castings shall be date stamped for quality assurance and traceability~~

~~9. The Grooved mechanical coupling manufacturer shall have a factory trained field representative to be available to visit the job site. That representative shall provide training for contractor's field personnel, and view installed product to promote conformance to installation requirements, if requested by the owner, architect or engineer. The name and contact information of that representative should be part of the submittal package.~~

. .01 General Requirements

A. Hydronic Piping Design:

1. General: Follow the Hydronic System Pipe Sizing guidelines in current edition of ASHRAE Fundamentals Handbook.

2. Design to keep system pressure drop low to minimize pump energy and long-term operating costs.

    a. Use pipe fittings with low pressure drop characteristics such as long radius elbows, 45° laterals and Tee Wyes in main branches, tapered concentric/eccentric reducers, and bell-mouth inlets.

    b. Do not use fittings with abrupt changes that cause high pressure drops such as non-tapered reducing flanges or couplings, or bullhead tee connections (either two streams connected to each end of a tee with the discharge on the branch, or the main flow coming into the branch connection and discharging at each end).

3. Pipe sizes shall be indicated on the plans at each change in direction and at all branch take off locations.

4. Minimum distribution pipe size shall be ¾", except ½" runout piping may be used after shut-off valves to individual terminals.

5. Piping systems shall be designed and installed with adequate pitch to permit all sections of the system to be properly and fully drained. All supply water piping shall be graded up and return graded down in the direction of flow. Provide sediment leg and hose end ball drain valves at all low points of systems, at bases of riser, and at lowest points at equipment runouts, typically on downstream side of shut-off valves.

6. Avoid running piping in such a way that will create air traps at local high points or tend to accumulate dirt legs at low local low points. If otherwise unavoidable, provide automatic air vents at high points and blow down drain valves on dirt legs at low points.

7. Differential pressure control of system pumps shall never be accomplished at the pump. The pressure bypass shall be provided near the end of the system.

8. All piping run within the building shall be run concealed in the finished portions of building in pipe spaces, ceilings or furred chases and exposed only in mechanical rooms and where shown on the drawings.
9. No pipe shall pass in front of or interfere with any openings, door or window. Head room in front of openings and doors shall in no case be less than the top of the opening.
10. Piping shall not pass exposed through electrical rooms or be erected over any switchboard or other electrical gear.
11. Provide 2-inch clearance between insulated piping and other obstructions.

B. Unions:

1. No union shall be placed in a location which will be inaccessible.

2. Unions shall be installed adjacent to all equipment for repair and replacement.

C. Electrolysis Control:

1. Electrolysis control between dissimilar materials shall be achieved through the use of dielectric nipples and a non-dielectric union.

2. Dielectric unions are prohibited.

D. Sleeves:

1. All pipes passing through wall or floor construction shall be fitted with sleeves. Each sleeve shall extend through its respective floor, wall or partition and shall be cut flush with each surface unless otherwise specified. Sleeves shall be two pipe sizes larger than

the pipe when un-insulated and of sufficient size to allow for the insulation without binding. Floor sleeves in mechanical rooms shall extend 4 inches above finished floor, all other spaces minimum one inch above finished floor.

2. Sleeves in bearing walls, masonry walls, masonry partitions, and floors shall be standard weight steel pipe finished with smooth edges. For other than masonry partitions, through suspended ceilings and for concealed vertical piping, sleeves shall be No. 22 USG galvanized steel.

3. Where pipes pass through waterproofed floor or walls, design of sleeves shall be such that waterproofing can be flashed into and around the sleeves.

4. Sleeves through exterior walls below grade shall have the space between pipes and sleeves caulked watertight.

5. Install one-piece chrome-plated escutcheon plates with set screw at sleeves for all pipes exposed in finished areas.

6. The annular space between sleeves and pipe shall be filled with fiberglass insulation and caulked in non-fire rated situations.

7. Where pipes pass through fire-rated floors, walls, or partitions, the use of a UL approved system for through penetrations is required. The annular space around the pipes shall be packed with mineral wool or other noncombustible material and sealed at each exposed edge to maintain the rating of the system in accordance with the through penetration sealant manufacturer's recommendations.

E. System and Equipment Drains:

1. Where sectionalizing valves are installed, a drain shall be installed on downstream side of valve to drain that section of the system.

2. All cooling tower drains and overflow are to be piped to sanitary system (not onto roof).

3. All system and equipment drains are to be piped to a floor drain.

F. Welding:

1. All welding shall be done in accordance with the AWS.

2. All boiler, pressure vessel, and hydronic piping welding must be done by certified welders as required by applicable codes.

3. All welding must be done with portable welding machines.

G. Pressure Tests:

1. Tests shall be in accordance with Guide Specification.

2. All piping must be tested prior to receiving insulation.

3. Pressure tests must be witnessed and acknowledged in writing by a University representative.

H. Piping System Cleaning:

1. All hydronic systems shall be chemically cleaned after all items of equipment have been connected to the system and all piping has been completed. Cleaning shall be done prior to installing chemical treatment or glycol, and prior to acceptance by the University. See 23 25 00 for more information.

2. Notify the University 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.

02 Gauge Piping

A. All gauge piping on hydronic systems shall be extra-strong IPS red brass piping federal specification WW-P-351, Grade A, with threaded joints.

B. For high pressure steam systems, pressure gauge connections shall be suitable for the maximum allowable working pressure and temperature, but if the temperature exceeds 406°F, brass or copper pipe or tubing shall not be used. The minimum size syphon shall be 1/4" inside diameter. For low-pressure steam systems, all gauge piping shall be non-ferrous.

C. Provide gauge cocks (low pressure) or gate valves (high pressure) for isolation.

.03 Cooling Coil Condensate Drain Piping

A. Refer to Guide Specifications.

B. Condensate drain piping shall not be less than 1" in diameter.

C. Provide cleanouts at traps and other locations as required.

.04 Guide Specifications:

A. Design Professional shall carefully review and edit the guideline specifications below, adapting them as needed to achieve application-specific, fully developed specifications for each project.
B. These shall be edited using the process described in the instructions contained at the beginning of the document. Proposed modifications shall be reviewed with OPP staff.
C. Finalized version shall be included in the project contract documents. Use of other specifications is not acceptable.

Document	Version Date	Description
23 21 13 Hydronic Piping Guide Specification	July 6, 2012	OPP minimum specification requirements for HVAC Hydronic Piping.

.~~03~~ 05 Hydronic Specialties

A. Y-TYPE PIPELINE STRAINERS

1. General: Locate strainers to protect components from water born debris. Install in entering line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:
    a. Chillers (as recommended by chiller manufacturer)
    b. Heat Transfer Equipment
    c. Pressure reducing or regulating valves.
    d. Pumps
        1. Exceptions:
            i. If suction diffuser with integral strainer is used, then omit separate y-strainer.
            ii. Do not use strainers that can increase pressure drop and/or become clogged on pumps serving open tower condenser water loops. Use tangential solids separator systems (Lakos or similar).
    e. Temperature control valves.
2. Product Requirements: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for respective working pressure of piping system. Provide type 304 stainless steel screens, with perforations (or mesh for sizes under 2") per schedule below.

SERVICE	PIPE SIZE	Coarse Straining (typically at central plant equipment)	Medium Straining (typically at terminal equipment, i.e. with temperature or pressure control valves)
Water	1/4 to 2"	1/16" (0.057)	1/32" (0.033) (20 mesh)
Water	2 1/2 to 4"	1/8"	1/16" (0.057)
Water	5" and up	3/16"	1/8"
Air or Gas	1/4 to 2"	1/32" (0.033) (20 mesh)	0.009 (60 mesh)
Air or Gas	2 1/2 to 6"	1/16" (0.057)	1/32" (0.033)
Air or	8" and	1.8"	1/10"

Gas	up		

a. Threaded Ends, 2" and Smaller: Cast-iron or bronze body, screwed screen retainer with centered blowdown fitted with drain plug. Press-joint pipe fittings are an acceptable option.
b. Flanged Ends, 2½" and Larger: Cast-iron or steel body, bolted screen retainer with off-centered blowdown fitted with hose end drain valve.
c. Grooved Ends, 2½" and Larger: Wye pattern, steel, ductile-iron or malleable-iron body and access end cap with off-center blowdown fitted with hose end drain valve, access coupling with EDPM gasket.
d. Acceptable Manufacturers: Subject to compliance with requirements, provide Y-type strainers of one of the following:
    1. Apollo; Conbraco
    2. Armstrong International.
    3. Hoffman Specialty ITT; Fluid Handling Div.
    4. Metraflex Co.
    5. Spirax Sarco.
    6. Watts Regulator Co.

3. Installation: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions.
    a. Y-type strainers in horizontal steam or gas lines shall be installed so that the pocket is in the horizontal plane. This stops water collecting in the pocket, helping to prevent water droplets being carried over, which can cause erosion and affect heat transfer processes.
    b. On liquid systems the pocket should point vertically downwards. This ensures that the removed debris is not drawn back into the upstream pipework during low flow conditions.
    c. Although it is advisable to install strainers in horizontal lines, this is not always possible, and they can be installed in vertical pipelines if the flow is downwards, in which case the debris is naturally directed into the pocket. Installation is prohibited with upward flow, as the strainer would have to be installed with the opening of the pocket pointing downwards and the debris would fall back down the pipe.
    d. Install pipe nipple and hose end drain valve in strainer blowdown connection, full size of connection, except for strainers 2" and smaller installed ahead of control valves feeding individual terminals.
    e. Where indicated, provide drain line from shutoff valve to plumbing drain, full size of blowdown connection.
    f. Where strainers are installed in pipe branches serving multiple terminals rather than at each individual terminal, provide isolation valves on each side of the strainer to allow for routine blowdown service without draining the piping system.
    g. Be sure to remove any temporary fine mesh start up screens if used during initial cleaning and flushing of systems. After being removed, temporary start up screens shall be tagged and attached with small brass jack chain and s-hook to the outside of the strainer body for future re-use during future cleaning and flushing.

B. Air Eliminator and Dirt Separators
    1. High Performance Coalescing type air eliminator and dirt separators shall be installed in each closed hydronic system.
        a. Pipe size is not a factor and all units should be selected at the point of peak efficiency per the manufacturer's recommendations, typically with entering velocities not to exceed 4 feet per second at specified GPM. Units specifically designed for high velocity systems may have an entering velocity of up to 10 feet per second. Units shall be selected for low to negligible permanent system pressure drop, not to exceed maximum of 3 feet of head.
        b. Air Eliminators shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid. Dirt separation shall be at least 80% of all particles 30 micron and larger within 100 passes. Performance shall be third party tested by independent laboratory.
        c. All combination units shall be fabricated steel, rated for a minimum working pressure of 150 psig and temperature of 250°F.
            1. Any units not meeting the exemption criteria for unfired pressure vessels in the PA L&I Boiler and Unfired Pressure Vessel Regulations must be constructed and stamped in accordance with the latest revision of the ASME Boiler and Pressure Vessel Code.
        d. Units shall include an internal bundle of highly durable, superior corrosion resistant, coalescing media filling the entire vessel to suppress turbulence and provide high efficiency. The bundle shall consist an assembly of rigidly constructed vertical tubes of stainless steel or copper wire matrix designed to coalesce microbubbles out of solution and form larger air bubbles that rise to the top of the vessel and to separate dirt particles that collect at the bottom.
        e. Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be a high capacity, automatic float actuated air venting mechanism with a separate ball isolation valve to enable service of auto air vent without shutting off the main flow.
        f. Units shall include a side tap near the top with a manual ball skim valve to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.
        g. Dirt Separators shall have the vessel extended below the main pipe connections ~~an equal distance~~ for dirt separation with a bottom tap and blow down valve of sufficient size to not easily become blocked. Unit shall be designed such that pressure drop does not increase as the dirt collection area fills. Include removable bottom cover for easy cleaning of interior of unit.
        h. Manufacturers: Subject to compliance with requirements and final review and approval by OPP, manufacturers offering coalescing air and dirt separators include:
            1. Armstrong Pump, DAS series,
            2. Bell and Gossett, CRS series,
            3. Spirotherm, Inc, Spirovent Dirt series,
            4. Thrush, AAR-O-Vent series,
    2. Dirt blowdown connection shall be connected with a tee. The side tap shall be piped to bag filter assembly with isolation valve. During filtered blowdown, system water shall be continuously recirculated back into main piping to minimize fluid loss and addition of

makeup water and associated air. The straight through bottom tap shall include blow down valve to allow optional start-up flushing and purging significant dirt in the system without going through the bag filter. Refer to Hydronic Plant Piping Detail.

3. Do not retrofit to air management type systems with existing open (non-diaphragm) type expansion tanks without also upgrading the expansion tank to closed diaphragm type.

C. Expansion Tanks

1. Tanks shall be diaphragm type, ASME constructed, complete with inlet and air charging valve.

D. Flow Balancing Valves

1. General: Refer to guidelines in 23 21 00 Hydronic Piping - Flow Balance and Differential Pressure Control.
2. Size balancing valves for the specified flow rates, which may not necessarily be the same as the line size.

E. Side Stream Water Filters

1. Side stream water filters shall be used on all heating and/or cooling closed piping systems and on all open recirculating systems (cooling towers).
2. The Professional shall follow the University's water treatment guidelines found in The Design and Construction Standards 23 25 00 for a more complete description of the requirements for side stream water filters.

F. Guideline Details:

1. Professional shall carefully review and edit the guideline installation details below, adapting them as needed to achieve application-specific, fully developed details for each project.

Document	Version Date	Description
Detail # 232113-D01 Hydronic Plant Piping Schematic (AutoCAD) Detail # 232113-D01 Hydronic Plant Piping Schematic (PDF)	November 9, 2011	This schematic detail indicates general requirements and arrangement of hydronic specialties associated with each closed hydronic plant system with a combined air and dirt eliminator.
Detail # 232113-D02 Hydronic Plant Piping Schematic #2 (AutoCAD)	June 5, 2012	This schematic detail indicates general requirements and arrangement of hydronic specialties associated with each closed hydronic plant system with separate air and dirt

Detail # 232113-D02 Hydronic Plant Piping Schematic #2 (PDF)		eliminators..

.04 Cold Water Make-up Piping

A. All cold water piping shall be Type 'L' hard drawn seamless copper tubing.

B. All cold water piping joints shall be soldered, no lead type.

C. Provide parallel filters on all incoming make-up water lines.

D. Provide a (RPZ) reduced pressure principle backflow preventer.

E. Cold water make-up piping is not to be directly connected to any system that utilizes glycol.

.05 Gauge Piping

A. All gauge piping on hydronic systems shall be extra-strong IPS red brass piping federal specification WW-P-351, Grade A, with threaded joints.

B. For high pressure steam systems, pressure gauge connections shall be suitable for the maximum allowable working pressure and temperature, but if the temperature exceeds 406°F, brass or copper pipe or tubing shall not be used. The minimum size syphon shall be 1/4" inside diameter. For low-pressure steam systems, all gauge piping shall be non-ferrous.

C. Provide gauge cocks (low pressure) or gate valves (high pressure) for isolation.

.06 Cooling Coil Condensate Drain Piping

A. Cooling coil condensate drain piping shall be Type L, hard drawn, seamless copper tubing. Schedule 40 PVC with solvent weld joints may be used when there is no risk of hot water draining into the system. PVC shall not be used in air plenums.

B. Provide a trap for twice system total static pressure or 2" minimum.

C. No piping less than 1" in diameter.

D. Provide cleanouts at traps and other locations as required.

.07 Blowdown Piping (Boiler)

A. Schedule 80, black steel, welded.

B. Pipe to funnel type floor drain or approved receptor.

C. For high pressure boilers (over 15 psig steam), specify a heat recovery unit on the blowdown system. Flash steam could be utilized at the deaerator or other low pressure applications and hot water could be used to pre-heat the boiler make-up water.

1. Verify with the University, or with the local municipal authority, the permissible maximum temperature of waste water.

.08 Ground-coupled heat pump well field systems

A. The University encourages the use and application of equipment that reduce the energy consumption of building systems. However, the installation of ground-coupled or geothermal wells have groundwater contamination risks that must be addressed prior to design of any geothermal or ground-coupled systems.

B. Prior to the start of design, the Design Professional shall review any proposed geothermal or ground-coupled systems at any University location with the Office of Physical Plant, Engineering Services and obtain written consent to proceed prior to any further design development or installation. No geothermal or ground-coupled systems shall be installed at any University location without written approval of the Office of Physical Plant, Engineering Services.

C. Where approved, well systems shall be designed and constructed in accordance with 23 81 00.03 and 33 20 00.

END of revision

Update Commentary:

Section was updated primarily for the following reasons:

1) ***To add guidelines and requirements for the basic design of hydronic piping.***
2) ***To add 23 21 13 Hydronic Piping Guide Specification Section.***
3) ***To edit and reorganize to minimize duplications and cross references with other related sections 23 21 00 and new guide specification.***
4) ***To add new Hyrdronic Plant Piping Detail #2 for separate air and dirt eliminators.***