SECTION **23** 21 13 - HYDRONIC PIPING

PART I - GENERAL

1.1 DEFINITION

A. Hydronic System: Non-potable water-based heat transfer system, excluding steam. Hydronic systems include hot water heating, chilled water, chilled beam and condenser water systems.

1.2 SECTION INCLUDES

A. Pipe and Fittings
    1. Metallic Pipe and Fittings
    2. Non-metallic (Polymeric) Pipe and Fittings
B. Valves
    1. Shut Off Valves
        a. HVAC Grade
        b. Industrial Grade
    2. Globe Valves
        a. HVAC Grade
        b. Industrial Grade
    3. Silent Check Valves
        a. HVAC Grade
        b. Industrial Grade
    4. Swing Check Valves
        a. HVAC Grade
    5. Manual Balancing Valves
    6. Pressure Independent Flow Limiting Valves
        a. Fixed flow
        b. Adjustable flow
C. “Coil Pack” Assemblies
D. Vents and Drains

[Note to AE: Clearly indicate if HVAC Grade or Industrial Grade valves are to be provided for specific applications. Provide appropriate valve specifications in project documents.]

[Note to AE: All shut-off valves in chilled water plants shall be industrial grade.]

1.3 RELATED SECTIONS

A. *Section 23 20 00 – Pipe Joining*
B. *Section 23 20 16 - Hydronic Specialties*
C. *Section 23 22 13 - Steam And Condensate Piping*
D. *Section 23 09 13 – Instrumentation and Control Devices for HVAC*
E. *Section 23 07 19 – HVAC Piping Insulation*

1.4 REFERENCES

A. *ASME Standard B31.9 - Building Services Piping*

B. Applicable *ASME B16 Standard*s for valves and fittings

C. *ASTM F 2389 - Standard Specification for Pressure-rated Polypropylene (PP) Piping System*

D. *Illinois Steel Products Procurement Act*

E. *International Mechanical Code*

1.5 QUALITY ASSURANCE

A. Products and execution shall be in compliance with applicable codes and standards including those referenced above in paragraph entitled *REFERENCES.*.

B. Installation, start-up and operation shall be in compliance with Manufacturer's recommendations and IOM.

1.6 SUBMITTALS

A. Pipe and tubing: Type, material, ASTM number, schedule/wall thickness

B. Pipe certification, indication of domestic manufacture

C. Fittings: Type, material, ASME number, pressure class

D. Flanges: Type, material, ASTM number, pressure class

E. Unions: Type, material, ASTM number, pressure class

F. Flange gaskets; material, construction, temperature/ pressure rating

G. Welder Certifications

H. Polypropylene piping systems

1. Pressure/leak test documentation as required by Manufacturer to satisfy warranty requirements.

2. Test documentation shall be submitted to AE and directly to Manufacturer.

3. Documentation shall clearly identify Owner, facility and system.

1.7 DISALLOWED PRODUCTS

A. Roll groove or cut groove joints

1. Except in limited areas where hot work is disallowed by Owner. Formal variance required.

B. Press-connect joints

1. Except in limited areas where hot work is disallowed by Owner. Formal variance required.

[Note to AE: Grooved and press-connect joints are allowed only in <u>specific areas</u> where hot work is disallowed. This typically does not encompass entire building systems. <u>Few locations exist</u> on campus where hot work is truly disallowed. Owner shall be consulted in identifying such locations. Fusion welded polypropylene piping (PP-R/PP-RCT) is typically preferred in "no hot work" areas if Code allows.]

[Note to AE: Given that grooved joints and press-connect joints are typically not allowed on UIUC projects no specification has been provided for such herein. If required for a specific project, the AE shall insert specifications for these products as appropriate.]

C. Mechanically formed extruded outlets

D. Piercing valves and fittings

E. Saddle connections

F. Welded branch connections

G. Reducing bushings and flanges

H. Dielectric unions or fittings

1. Except “Clearflow” dielectric nipples

I. Flexible hose

1. Except coil pack assemblies as specified

2. Except final connection to equipment as approved by Owner

J. Nonmetallic (e.g. polypropylene) piping systems

1. Except as approved by Owner and as specified in paragraphs *2.1B* and *2.1C* below

K. Nonmetallic valves

L. Other non-standard pipe and fittings

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pipe and tubing shall be transported with ends tightly covered, protected from physical damage. Copper tubing and threaded pipe shall have factory applied end caps maintained in place throughout transportation and storage.

B. Fittings, valves, specialties and materials shall be transported protected from physical damage and protected from weather.

C. Large pipe may be stored outdoors on rack or wood blocking with ends tightly covered.

D. All materials shall be stored indoors protected from temperature, physical damage and exposure to fluids, dust and debris. Containers of solder, brazing and weld consumables, pastes and fluids shall remain sealed until use. Opened containers shall be kept sealed when not in use.

1.9 WARRANTY

A. Products and installation thereof shall be warranted to be free from defects in material and workmanship for period of one year from date placed into useful service or 18 months from date of delivery, whichever occurs first. Defective product shall be repaired or replaced at no cost to Owner.

B. All joints shall be warranted to be free from leaks and imperfections for same time period. Defective joint shall be repaired or replaced at no cost to Owner. Impacted piping system shall manipulated as required to make repair and fluid media shall be brought back to original condition and fill volume at no cost to Owner.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. 125 PSIG, 250F, Metallic

1. Size 2” and Smaller - Copper

a. Tubing: Copper, ASTM B88, Type L, Hard Drawn Seamless

b. Fittings: Wrought Copper, ASME B16.22 or Cast Copper Alloy, ASME B16.18, Solder Joint

c. Pipe nipples: Red Brass, ASTM B-687, Schedule 80, Seamless, NPT

d. Unions: Wrought Copper, ASME B16.22 or cast Copper Alloy, ASME B16.18, Solder Joint

e. Flanges: Cast Bronze, Class 125, ASME B16.24, Solder Joint

2. Size 2” and Smaller

a. Pipe: Carbon Steel, ASTM A53 Grade B – Type E or S, Schedule 40

b. Fittings: Cast Iron, Class 125, NPT

c. Pipe nipples: Carbon steel, ASTM A53 Grade B, **Schedule 80**

d. Unions: Cast Iron, Class 250, NPT

3. Size 2 ½" and Larger

a. Pipe: Carbon Steel, ASTM A 53 Grade B, Type E or S, Schedule 40 or Schedule Standard

b. Fittings: Wrought Carbon Steel, ASTM A234 WPB, Weld Neck

c. Flanges: Forged Steel, Class 150, ASTM A105, ASME/ANSI B16.5, Weld Neck, Raised Face except where bolted to flat face flange

[Note to AE: See specifications below for non-metallic hydronic piping systems (e.g. polypropylene). These present certain advantages over traditional metallic systems. The foremost of these is elimination of corrosion within the system as well as elimination of marginal solder joints and associated leaks. Thus, with written Owner approval, PP-R and PP-RCT pipe and fittings may be used on a limited case by case basis within allowable pressure/temperature limitations. As of the time of this writing the use of PP-R shall be limited to lower temperature applications (e.g. chilled water, condenser water). PP-RCT may be used for lower temperature or elevated temperature applications (hot water). Default wall thickness for lower temperature applications shall be SDR 11. Default wall thickness for elevated temperature applications shall be SDR 9.

For each elevated temperature application a "worst-case" analysis shall be performed. A possible but unlikely worst-case scenario for a HW heating system could be as follows: 1) Campus steam distribution pressure elevated. 2) Steam PRV (if existent) failed open. 3) Steam control valve open (or leaking). 4) Elevated pressure within HW system pressure (due to high relief valve setting). 5) Pump(s) off or running slowly with all system control valves closed. In such rare scenario the fluid temperature could reach the steam saturation temperature, the fluid could reach its boiling point and/or the fluid pressure could reach the relief valve setting. A judgement shall be made regarding the realistic potential for such failure mode and length of time such failure mode could realistically persist. The manufacturer shall be engaged in determining the impact of such event on the life of the PP-RCT system as well as any impact on the product warranty. A summary of this evaluation shall be presented to Owner for approval.

If a PP-RCT system is installed, several feet (approximately 6') of metallic pipe shall be provided at each connection to heat producing equipment to facilitate heat dissipation. Relief valve setting shall be as low as practical (e.g. 50-60 PSIG). Hard-wired over-temp safeties shall be provided. Standard metallic valves and specialties with NPT or flanged connections shall be utilized as specified within project documents. At the time of this writing use of non-metallic valves and specialties have not yet been approved across-the-board but is contingent upon approval of Owner.

Nonmetallic piping shall not be installation within air circulation plenums unless fully compliant with NFPA Life Safety Code and approved by Authority Having Jurisdiction. Written certification of compliance with applicable Codes shall be provided by manufacturer.]

B. 100 PSIG, 160F - Polypropylene

1. Size 4" and Smaller

a. Tubing: Extruded PP-R / PP-RCT, with fibrous layer, ASTM F2389, SDR 11

b. Fittings: PP-R / PP-RCT ASTM F2389

c. Joints: Heat Fusion Socket Weld

2. Size 6" and larger

a. Tubing: Extruded PP-R / PP-RCT, with fibrous layer, ASTM F2389, SDR 11

b. Fittings: PP-R / PP-RCT, ASTM F2389

c. Joints: Heat Fusion Butt Weld

C. 120 PSIG, 200F Operating / 100 PSID, 250F Upset – Polypropylene

1. Size 4" and Smaller

a. Tubing: Extruded PP-RCT with fibrous layer, ASTM F2389, SDR 9

b. Fittings: PP-RCT, ASTM F2389

c. Joints: Heat Fusion Socket Weld

2. Size 6" and larger

a. Tubing: Extruded PP-RCT with fibrous layer, ASTM F2389, SDR 9

b. Fittings: PP-RCT, ASTM 2389

c. Joints: Heat Fusion Butt Weld

D. Product Warranty

1. PP-R and PP-RCT piping systems including all components

a. Piping systems shall be warranted to be free of defects in materials and manufacturing and to perform as advertised in manufacturer's published literature and as specified herein for period of 10 years from date of system start-up.

b. Warranty shall cover labor and material costs of repairing and/or replacing defective materials and repairing any damage caused by failure of piping system. Fulfillment of warranty shall be at no cost to Owner.

[Note to AE: When applying following valve specifications clearly indicate if HVAC Grade or Industrial Grade valves are to be provided for specific application. Provide appropriate valve specifications.]

2.2 SHUT-OFF VALVES – HVAC GRADE

Notes:

1. Shut-off valves shall be quarter turn ball or butterfly type. Gate valves are allowed only for direct replacement of existing gate valves.
2. When multiple valve types or "overlapping" sizes are specified for given application, "Contractor's Option" applies.

[Note to AE: Given that gate valves are typically disallowed within building systems, no specification has been provided herein. If required for a specific project AE shall provide gate valve specifications as appropriate.]

A. Quarter-Turn Type

1. Size 2 1/2" and Smaller, Threaded Two-Piece Full-Port Ball Valve

a. 600 CWP, 150 SWP

b. 250F temperature rating

c. Rated for 50% glycol solution

d. Shut-off class VI, bi-directional.

e. Two-piece cast bronze body. Yellow brass not acceptable

f. NPT connections

g. 316 stainless steel full-port solid tunneled ball

h. 316 stainless steel stem and nut

i. Blow-out proof stem design

j. PTFE seats

k. Adjustable stem packing

l. Lever handle

m. Insulated piping applications: Provide stem extension. Formed metal extension not acceptable.

n. Chilled water applications: Provide protective stem extension shield to allow operation with no disturbance to insulation. Basis: Nibco Nibseal

o. Approved manufacturers

1) Apollo 77C-140-A

2) Nibco T585-70-66

3) Milwaukee BA-400S3

2. Size 2 1/2" and Larger, Lug Style Resilient-Seated Butterfly Valve

a. Bi-directional dead-end service at rated pressure

b. Bubble-tight shut-off

c. Pressure rating:

1) 12" and smaller: 200 PSIG, except AMRI 150 PSIG (for reduced torque)

2) 14" and larger: 150 PSIG

d. 250F temperature rating

e. Rated for 50% glycol solution

f. Ductile iron lug style body. Cast iron or wafer style body not acceptable

g. Industrial paint or epoxy coating

h. EPDM seat

g. Aluminum bronze or stainless steel disc

h. Two-piece stainless steel shaft

i. Upper and lower bearings

j. Blow-out proof shaft design

k. Manual actuator

1) Valves 6" and smaller: 10-position lever handle

2) Valves 8" and larger: Geared rotary hand-wheel operator

l. Approved Manufacturers

1) Amri Isoria

2) Cameron Demco

3) Ebro model Z014

4) Pratt BF Series

Note to Contractor: In an attempt to improve quality, approved manufacturers of resilient seated BF valves have changed relative to those previously approved. *[Note to AE: Take note of this quality upgrade.]*

m. Approved Substitution

1) High performance butterfly valve per specification below

2.3 SHUT-OFF VALVES – INDUSTRIAL GRADE

[Note to AE: As state above, clearly indicate if HVAC Grade or Industrial Grade valves are to be provided for specific applications. Provide appropriate valve specifications.]

[Note to AE: All shut-off valves in chilled water plants shall be industrial grade.]

A. Quarter-Turn Type

1. Size 2 1/2" and Smaller, Threaded Three-Piece Full-Port Ball Valve
    a. Pressure class 600
    b. 150 PSID shut-off rating
    c. 250F temperature rating
    d. Rated for 50% glycol/water solution
    e. Leakage class VI, bi-directional
    f. Carbon steel or stainless steel three-piece body
    g. NPT connections
    h. Type 316 stainless steel full-port ball and stem
    i. Blow-out proof stem design
    j. Reinforced PTFE (RPTFE) or TFM seats
    k. Live-loaded stem packing
    l. Approved manufacturers
        1) Jamesbury
        2) Habonim
        3) PBM
        4) Worcester
2. Size 2 ½" and Larger, Lug Style High Performance Butterfly Valve
    a. ANSI Class 150
    b. Shut-off class VI, bi-directional
    c. Stainless steel or carbon steel lug-style body
    d. 316 stainless steel double-offset disc
    e. Reinforced PTFE (RPFT) seats
    f. Disc centering feature
    g. 17/4 PH stainless steel shaft
    h. Blow-out proof shaft design
    i. Stainless steel / polymer composite shaft bearings
    j. Adjustable graphite shaft packing
    k. Geared rotary hand-wheel operator
    l. Approved manufacturers
        a. Jamesbury
        b. Cameron W-K-M
        c. Xomox

2.4 GLOBE VALVES – HVAC GRADE

A. Size 2" and Smaller, Threaded Bronze Globe Valve

1. ANSI Class 150
2. Cast bronze body
3. Union bonnet
4. NPT connections
5. Renewable disc
6. Basis of design: Nibco T-235-Y

B. Size 2 ½" and Larger, Flanged Cast Iron Globe Valve

1. ANSI Class 125
2. Cast iron body
3. Bolted bonnet
4. Flanged connections
5. Bronze trim
6. Renewable seat and disc
7. Basis of design: Nibco F-718-B

2.5 GLOBE VALVES - INDUSTIAL GRADE

A. Size 2" and Smaller – Threaded Bronze Globe Valve

1. ANSI Class 300
2. Cast bronze body
3. Union bonnet
4. NPT connections
5. Renewable stainless steel pug and disc
6. Basis of design: 128T Series

B. Size 2 ½" and Larger

1. ANSI Class 250
2. Cast iron body and cover
3. Bolted bonnet
4. Flanged connections
5. Bronze trim
6. Renewable disc and seat
7. Basis of design: Nibco F-768-B

[Note to AE: All inline check valves 2 ½" and larger in systems with continuous circulation shall be flanged type. Wafer type is not allowed. Wafer checks, with their lower Cv, consume more energy due to increased system pressure drop. Wafer check valves may be used in systems with intermittent flow.]

2.6 SILENT CHECK VALVES – HVAC GRADE

A. Size 2" and Smaller – Threaded Inline Lift Check

1. 125 SWP, 400 CWP
2. Cast bronze body
3. NPT connections
4. PTFE plug/disc

5. Stainless steel trim
6. Repairable
7. Basis of design: Apollo CVB 61-200

B. Size 2 ½" through 8", Flanged Globe Style Center-Guided
1. 125 SWP, 200 CWP
2. Cast iron body
3. Flanged or lug style connections
4. Wafer configuration not allowed
5. Renewable disc and seat
6. 316 SS spring/trim
7. Basis of design: Keckley Style CG

C. Size 10" and Larger, Flanged Spring-Loaded Dual Disc
1. Class 125 or 150
2. Flanged or lug-style connections
3. Water configuration not allowed
4. Renewable discs and seat
5. 316 SS spring/trim
6. Basis of design: Keckley Style DD

2.7 SILENT CHECK VALVES – INDUSTRIAL GRADE

A. Size 2" and Smaller, Inline Body-Guided
1. Repairable non-slam spring-loaded design
2. ANSI class 300
3. Steel or stainless steel body
4. NPT connections
5. 250 degrees F temperature rating
6. Body-guided disc
7. Stainless steel trim and disc
8. Approved manufacturers
a. DFT model SCV
b. Watson McDaniel WSSCV

B. Size 2 ½" and Larger, Inline Center-Guided
1. Repairable non-slam spring-loaded design
2. ANSI class 150
3. Steel or stainless steel body
4. Wafer or lug style body
5. 250 degrees F temperature rating
6. Center-guided disc
7. Stainless steel trim and disc
8. Basis of design: DFT model WLC

2.8 SWING CHECK VALVES – HVAC GRADE

A. Size 2" and Smaller, Threaded Bronze Swing Check

1. 150 SWP, 300 CWP
2. Cast bronze body and threaded cap
3. NPT connections
4. Renewable bronze disk
5. Renewable/regrindable bronze seat

B. Size 2 1/2:" and Larger, Flanged Cast Iron Swing Check

1. 125 SWP, 200 CWP
2. Cast iron body and bolted bonnet
3. Flanged connections
4. Renewable disc and seat
9. Basis of design: DFT model WLC

2.9 BALANCING VALVES

[Note to AE: The use of balance valves in variable flow hydronic systems is generally discouraged, especially at terminal and unitary units such as reheat coils, finned tube elements and fan coil units. Manual balancing valves can actually do more harm than good. There are multiple valid reasons to support this position. These are developed within the Hydronic Heating/Cooling Section within the General Guidelines. Yet a specification has been provided herein for applications where such valves are required. Balancing flow through multiple stacked coils within an AHU serves an example.]

[Note to AE: Although UIUC Standards require bronze body ball valves; balancing valves are not available in bronze. Thus, forged brass balancing valves are deemed acceptable.]

A. Fixed-Orifice Wye-Pattern Globe Type

1. Size 2" and Smaller
   a. 300 PSIG at 250F
   b. Rated for 50% glycol/water solution
   c. Forged brass body
   d. NPT connections
   e. Multi-turn, calibrated
   f. Memory stop
   g. PT ports
   h. Approved manufacturers
      1) TA/Victaulic
      2) Macon
      3) Mepco
      4) Wheatley
      5) Armstrong
      6) IMI Flow Design Acusetter
   i. Not approved
      (a) Nibco

(b) Bell and Gossett Circuit Setter

2. Size 2 ½" and Larger
   a. 250 PSIG at 250F
   b. Rated for 50% glycol/water solution
   c. Cast iron or ductile iron body
   d. Flanged connections
   e. Multi-turn, calibrated
   f. Memory stop
   g. PT ports
   h. Basis of design: DFT model WLC

2.10 PRESSURE INDEPENDENT FLOW LIMITING VALVES

[Note to AE: Although common practice, a flow limiting valve shall not be installed in series with a two-way control valve. When installed in series, the two valves work at counter purposes. The function of the control valve is to vary flow; the function of the PI flow limiting valve is to maintain constant flow. As with manual balancing valves, pressure independent flow limiting valves are not available in bronze. Thus, forged brass components are deemed acceptable for this specific application.]

A. Fixed Flow Type
   1. Size 2" and Smaller
      a. 600 CWP
      b. 250F temperature rating
      c. Rated for 50% glycol solution
      d. Forged brass construction
      e. NPT connections
      f. P/T test plugs
      g. Stainless steel cartridge and spring
      h. Integral isolation ball valve
      i. Integral union
      j. Integral wye strainer
         1) 20 mesh stainless steel screen
         2) Blow-down/drain valve
         3) Hose adapter and cap
      k. Elastomers
         (f) Union: Viton O-ring
            (a) Color coded to prevent confusion with EPDM
         (g) Balance: EPDM
      l. Insulated piping applications
         1) Valve stem and P/T port extensions
         2) Formed metal valve stem extension not acceptable
      m. Operating pressure range as determined by application

n. Approved Manufacturers
    1) Nexus UltraMatic
    2) Griswold Isolator
    3) IMI Flow Design Autoflow
2. Size 2 1/2" - 3”
    a. 150 PSIG
    b. 250F temperature rating
    c. Rated for 50% glycol solution
    d. Ductile iron body
    e. Flanged connections
    f. P/T test plugs
    g. Insulated piping applications:
        1) Valve stem and P/T port extensions
        2) Formed metal valve stem extension not acceptable
    h. Operating pressure range as determined by application
    i. Basis of Design: Griswold Uni-Flange
    j. Also approved
        1) IMI Flow Design
        2) Pro-hydronics

C. Adjustable Flow Type
1. Size 2” and Smaller
    a. 400 CWP
    b. 250F temperature rating
    c. Rated for 50% glycol solution
    d. Forged brass construction
    e. NPT connections
    f. Multi-turn, calibrated flow rate selector handle with memory stop
    g. P/T test plugs
    h. Integral isolation ball valve
    i. Integral union
    j. Integral wye strainer
        1) 20 mesh stainless steel screen
        2) Blow-down/drain valve
        3) Hose adapter and cap
    k. Union
    l. Elastomers
        1) Union: Viton O-ring
            (a) Color coded to prevent confusion with EPDM
        2) Balance: EPDM

m. Operating pressure range as determined by application

n. Insulated piping applications:

1) Provide valve stem and P/T port extensions

2) Formed metal valve stem extension not acceptable

o. Approved Manufacturers

1) Bell and Gossett Circuit Sentry Flo-Setter

2) IMI Flow Design Autoflow/Harmony

2. Size 2 1/2" and Larger

a. 150 PSIG

b. 250F temperature rating

c. Rated for 50% glycol solution

d. Ductile iron body

e. Flanged connections

f. Multi-turn, calibrated flow rate selector handle with memory stop

g. P/T test plugs

h. Operating pressure range as determined by application

i. Insulated piping applications:

1) Provide valve stem and P/T port extensions

2) Formed metal valve stem extension not allowed extension not acceptable.

j. Approved Manufacturers:

1) FloCon SH (a Griswold company)

2) IMI Flow Design

2.11 "COIL PACK" MULTI-FUNCTION VALVE ASSEMBLIES

[Note to AE: Although UIUC Standards typically require bronze body ball valves, coil pack assemblies are not available in bronze. Thus, forged brass components are deemed acceptable for this specific application. Although use of balance valves at terminal units is discouraged by the University, a balancing valve option has been included within these specifications for consultants who insist on requiring them. Multi-turn globe type (e.g. TA) balance valves are specified for UIUC projects when (rarely) required. But for coil pack assemblies (only) calibrated orifice type are deemed acceptable. These shall be left in the wide open position and not incorporated in the balancing contract. The project specifications should clearly indicate this. Although previously disallowed, high quality flexible hoses of limited length are now allowed per specification provided below.]

A. Two-way Type with Strainer

1. Size 1 1/4" and Smaller (maximum coil pack size)

a. 600 CWP

b. 250F temperature rating

c. Rated for 50% glycol solution

d. Forged brass construction

e. NPT connections

f. P/T test plugs

g. Integral isolation ball valves

h. Integral wye strainer
    1) 20 mesh stainless steel screen
    2) Blow-down/drain valve
    3) Hose adapter and cap
i. Manual balancing valve *[Note to AE: As addressed in commentary above, this paragraph may be deleted. As explained in commentary for section "2.3 – Manual Balancing Valves", such devices may actually do more harm than good.]*
    1) Calibrated multi-turn globe style (preferred)
    2) See paragraph *2.2D Manual Balancing Valves* for specification
    3) Calibrated orifice type allowed
    4) Memory stop
    5) P/T ports
j. Adapter/tail-pieces
    1) Union with P/T plug, drain, and/or vent
k. Air vent
    1) Tool-less type only; "coin vent" or "screwdriver vent" not allowed
    2) Provision for horizontal attachment of hose or tubing
l. Hose (as applicable)
    1) Rated 400 PSIG at 250 degrees F.
    2) 18" maximum length
    3) Stainless steel braid
m. Elastomers
    1) Unions: Viton O-ring
        (a) Color coded (to prevent confusion with EPDM)
    2) Other elastomers: EPDM
n. Insulated piping applications: Provide valve stem and P/T plug extensions. Formed metal valve stem extension not acceptable.
o. Identification tag with model # and GPM
p. Approved Manufacturers
    1) Nexus
    2) Macon
    3) Griswold
    4) TA/Victaulic
q. Not Approved
    1) HCI Terminator
    2) Nibco

2.12 VENTS AND DRAINS

A. Air Vents

1. Vents shall be ½" or ¾" ball valves as specified above in section entitled *Shut-Off Valves* except valves may be standard port. Vent shall incorporate down-turned discharge pipe with hose adapter and cap.
2. ¼" ball valves may be used where space is inadequate for ½" ball valve (e.g. within cabinet of heat transfer equipment). Hose adapter not required for ¼" vent.
3. Automatic air vents not allowed unless integral to equipment (e.g. air/dirt separator).

B. Drains

1. Drain valves shall be ¾" or 1" full port ball valves as specified above in section entitled *Shut-Off Valves*. Drain shall incorporate hose adapter and cap.
2. Smaller drain valves may be used when piping is smaller than ¾". In such cases drain valve shall be same size as pipe. Hose adapter not required for drains smaller than ½".
3. "Boiler drains" not allowed.

PART 3 - EXECUTION

3.1 PIPE AND FITTINGS

A. Interior of pipe and fittings shall be thoroughly cleaned prior to assembly.

B. Piping shall be installed plumb and orthogonal relative to floors and walls.

C. Piping shall be located and configured to avoid interferences and maintain access to devices and equipment requiring service.

D. Piping shall not be located above electrical panel boards, switchgear, switchboards or motor control centers and shall comply with requirements of *NEC - National Electric Code*.

E. Anchors, expansion joints, swing joints and expansion loops shall be provided as required to provide/control movement.

F. Horizontal mains shall be pitched up 1" per 40' in direction of flow.

I. Eccentric fittings shall be used for changes in pipe size in horizontal lines and shall be oriented with top of pipe straight.

J. Elbows and tees shall be long radius type. Short radius not allowed.

K. Bull-head tee configuration not allowed.

L. "Weldolets", "Threadolets" and "Sockolets" may be used for branch connections and instrumentation. Maximum size of branch shall be two pipe sizes smaller than main.

M. All steel and brass threaded pipe nipples shall be **schedule 80**.

N. Unless otherwise indicated, branch lines shall be connected to sides of horizontal mains. Branches shall not be connected to top or bottom of mains.

O. Where separation of copper and ferrous piping is required brass fittings, bronze fittings, bronze body valves or "Clearflow" dielectric fittings shall be used. Standard dielectric fittings are not allowed.

K. For non-metallic (polypropylene) piping installed in hot water heating systems a minimum of 6 ft. of metallic piping shall be provided between non-metallic piping and heat exchanger (steam converter).

L. Nonmetallic piping shall not be installation within air circulation plenums unless fully compliant with NFPA Life Safety Code and approved by Authority Having Jurisdiction. Written certification of compliance shall be provided by manufacturer.

M. At a minimum, manual isolation valves shall be provided…

1. At branch connections to supply and return mains as indicated on drawings.
2. At supply and return connecting to each unit, device or piece of equipment.

3. At inlet and outlet of each control valve or other automated device.
4. At other locations in piping system as indicated on drawings.

N. Isolation valves in branch piping shall be located as near connection to mains as practical.

O. Isolation valves in branch lines serving vents, drains, and instrumentation shall be close-coupled with branch valves located near mains.

P. At a minimum, unions or flanges shall be provided…
1. At connections to each unit, device or piece of equipment
2. At specialties such as strainers, expansion tanks, etc.
3. At equipment or branch side of each manual valve.
4. At inlet and outlet of each control valve or other automated device.
5. Where required to facilitate removal of piping sections that interfere with tube pulls or equipment removal.

Q. When connecting raised face steel flanges to flat face cast iron flanges, raised face flange shall be machined flat for proper connection.

3.2 PIPE JOINING

A. All soldered, brazed, threaded and welded pipe connections shall comply with requirements of *ASME B31.9* and *UIUC Facilities Standards Section 23 20 00 – Pipe Joining.*

B. Any requirement for destructive testing applies.

3.3 VALVES

A. Disc Position
1. Resilient Seated Butterfly Valve
a. Valve shall be installed with disc partially open. Installation with disc in closed position will damage seat *[Note to AE: This is important. It installing resilient seated butterfly valves in the fully closed position results in permanent seat deformation and resultant leak-through for the duration of valve life.]*

B. Valve Orientation
1. Ball Valve
a. Valve may be installed in any position except with stem oriented vertically downward (i.e. with handle at bottom).
b. Valve shall be installed such that the direction of flow indication on the valve body and/or product literature, if any, matches the actual direction of fluid flow through the valve.
2. Butterfly Valve
a. Valve shall be installed such that the shaft is oriented horizontally. In no case shall the valve be installed such that the shaft is oriented vertically downward (i.e. with the actuator at the bottom).
b. Valve shall be installed such that the direction of flow indication on the valve body and/or product literature, if any, matches the actual direction of fluid flow through the valve.
3. Check Valves
a. Swing Check Valves
1) Check valve shall be installed in horizontal or vertical up flow configuration. They shall not be installed in vertical downward flow configuration.

b. Silent Check Valves

1) Check valve shall be installed in vertical up flow configuration only.

C. Valve Insulation

1. Insulated Piping Applications

a. Valves in insulated piping systems shall have the body, flanges, etc., completely insulated. The practice of leaving heating valves and associated unions/flanges un-insulated is not acceptable.

b. Insulated valves shall be equipped with extended stems and protective shields as required to allow operation without disturbing insulation.

c. Valves shall be provided with lock-out trim where indicated on the drawings. Extended stems are not required on valves with lock out trim.

3.4 PRESSURE INDPENDENT FLOW LIMITING VALVES

A. Fixed Flow Type

1. Operating pressure range shall be selected prior to shipment.
2. Wye strainer shall be provided upstream of valve if not integral.
3. Flow limiting valve shall not be installed in series with control valve.

B. Adjustable Flow Type

1. Operating pressure range shall be selected prior to shipment.
2. Wye strainer shall be provided upstream of valve if not integral.
3. Flow rate shall be adjusted per design and locked in place.
4. Flow limiting valve shall not be installed in series with control valve.

3.5 MANUAL BALANCING VALVES

A. Balancing valve shall be located in return line near coil/unit served as applicable.

B. Adequate straight run shall be provided upstream and downstream of valve per manufacturer's recommendations.

C. Valve size shall be properly selected per manufacturer's recommendations. Proper size is often smaller than pipe size.

D. Balancing valves shall be used for balancing only. They shall not be used for isolation. A separate valve shall be provided for isolation.

3.6 "COIL PACK" MULTIFUNCTION VALVE ASSEMBLIES

A. Configuration

1. Coil pack shall be assembled with isolation valves in supply and return piping such that all components may be isolated from system piping.

B. Strainer Assembly

1. Strainer assembly shall be provided with isolation valve, union, blow-down/drain, hose adapter, cap in supply piping near coil inlet.

C. Hoses (as applicable)

1. Hoses shall be connected at coil inlet and outlet.
2. Hose length shall be limited to maximum allowed (see above specification).
3. Bend radius shall be limited to manufacturer recommendation.
4. Piping shall be supported independently of unit.

D. Adapters

1. Union/adapter shall be installed in return piping near coil outlet.
2. Control valve shall be installed (specified elsewhere).
3. Union/adapter and isolation valve shall be provided in return piping downstream of control valve.

E. Vents and Drains

1. Air vent shall be provided at high point of coil outlet.
2. Drain shall be provided at low point of coil inlet.

F. P/T plugs

1. P/T plugs shall be provided at coil inlet and outlet for pressure and temperature measurement.

3.7 VENTS AND DRAINS

A. Vents

1. Air vents shall be provided at all highpoints in system where air may collect. Additionally, vents shall be provided at locations shown on drawings. When possible, vents shall be installed at locations where flow turns downward.
2. Air vents shall be "close coupled" to pipe and shall incorporate down-turned discharge pipe with hose adapter and cap. Exception: Hose adapter and cap not required for ¼" vent valves. Hose adapter and cap not required for vents integral to coil pack assemblies. Down-turned discharge still required.
3. Air vent installation shall be in compliance with *Drawing 23 21 13-02 Hydronic Air Vent and Drain Valve Installation.*

B. Drains

1. Drain valves shall be provided at all low points in piping system where water may gather and where debris may collect to allow full drainage of fluid from system. Additionally, drains shall be provided at locations shown on drawings. When possible, drains shall be installed at locations where flow turns upward.
2. Drains shall be "close coupled" to pipe and shall incorporate discharge pipe with hose adapter and cap. Exception for small piping addressed above in paragraph entitled *Drains*.
3. Installation shall be in compliance with *Drawing 23 21 13-02 Hydronic Air Vent and Drain Valve Installation.*

C. Cooling Coil Vent and Drain

1. Brass pipe nipples shall be provided at cooling coil vent and drain connections. All piping between coil and valve shall be schedule 80 brass. *[Note to AE: The University has found that cooling coil vent and drain piping is especially vulnerable to corrosion. Thus brass is preferred over steel for this application.]*

D. Cooling Coil Condensate Drains

1. Dedicated drain line shall be provided for each condensate drain connection.
2. Trap shall be provided in each drain line of sufficient depth to prevent conditioned air from moving through piping. Trap shall be constructed with plugged or capped tee for cleanout purposes.
3. Drain piping shall be extended to approved drain location, pitched downward ¼" per foot and terminated in code compliant manner.

3.8 INSTRUMENTATION

A. Instrumentation (e.g. pressure gauge manifold, pressure transmitter) shall be provided as indicated on drawings.

B. Instrumentation piping from isolation valve to instrument(s) shall be ½" copper or stainless steel tubing.

3.9 PRESSURE TESTING

A. Hydrostatic leak test shall be performed in presence of Owner's representative. 72 hour advance notification shall be provided.

B. Piping system shall be uninsulated at time test is performed.

C. System shall be filled with clean water and air shall be vented from all piping and devices.

D. Pressure test may be made of isolated portions of system to facilitate general progress of installation. Any revisions made in piping systems require retest of affected portions of piping systems.

E. Valves in test segment shall be opened including isolation valves for devices and instrumentation rated for test pressure.

F. Expansion tank isolation valve shall be closed.

G. Relief valves shall be temporarily plugged or otherwise disabled as appropriate.

H. Vessels, components and instrumentation not rated for test pressure or vulnerable to damage shall be isolated.

I. System shall be hydrostatically tested to 1.5 times maximum system operating pressure, 100 PSIG or pressure relief valve setting, whichever is greatest.

J. Test gauge shall be used. At a minimum, gauge shall comply with requirements in *Section 23 05 19 – Meters and Gauges for HVAC Piping*.

1. Gauge shall be ANSI Grade AA (2A), ½% full scale accuracy minimum.

K. Test pressure shall be held for 2 hours minimum with no drop in gage pressure. Piping, joints and connections shall be inspected for leakage.

L. After leaks are eliminated test shall be repeated until system is demonstrated to be leak tight to satisfaction of Owner.

M. Relief valves shall be reinstalled and valves and components restored to operating position/configuration.

N. Components not hydrostatically tested shall be protected by relief valve during system operation.

O. Written report shall be provided to AE.

3.10 PREOPERATIONAL CLEANING

A. Preoperational cleaning shall be accomplished in compliance with *Section 23 25 00 – Water Treatment for Hydronic Systems*

3.11 CHEMICAL TREATMENT

A. System chemical treatment shall be accomplished in compliance with Section *23 25 00 – Water Treatment for Hydronic Systems*.

3.12 PAINTING

A. Unless otherwise directed by AE, all exposed steel piping shall be degreased, primed and painted as directed by AE. Color shall be selected by Architect.

END OF SECTION **23** 21 13

This section of the *U of I Facilities Standards* establishes minimum requirements only.
It should not be used as a complete specification.