SECTION 23 22 13 - STEAM AND CONDENSATE PIPING

PART I - GENERAL

1.1 SECTION INCLUDES

A. Pipe and Fittings for Building Steam Systems

B. Valves for Steam and Condensate Systems

C. Preoperational Cleaning

D. Pressure Testing

1.2 RELATED SECTIONS

A. *Section 33 63 23 – Tunnel Steam and Condensate System*s

1. Specifications for utility steam systems (i.e. tunnel and underground) including pipe, fittings and valves are provided separately in *Division 33 – Utilities*. This *Section 23 22 13* within *HVAC* applies to building steam and condensate systems only.

2. Specifications for utility steam system components, including valves, are provided separately in *Division 33 - Utilities* as referenced herein.

3. Clarification: Specifications for building main steam shut off valves and associated steam trap and blow-down valves are provided in *Division 33 – Utilities* rather than *Division 23 - HVAC.* Such valves are considered to be components of the utility system rather than the building system.

B. *Section 23 20 00 - Pipe Joining*

C. *Section 23 22 16 - Steam and Condensate Specialties*

D. *Section 23 09 13 – Instrumentation and Control Devices for HVAC*

E. *Section 23 07 19 – HVAC Piping Insulation*

1.3 REFERENCES

A. *ASME B31.9 – Building Services Piping*

B. *ASME B31.1 – Power Piping*

C. Applicable *ASME B16 Standards* for valves and fittings

D. *Section 23 07 19 – HVAC Pipe Insulation*

E. *Illinois Steel Products Procurement Act*

F. *International Mechanical Code*

1.4 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 shall be in compliance with Manufacturer's recommendations and IOM.

1.5 SUBMITTALS

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

B. Pipe certification, indication of domestic manufacture

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

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

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

F. Flange gaskets: Material, construction, temperature/pressure rating

G. Valves: Type, pressure class, leakage class, pressure/temperature rating, materials of construction, construction details

H. Welder Certifications

I. Leak test report

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pipe and tubing shall be transported with ends tightly covered. Threaded pipe shall have factory applied end caps maintained in place throughout transportation and storage.

B. Materials and equipment shall be protected from physical damage and weather during transport.

C. Pipe, tubing, materials and equipment shall be stored indoors protected from physical damage and exposure to dust and debris.

D. Large pipe may be stored outdoors on wood blocking with ends tightly covered.

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

1.7 WARRANTY

A. Products 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. Joints shall be warranted to be free from leaks and imperfections for same time period. Defective joints shall be repaired or replaced at no cost to Owner.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS FOR <u>BUILDING</u> STEAM AND CONDENSATE SYSTEMS

Notes:

1. As stated above, specifications for utility steam systems including pipe, fittings and valves are provided separately in *Division 33 – Utilities*
2. Building entrance piping, first valve inside building, associated steam traps, blow downs and associated piping and valves are considered components of utility system.
3. For direct-fed building with <u>no PRV station</u>: All building steam heating piping, valves and system components shall be selected for ‘medium pressure” service.
4. For building with PRV station: All valves and components in heating system upstream of PRV shall be selected for “medium pressure” service.

Additional Note:

1. When multiple valve types or “overlapping” sizes are specified for given application, “<u>Contractor’s Option</u>” applies.

A. High Pressure Steam and Condensate

Normal Operation: <165 PSIG, <400F

Worst Case: 175 PSIG, 450F (plant relief valve setting)

-- Typically for kitchen, laboratory and other process systems

1. Pipe and Fittings

b. Size 2” and Smaller

1) Pipe: Carbon Steel, ASTM A106 Grade B Seamless, Schedule Standard

2) Fittings: Forged Steel, ASTM A105, 3000 Lb.

3) Unions: Forged Steel, ASTM A105, 3000 Lb.

(a) Unions at final connections only

c. Size 2 ½” and Larger

1) Pipe: Carbon Steel, ASTM A106 Grade B Seamless, Schedule Standard

2) Fittings: Carbon Steel, ASTM A234 WPB, Seamless, Schedule Standard, Long Radius, Welding

3) Flanges: Forged Steel, Class 300, ASTM A105, ASME/ANSI B16.5, Weld Neck, Raised Face

(a) Flanges at final connections only, otherwise welded joints

B. Medium Pressure ‘Campus Steam’ and Condensate

Normal Operation: <60 PSIG, <350F

Worst Case: 125 PSIG, 400F (plant relief valve setting)

-- Typically for building heating system with no PRV

-- If PRV existant, applies to piping upstream of PRV

1. Pipe and Fittings

a. Size 2” and Smaller

1) Pipe: Carbon Steel, ASTM A53 Grade B E or S, Schedule Standard

2) Fittings: Cast Iron, Class 125, NPT

3) Unions: Cast Iron, Class 250, NPT

b. Size 2 ½” and Larger

1) Pipe: Carbon Steel, ASTM A53 Grade B E or S, Schedule Standard

2) Fittings: Carbon Steel, ASTM A234 WPB Seamless, Schedule Standard, Long Radius, Welding

3) Flanges: Forged Steel, Class 150, ASTM A105, ASME/ANSI B16.5, Weld Neck, Raised Face

C. Low Pressure Steam and Condensate

Normal Operation: $\leq$ 15 PSIG, $\leq$ 300F

Worst Case: 25 PSIG (building relief valve setting), 350F

-- Typically for heating system downstream of building PRV if existant

1. Pipe and Fittings

a. Size 2” and Smaller

1) Pipe: Carbon Steel, ASTM A53 Grade B - E or S, Schedule Standard

2) Fittings: Cast Iron, Class 125, NPT

3) Unions: Cast Iron, Class 250, NPT

b. Size 2 ½” and Larger

1) Pipe: Carbon Steel, ASTM A53 Grade B - E or S, Schedule Standard

2) Fittings: Carbon Steel, ASTM A234 WPB Seamless, Schedule Standard, Long Radius, Welding

3) Flanges: Forged Steel, Class 150, ASTM A105, ASME/ANSI B16.5, Weld Neck, Raised Face

D. Condensate Gravity Return, Vented

1. Pipe and Fittings

a. Size 2" and Smaller

1) Pipe: Carbon Steel, ASTM A53 Grade B E or S, Schedule 80, Threaded

2) Fittings: Cast Iron, Class 150, NPT

3) Unions: Cast Iron, Class 250, NPT

b. Size 2 ½" and Larger

1) Pipe: Carbon Steel, ASTM A53 Grade B E or S, Schedule 80

2) Fittings: Carbon Steel, ASTM A234 WPB Seamless, Schedule Standard, Long Radius, Welding

3) Flanges: Forged Steel, Class 150, ASTM A105, ASME/ANSI B16.5, Weld Neck, Raised Face

E. Pumped Condensate

Normal Operation: <60 PSIG, < 212F

Worst Case: Same

1. Pipe and Fittings

a. Size 2" and Smaller

1) Pipe: Carbon Steel, ASTM A53 Grade B E or S, Schedule 80, Threaded

2) Fittings: Cast Iron, Class 125, Threaded

3) Unions: Cast Iron, Class 250, Threaded

b. Size 2 ½" and Larger

1) Pipe: Carbon Steel, ASTM A53 Grade B E or S, Schedule 80

2) Fittings: Carbon Steel, ASTM A234 WPB Seamless, Schedule Standard, Long Radius, Welding

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

2.2 JOINING MATERIALS

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

B. Threaded Joints

1. Thread Sealant

a. Paste type, non-hardenening, rated for temperature

F. Flanged Joints

1. Gaskets, All Steam Pressures

1) Spiral wound type

2) Stainless steel with flexible graphite filler material

3) Basis of design: Flexitallic Flexicarb (gray stripe)

[Note to AE: The University has found non-asbestos compressed fiber type gaskets to be inadequate for steam service of any type or pressure. Spiral wound gaskets are required for all steam applications.]

2. Bolts
   a. Hexagonal: ASME B18.2.1
   b. Temperatures less than 400F
      1) Carbon steel, ASTM A307 Grade B
   c. Temperatures 400F – 790F
      2) Alloy steel, ASTM A193 Grade B7
3. Nuts
   a. Hexagonal: ASME B18.2.2
   b. Temperatures less than 400F
      1) Carbon steel, ASTM A194 Grade B
   c. Temperatures 400F – 790F
      1) Carbon Steel, ASTM A194 Grade 2H

G. Welded Joints
1. Materials and Methods: In compliance with Weld Procedure Specifications (WPS)
2. Welding Requirements: In compliance with section below entitled *WELDING.*

2.3 SHUT-OFF VALVES

Notes:

1. Within building systems shut-off valves shall be quarter turn ball or butterfly type. Gate valves within buildings are allowed only for direct replacement of existing gate valves.
2. As stated above, building entrance piping, first valve inside building and associated blowdown and trap isolation valves are considered components of utility system and as such are specified in *Division 33 – Utilities*. Thus it is acceptable for these to be gate valves in sizes 3" and smaller.

[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. High Pressure Steam and Condensate

-- Typically for process systems

1. Size 2" and Smaller, Socket-Weld Forged Steel Wedge Gate Valve
   a. ANSI Class 800
   b. Shut-off class IV, bi-directional
   c. Forged carbon steel body
   d. Socket-welding connections
   e. Bolted bonnet
   f. Outside screw and yoke, rising stem design
   g. 13% chrome steel wedge
   h. Alloy 6 (Stellite) hard-faced seats

i. Renewable seat rings
j. Integral back seat for positive packing chamber isolation
k. Stainless steel gasket with graphite filler
l. Graphite stem packing
m. Spoked hand wheel
n. Approved manufacturers
    1) Bonnie Forge
    2) Hancock
    3) Smith

2. Size 2 ½ and 3", Butt-Weld Cast Steel Wedge Gate Valve
    a. ANSI Class 300
    b. Shut-off class IV, bi-directional
    c. Cast carbon steel body
    d. Butt-welding connections
    e. Outside screw and yoke, rising stem design
    f. 13% chrome steel flexible wedge
    g. Alloy 6 (Stellite) hard-faced seats
    h. Seal-welded seat rings
    i. Integral back seat for positive packing chamber isolation
    j. Stainless steel gasket with graphite filler
    k. Graphite stem packing
    l. Spoked hand wheel
    m. Approved manufacturers
        1) Kitz
        2) Velan
3. Size 4" and Larger, Butt-Weld Triple or Quad Offset Butterfly Valve
    a. ANSI Class 300
    b. API 598 zero leakage shutoff rating, bi-directional
    c. Carbon steel body steel body
    d. Butt-welding connections to match pipe schedule
    e. Carbon steel "floating disk" (i.e. disk not pinned or rigidly attached to shaft)
    f. 316 stainless steel disk rings and body seat
    g. "Torque seated" rather than flexible-seal design
    h. Adjustable graphite shaft packing
    i. Geared rotary hand-wheel operator sized for maximum rim pull of 100 lb.
    j. Approved Manufacturers
        1) Zwick Series Tri-Con
        2) Quadax

3) Xomox Series 9000

4) FlowSeal MS

B. Medium Pressure “Campus Steam” and Condensate

-- Typically for building heating system with no PRV or piping upstream of PRV if existent

1. Size 2 1/2” and Smaller, Threaded Two-Piece Ball Valve
   a. ANSI Class 600
   b. Shut-off class VI, bi-directional
   c. Carbon steel body
   d. NPT connections
   e. 316 stainless steel ball and stem
   f. Blow-out proof stem design
   g. Vented ball
   h. Carbon/graphite reinforced TFM seats
   i. Live-loaded or adjustable graphite stem packing
   j. Latch-lock handle
   k. Extended stem to clear insulation
   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 TFM 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:
      1) Jamesbury
      2) Cameron W-K-M
      3) Xomox

C. Low Pressure Steam and Condensate

-- Typically for heating system downstream of building PRV if existant

1. Size 2 1/2" and Smaller, Threaded Two-Piece Ball Valve
   a. 600 CWP, 150 SWP
   b. Shut-off class VI, bi-directional
   c. Cast bronze body
   d. NPT connections
   e. 316 stainless steel ball
   f. Vented ball
   g. 316 stainless steel stem and nut
   h. Blow-out proof stem design
   i. Reinforced PTFE (RPTFE) seats
   j. Adjustable stem packing
   k. Extended stem to clear insulation
   l. Latch-lock handle
   m. Approved manufacturers
      1) Apollo Series 70-140-64
      2) Nibco T-585-70-66-ST
      3) Milwaukee BA-400S3
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 TFM seats
   f. Disc spacers to center disc in seat
   g. PH-4 stainless steel shaft
   h. Blow-out proof shaft design
   i. Stainless steel backed polymer shaft bearings
   j. Adjustable graphite shaft packing
   k. Geared rotary hand-wheel operator
   l. Approved manufacturers
      1) Jamesbury
      2) Cameron W-K-M
      3) Xomox

D. Pumped Condensate

Normal Operation: <60 PSIG, < 212F

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

a. 2,000 CWP, 150 SWP
b. Shut-off class VI, bi-directional
c. Carbon steel body
d. NPT connections
e. 316 stainless steel ball and stem
f. Blow-out proof stem design
g. Vented ball
h. Reinforced PTFE (RPTFE) seats
i. Adjustable stem packing
j. Extended stem to clear insulation
k. Latch-lock handle
l. Approved manufacturers
1) Apollo Series 73A-140
2) Nibco TC-580-CS-R-25-LL
3) Milwaukee 20CSOR-N1-XLH
4) Jamesbury

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 TFM seats
f. Disc spacers to center disc in seat
g. PH-4 stainless steel shaft
h. Blow-out proof shaft design
i. Stainless steel backed polymer shaft bearings
j. Adjustable graphite shaft packing
k. Geared rotary hand-wheel operator
l. Approved manufacturers
1) Jamesbury
2) Cameron W-K-M
3) Xomox

2.4 GLOBE VALVES

A. High Pressure Steam and Condensate

- Typical application: Warmup line at building entrance valve

1. Size 2" and Smaller, Threaded Forged Steel Globe Valve
a. ANSI Class 800
b. Forged carbon steel body

c. NPT connections
d. Bolted bonnet
e. Outside screw and yoke, rising stem design
f. 13% chrome steel loose solid disc
g. Alloy 6 (Stellite) hard-faced seat
h. Integral back seat for positive packing chamber isolation
i. Approved manufacturers
1) Bonney Forge
2) Hancock
3) Smith

2. Size 2 ½ and 3", Butt-Weld Cast Steel Globe Valve
a. ANSI Class 150
b. Cast carbon steel body
c. Butt-welding connections
d. Outside screw and yoke, rising stem design
e. 13% chrome steel plug
f. Alloy 6 (Stellite) hard-faced seat
g. Seal-welded seat ring
h. Integral back seat for positive packing chamber isolation
i. Stainless steel gasket with graphite filler
j. Graphite stem packing
k. Spoked hand wheel
l. Approved manufacturers
1) Kitz
2) Velan

B. Medium Pressure Steam and Condensate
- Typical application: Manual bypass at control valve
1. Size 2" and Smaller, Cast Bronze Globe Valve
a. ANSI Class 300
b. Cast bronze body
c. Union bonnet
d. NPT connections
e. Renewable stainless steel plug and disc
f. Basis of design: Nibco T-276-AP

2. Size 2 1/2" and Larger, Flanged Cast Iron Globe Valve
a. ANSI Class 250
b. Cast iron body
c. Bolted bonnet

d. Flanged connections
e. Bronze seat and trim
f. Renewable disc and seat
g. Basis of design: Nibco F-768-B

C. Low Pressure Steam and Condensate

1. Size 2” and Smaller, Cast Bronze Globe Valve

a. ANSI Class 150
b. Cast bronze body
c. Union bonnet
d. NPT connections
e. Renewable disc
f. Basis of design: Nibco T-235

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

a. ANSI Class 125
b. Cast iron body
c. Bolted bonnet
d. Flanged connections
e. Bronze trim
f. Renewable disc and seat
g. Basis of design: Nibco F-718-B

2.5 SWING CHECK VALVES

A. High Pressure Steam and Condensate

1. Size 2” and Smaller, Socket-Weld Forged Steel Swing Check

a. ANSI Class 800
b. Forged carbon steel body
c. Socket-welding connections
d. Bolted cover
e. Stainless steel disc
f. Alloy 6 (Stellite) hard-faced seats
g. Renewable seat rings
h. Stainless steel gasket with graphite filler
i. Approved manufacturers

(a) Bonnie Forge
(b) Hancock
(c) Smith

B. Medium Pressure Steam and Condensate

1. Size 2” and Smaller, Threaded Bronze Swing Check

a. ANSI Class 300

b. Cast bronze body
c. NPT connections
d. Renewable disc, regrindable seat
e. Basis of design: Nibco T-473-B

2. Size 2 1/2:" and Larger, Flanged Cast Iron Swing Check
a. ANSI Class 250
b. Cast iron body
c. Bolted bonnet
d. Flanged connections
e. Bronze trim
f. Renewable disc and seat

C. Low Pressure Steam and Condensate

1. Size 2" and Smaller, Threaded Swing Check
a. ANSI Class 150
b. Bronze body
c. NPT connections
d. Renewable disc, regrindable seat
e. Basis of design: Nibco T-433-B

2. Size 2 ½" and Larger, Flanged Cast Iron Swing Check
a. ANSI Class 125
b. Cast iron body and cover
c. Flanged connections
d. Bolted bonnet
e. Bronze trim
f. Renewable disc and seat
g. Basis of design: Nibco F-918-B

2.6 IN-LINE CHECK VALVES – INDUSTRIAL GRADE

- Typical Application: Condensate Pump Discharge

1. "Severe Duty" Check Valves

[Note to AE: It has been the experience of the University that rebuildable "severe duty" check valves are required for steam condensate pump discharge service. When applied to this demanding application standard duty valves fail quickly. Valve failure results in reverse flow of condensate from the central system back through the associated pump and into the receiver. In some cases, condensate is wasted to drain as the receiver overflows. Reverse flow can also cause meter reading inaccuracy. Some meters are incapable of distinguishing forward flow from reverse flow (e.g. nutating disc meters).]

a. Size 2" and Smaller
2) Repairable non-slam spring-loaded design
3) ANSI Class 300
4) Steel or stainless steel body

5) NPT connections
6) 250 degrees F temperature rating
7) Center-guided disc
8) Stainless steel trim and disc
9) Approved Manufacturers
(a) DFT model SCV
(b) Watson McDaniel WSSCV

b. Size 2 ½" and Larger
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
(a) DFT model WLC

2.7 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

1) Union: Viton O-ring
   (a) Color coded to prevent confusion with EPDM
2) Balance: EPDM

l. Insulated piping applications
   1) Valve stem and P/T port extensions
      (a) 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
      1) See section by same name in *23 05 19 Meters and Gauges for HVAC Piping*.
   g. Operating pressure range as determined by application
   h. Insulated piping applications:
      1) Valve stem and P/T port extensions
         (a) Formed metal valve stem extension not acceptable
   i. Basis of Design: Griswold Uni-Flange
   j. Also approved
      (a) IMI Flow design
      (b) Pro-hydronics

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 valves, 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 *National Electric Code*.

E. Anchors, expansion joints, swing joints, expansion loops and guides shall be provided as required to provide/control movement and shall be provided as indicated in project drawings.

F. Piping shall be installed to facilitate insulation.

G. Horizontal steam piping shall be pitched down 1" per 40' in direction of flow.

H. Horizontal condensate piping shall be pitched down 1" per 20' in direction of flow.

I. Eccentric fittings shall be used for changes in pipe size in horizontal lines and shall be oriented with bottom 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. Maximum size of branch shall be two pipe sizes smaller than main.

M. Unless otherwise indicated, branch steam supply piping shall be connected to top or within 45 degrees of top of main.

N. Condensate drip leg shall be provided at each low point, natural drainage points and end of main in piping system for sediment collection and condensate removal. Inverted bucket steam trap shall be provided at each drip leg.

1. Drip leg shall be full pipe size for main size 4" and smaller, 4" minimum for main size 6" and ½ pipe size for main size 8" and larger.

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

1. At branch connections to steam supply mains as indicated on drawings.
2. At supply connections to each unit, device or piece of equipment.
3. At inlet and outlet of each steam control valve or PRV.
4. At inlet and outlet of each steam trap.

P. At a minimum, unions or flanges shall be provided…

1. At each connection to units, devices and equipment.
2. At strainers and other specialties.
3. At equipment or branch side of manual isolation valves.
4. At inlet and outlet of each trap.
5. Where required to facilitate removal of piping sections that interfere with tube pulls or equipment removal.

Q. Horizontal check valve shall be provided at discharge of each steam trap.

R. Test valve shall be provided at outlet of each steam trap. Test valve shall be line-size, ¾" minimum.

3.2 PIPE JOINING

A. All welded and threaded pipe connections shall comply with requirements of *ASME B31.1* and *Section 23 20 00 – Pipe Joining* as applicable.

B. Threaded Joints

1. Tapered NPT threads shall be properly cut on piping at joints.
2. Joint sealant shall be applied.
3. Torque shall be applied to properly seat threads.

C. Flanged Joints

1. Flanges shall be properly aligned with minimal application of force.
2. Gasket shall be properly positioned.
3. Bolts shall be inserted and anti-seize compound applied.

4. Bolts shall be torqued to specified value.

D. Welded Joints

1. See section below entitled *WELDING.*

3.6 WELDING

A. Qualifications

1. All welders and welding procedure specifications (WPS) shall be qualified as set forth in *ASME Boiler and Pressure Vessel Code, Section IX*

a. Welder

1) Prior to performing project welds documentation shall be submitted confirming that each welder has passed required procedure test. Welders shall be qualified as required by *ASME B31.1* or *ASME B31.9* as applicable.

2) Welder qualifications shall be current. If qualification test is more than six months old record of continuity shall be provided indicating welder has performed applicable and approved welding at least every six months since date of qualification test. Record of continuity shall be to satisfaction of AE.

b. Weld Procedure Specifications (WPS)

1) Welding procedure specifications shall be provided for project specific welding methods and materials.

B. Weld Record

1. Procedure for locating, monitoring, recording and maintaining quality of welds shall be submitted to AE for approval.

2. Welder identification shall be provided for each weld. Identification shall consist of pipe stamp and welding record. Requirement for welder identification may be relaxed with written approval of AE.

C. Weld Inspection and Examination

1. All welds in piping and piping components shall be carefully visually examined in accordance with *ASME Standard B31.1* or *ASME B31.9* as applicable.

2. Periodically, as welding progresses, report shall be provided indicating status of project welding quality.

3. AE and Owner shall be provided opportunity to observe all aspects of welding prior to, during and after fabrication to assure that proper welding is provided to Owner's satisfaction. Off-site shop welding shall be included. Additionally, Owner maintains right to obtain independent weld examination.

4. AE and Owner shall retain right to stop in-progress welding work until resolution of any concerns are resolved to Owner's satisfaction. Such shall be at no cost to Owner.

5. Welds in piping and piping components shall be radiographically examined only as indicated in project documents. Radiographic examination shall be in accordance with *ASME B31.1*. Number or percentage of welds to be examined shall be as indicated in project documents. Specific welds to be examined shall be selected by AE. Testing agency shall be approved by AE and Owner.

[Note to AE: Indicate in documents if radiographic inspection is required and how many welds will be inspected in this manner. Specify number of welds to be inspected rather than percentage.]

D. Welding Procedures

1. All welding shall comply with applicable requirements of referenced *ASME* and *AWA* Standards.

2. All fittings shall be factory standard fittings. Fabricated fittings not allowed.
3. Backing rings shall not be used with welded joints.
4. Interior of pipe and fittings shall be thoroughly cleaned prior to and after welding/assembly.
5. Welds shall be built up with stringer-bead pass followed by hot pass, followed by cover or filler pass.
6. Valleys at center or edges of welds not allowed. Unsound or unfused metal, cracks, oxidation, blow hoes or non-metallic inclusions not allowed. Any such imperfections shall be corrected in compliance with referenced standards and to satisfaction of AE and Owner.
7. When hot-tapping, slag, drillings or "cookies" shall be prevented from entering piping system to greatest degree possible. Any material that enters piping shall be removed by use of magnet after drilling or cutting is complete.
8. Each weld shall be painted shortly after completion to prevent corrosion.

3.7 VALVES

A. 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 shaft is oriented horizontally. In no case shall valve be installed such that shaft is oriented vertically downward (i.e. with the actuator 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.

3. Gate and Globe Valves

a. Valve shall be installed with stem oriented vertically upward. In no case shall valve be installed with stem oriented vertically downward.

4. Check Valve

a. Swing check valve shall be installed upright in horizontal or vertical upward orientation.

b. Center-guided and body-guided check valves shall be installed in vertical upward orientation.

B. Valve Insulation

1. Insulated piping applications

a. Valves in insulated piping systems shall have 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 as required to allow operation without disturbing insulation.

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

3.8 INSTRUMENTATION

A. ½" minimum thread-o-let with schedule 80 pipe nipple and ½" minimum ball valve shall be provided at each connection of pressure instrumentation or instrumentation piping to main (e.g. pressure gauge, pressure gauge piping at pump).

3.9 PREOPERATIONAL CLEANING

A. Traps and Strainers

1. All strainer screens in steam and condensate systems shall be temporarily removed.

2. All steam traps shall be temporarily disconnected from steam and condensate supply piping.

B. Hand Cleaning

1. Slag, burrs, solder, thread sealant, etc. shall be physically removed from interior of installed piping system to degree practical as determined by AE and Owner.

C. Steam Supply Piping

1. Manual and automatic control valves shall be moved to open or closed position as appropriate for flushing.

2. Instruments and components vulnerable to damage/fouling shall be protected from contamination by temporarily removing, "valving off", disconnecting from piping, installing bypass piping, installing temporary "pancakes" at flanged connections or other method approved by AE and Owner.

3. All steam supply piping including drip legs and low points shall be filled with clean water and continuously flushed to sanitary drain until effluent is clean to satisfaction of AE and Owner.

4. All steam supply piping shall be energized with live steam after any required reassembly has been accomplished. Supply piping shall be allowed to "cook" for 12 hours minimum while contaminated condensate is safely captured, cooled and conveyed to drain. Process shall include drip legs and other low points in system. Procedure shall be continued until clean condensate is achieved to satisfaction of AE and Owner. Minimum "cook" time may be reduced by AE and Owner if deemed appropriate.

5. Samples of clean fluid shall be drawn by Owner for analysis. Samples shall be drawn from Owner selected sites. 72 hour advance notification shall be provided.

D. Condensate Piping

1. All steam traps shall be disconnected from condensate piping. Steam traps shall be protected from contamination and shall not be cleaned or flushed internally.

2. All condensate piping including low points shall be filled with clean water and continuously flushed to sanitary drain until effluent is clean to satisfaction of AE and Owner.

3. After flushing is complete, condensate return unit receiver(s) shall be flushed to drain until clean.

E. Reassembly

1. Strainer screens shall be reinstalled.

2. Steam traps shall be reconnected.

F. Additional Requirements for Selected Steam Systems

[Note to AE: Identify and specify additional cleaning requirements for selected steam systems as applicable. Abbreviated example follows:]

1. "Steam Blow"
    a. Additional "steam blow" shall be accomplished for critical systems as identified within documents.
    b. Industry standard procedures shall be applied. Project specific scope and requirements shall be as established by AE or Owner.

3.10 INSULATION

A. After leak testing is complete steam and condensate piping shall be insulated in compliance with Section *23 07 19 – HVAC Piping Insulation*.

END OF SECTION 23 22 13

This section of the *U of I Facilities Standards* establishes minimum requirements only.

It should not be used as a complete specification.