SECTION 23 21 00
HYDRONIC PIPING AND VALVES

PART 1 GENERAL

1.1 PURPOSE

A. This guideline is intended to provide useful information to the Professional Service Provider (PSP) to establish a basis of design. PSP is to apply the principles of this section such that the University of Texas at Arlington (UTA) may achieve a level of quality and consistency in the design and construction of their facilities. Deviations from these guidelines must be approved by UTA and may require justification through Life Cycle Cost (LCC) analysis and submitted to UTA for approval.

1.2 LESSONS LEARNED AND DESIGN CONSIDERATIONS

A. When connecting to existing facilities or working in existing facilities all dimensional information will be verified with actual measurements on site. Do not only use as built/design drawings.

B. Campus chilled water supply temperature set point is 42 degrees Fahrenheit. Design chilled water coils for 16 degrees Fahrenheit differential temperature.

C. Campus steam supply leaving the thermal plant is saturated steam at 80 psia and 324 degrees Fahrenheit.

D. When connecting to existing UTA campus utilities the contractor representative and a UTA representative (Usually UTA Engineer) will both verify together the use of each pipe and which pies should be connected to which new piping. This will be recorded by the contractor and signed off by both parties on the same document.

E. All coil control valves will be ball valves. No globe valves will be used.

1.3 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

C. Welder’s Certification: In accordance with ASME Sec. 9. Submit welder’s certifications prior to any shop or field fabrication. Welder’s certifications shall be current within six months of submission.

D. Maintain one copy of each document on site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

PART 2 PRODUCTS

2.1 GENERAL

A. This product section is intended to inform the PSP on the minimum standard of quality that should be incorporated in new designs. The PSP should evaluate these standards and incorporate or make additional

requirements per project specific requirements. Where the PSP considers any requirement listed not to be applicable or incompatible with the project design intent should be discussed with UTA Office of Facilities Management.

2.2 **STEEL PIPING:**

A. Scope: This section applies to all piping systems providing for welded piping, fittings, and other appurtenances. Specific systems requiring welded piping include, but are not limited to: chilled water, hot water, steam, steam condensate, and fire protection systems.

B. Pipe: Building chilled water and heating water piping shall be Standard weight, Grade A or B, black steel pipe conforming in all details to Standard ASTM Designation A135, A106, and A53, latest revisions.

C. Pipe: Campus chilled water piping shall be Standard weight, Grade A or B, black steel pipe conforming in all details to Standard ASTM Designation A135, A106, and A53, latest revisions.

D. Pipe: Steam piping shall be schedule 40, seamless, Grade B, black steel pipe conforming in all details to Standard ASTM Designation A135, A106, and A53, latest revisions.

E. Steam condensate shall be Schedule 80 steel pipe, seamless.

F. Minimum connection size on campus loop piping is 3/4".

G. Fittings:

1. All weld fittings shall be wrought carbon steel butt-welding fittings conforming to ASTM A234 and ASME/ANSI B16.9, latest edition, as made by Weld Bend, Tube Turn, Hackney, or Ladish Company. Attach to only pipe with a hole for the entire length. Each fitting shall be stamped as specified by ASME/ANSI B16.9 and, in addition, shall have the laboratory control number metal stenciled on each fitting for ready reference as to physical properties required for any fittings selected at random. Each fitting is to be marked in accordance with MSS SP-25. Markings shall be placed on the fittings at the farthest point from the edge to be welded to prevent disfiguring from the welding process. Submittal data for these fittings shall include a letter signed by an official of the manufacturing firm certifying compliance with these specifications.
2. All screwed pattern fittings specifically called for shall be Class 150 malleable iron fittings of Grinnell Company, Crane Company or Walworth Company manufacture (300 lb. for unions).

H. FABRICATION:

1. Refer to Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
2. Campus heating water and campus chilled water welded piping and fittings shall be fabricated in accordance with ASME/ANSI the latest edition of Standard B31.1 for Power Piping. Machine beveling in shop is preferred. Field beveling may be done by flame cutting to recognized standards.
3. Ensure complete penetration of deposited metal with base metal. Contractor shall provide filler metal suitable for use with base metal. Contractor shall keep inside of fittings free from globules of weld metal. All welded pipe joints shall be made by the fusion welding process, employing a metallic arc or gas welding process. All pipe shall have the ends beveled 37-1/2 degrees and all joints shall be aligned true before welding. Except as specified otherwise, all changes in direction, intersection of lines, reduction in pipe size and the like shall be made with factory-fabricated welding fittings. Mitering of pipe to form elbows, notching of straight runs to form tees, or any similar construction will not be permitted.
4. Align piping and equipment so that no part is offset more than 1/16 inch. Set all fittings and joints square and true, and preserve alignment during welding operation. Use of alignment rods inside pipe is prohibited.
5. Do not permit any weld to project within the pipe so as to restrict it. Tack welds, if used, must be of the same material and made by the same procedure as the completed weld. Otherwise, remove tack welds during welding operation.
6. Do not split, bend, flatten or otherwise damage piping before, during or after installation.

7. Remove dirt, scale and other foreign matter from the inside of piping, by swabbing or flushing, prior to the connection of other piping sections, fittings, valves or equipment.
8. In no cases shall Schedule 40 pipe be welded with less than three passes including one stringer/root, one filler and one lacer. Schedule 80 pipe shall be welded with not less than four passes including one stringer/root, two filler and one lacer. In all cases, however, the weld must be filled before the cap weld is added.
9. Procedure of Assembling Screw Pipe Fittings: All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.

I. WELD TESTING:
1. All welds are subject to inspection, visual and/or X-ray, for compliance with specifications. The owner will, at the owner's option, provide employees or employ a testing laboratory for the purposes of performing said inspections and/or X-ray testing. Initial visual and X-ray inspections will be provided by the owner. The contractor shall be responsible for all labor, material and travel expenses involved in the re-inspection and re-testing of any welds found to be unacceptable. In addition, the contractor shall be responsible for the costs involved in any and all additional testing required or recommended by ASME/ANSI Standards B31.1, B31.9, and B31.3 due to the discovery of poor, unacceptable, or rejected welds.
2. Welds lacking penetration, containing excessive porosity or cracks, or are found to be unacceptable for any reason, must be removed and replaced with an original quality weld as specified herein. All qualifying tests, welding and stress relieving procedures shall, moreover, be in accord with Standard Qualification for Welding Procedures, Welders and Welding Operators, Appendix A, Section 6 of the Code, current edition.

2.3 COPPER PIPE

A. No pipe or fittings smaller than 3/4" is to be used for this project unless shown on plans or details for local connections.

B. Copper Pipe: Piping four inches (4") to 2-1/2" shall be fabricated of Type L, hard drawn, copper pipe made of deoxidized copper (99.9% pure). This Type L copper pipe shall conform in every detail to ASTM Standard Specifications for COPPER WATER TUBE, latest edition B-88, and it shall be provided in 20-foot straight lengths. Copper pipe 4" and smaller may only be joined using non-lead-bearing solder, such as 95-5 silver or antimony solder (95 percent tin, and 5 percent silver or antimony). Copper pipe 4" and larger may be joined using roll grooved fittings.

C. Fittings: All fittings for four inch (4") to 2-1/2" water lines shall be Streamline Solder Fittings manufactured by Streamline Pipe and Fittings Division, Mueller Brass Company, or approved equal. These wrought copper fittings shall be rigid and strong with openings machined to accurate capillary fit for the pipe.

D. Mechanical Connected Pipe (Viega ProPress only); Pipe two inches (4") to 3/4 inches.
1. Copper Tube: ASTM B88, Type L (B), Drawn (H).
2. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze, mechanical press sealed, EPDM non-toxic synthetic rubber sealing element.
3. Joints: Mechanical press seal, EPDM non-toxic synthetic rubber sealing element.

E. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then ALL of the installed equipment and material, which may have come in contact with the lead, shall be

marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and reinstalled using ALL NEW MATERIALS.

2.4 CAMPUS CHILLED WATER AND STEAM CONDENSATE RETURN SYSTEM PIPING UNDERGROUND

A. **The system shall be FERRO-THERM as manufactured by Thermacor Process Inc. of Fort Worth, Texas.**

B. The carrier pipe and fittings shall be a PE3408 High Density Polyethylene (HDPE) pipe and comply with the requirements of ASTM D1248, ASTM 3350, AWWA C901 (2" through 3"). AWWA C906 (4" through 63"), and NSF Standards 14 and 61. Materials used in the manufacture of HDPE pipe and fittings shall have the following minimum physical properties:

1. Property Test Method Value
2. Cell Classification ASTM D3350 345434C
3. Density ASTM D1505 0.955 gm/cc
4. Flexural Modulus ASTM D790 136,000 psi
5. Tensile Strength @ Yield ASTM D638 3,500 psi
6. Elastic Modulus ASTM D638 125,000 psi
7. Brittleness Temperature ASTM D746 < -180 °F
8. Melting Point ASTM D789 260° F
9. Hardness ASTM D2240 Shore D 64
10. Impact Strength (IZOD) ASTM D256 42 in.-lb/in.

C. The outside diameter and minimum wall thickness shall be manufactured to Ductile Iron Pipe sizes and have a Standard Dimension Ratio (SDR) of 11 and a pressure rating of 160psi (Class 160).

D. All fittings shall be pressure rated to match the system piping to which they are joined. At the point of fusion, the outside diameter and minimum wall thickness of the fitting shall meet the outside diameter and minimum wall thickness specification of AWWA C901/C906 for the same size pipe. All fittings shall be properly rated and clearly labeled. The fitting manufacturer shall be the same as the pipe manufacturer. Molded fitting shall be made from P3408 and have fusion capability with the pipe. Fitting shall meet the requirements of the ASTM D3261 for the butt-type fittings.

E. Pipe and fittings shall be joined by thermal butt fusion, flange assemblies or mechanical methods in accordance with the manufacturer's recommendations and the requirements of AWWA C901/C906.

F. The HDPE pipe supplier shall provide the fusion equipment necessary for connecting the pipe and fittings.

G. Pipe and fittings shall be marked with the manufacturer, date of manufacture, lot lot number, size, PE code, pressure class, SDR#, AWWA designation number, and other information as described in AWWA C901/C906.

H. Expansion/contraction compensation will be accomplished utilizing factory pre-fabricated and pre-insulated expansion elbows, Z-bends, expansion loops, and anchors specifically designed for the intended application. External expansion compensation utilizing flexible expansion pads (minimum one inch thickness), extending on either side, both inside and outside the radius of the fittings are used with all fittings having expansion in excess of 1/2".

I. Carrier pipe shall be hydrostatically tested to 150 psig, or 1½ times the operating pressure, whichever is greater. After testing of the carrier pipe, all field joints shall be insulated, with kits provided by the pre-insulated pipe manufacturer. Field insulation of fittings shall not be acceptable. Field joint insulation shall be applied only in straight sections by pour foam in situ, using molds furnished by the system manufacturer. Field joint insulation surface shall be sealed with a heat shrinkable sleeve.

J. Underground systems shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill placed over the top of the pipe will meet H-20 highway loading.

K. Underground piping shall be bedded in compacted clean sand, in 6" layers, or fine gravel 8" under,

around and 6" over pipe. Cover with densely compacted select stabilized backfill. Piping trenches within 8'-0" from building shall not have pea gravel or sand but shall be selected backfill densely compacted and stabilized as specified elsewhere.

2.5 **CAMPUS STEAM PIPING UNDERGROUND**

B. The system shall be Duo-Therm "505" as manufactured by Thermacor Process Inc. of Fort Worth, Texas.

C. Pre-insulated Piping - Furnish a complete system of factory pre-insulated steel piping for the specified service. The system shall be a combination of a drainable, dryable, testable type conduit system, suitable for all ground water and soil conditions, site Classification "A" (Federal Construction Guide Spec. 02695), with an external covering of polyurethane insulation and an HDPE jacket. The system shall be provided as specified below and shown on the drawings.

D. The pre-insulated pipe manufacturer shall make a complete layout of the system showing anchors, expansion provisions, and building entrance details. Means for expansion must be made in pipe offsets or loops unless this is compensated for integrally in the system.

E. The conduit shall be 10-gauge, welded, smooth-wall black steel conforming to ASTM A-211, A-139, A-134, and A-135. Conduit shall be tested at the factory to insure air and watertight welds prior to any fabrication or application of coating. No internal coating of conduit

F. Conduit closures shall be 10-gauge steel, furnished with the conduit at a ratio of one closure for each fabricated item or length. Closures shall be field welded over adjacent units after pipe insulation.

G. Piping in the conduit shall be standard weight (Std. Wt. is the same as Sch. 40 through 10"), steel, ASTM A-53, Grade B, ERW. Steam lines shall be standard weight and Condensate lines shall be extra strong (XS is the same as Sch. 80 through 8"). Pipe joints shall be welded in accordance with the Pressure Piping Code, ASME/ ANSI B 31.1.

H. The Class "A" pipe insulation shall be mineral wool applied to the thickness based on Section 23 0719, Piping Insulation, paragraph 3.05 Insulation 'R' Value Schedule.

I. Pre-fabricated ells, loops, and tees shall be furnished and installed where shown on plans and shall consist of pipe, insulation, and conduit conforming to the same specification as hereinbefore stated for straight runs. Expansion loops shall be designed in accordance with the stress limits as dictated by the Power Piping Code, ASME/ ANSI B31.1. Loop piping shall be installed in conduit suitably sized to handle indicated pipe movement.

J. Terminal ends of conduits inside manholes, pits, or building walls shall be equipped with end seals consisting of a 1/2" steel plate welded to the pipe and conduit. End seals shall be equipped with drain and vent openings. Terminate all conduits 2" beyond the inside face of manhole or building walls.

K. Pre-fabricated anchors shall be furnished and installed where shown on plans and shall consist of a steel plate, welded to pipe and conduit. The steel anchor plate shall be 1/2" thick and shall be 1-1/2" larger horizontally and 1-1/2" larger vertically than the HDPE jacket outer diameter. Heat shrink wrap shall be used seal the overlap of anchor water shed over the HDPE jacket.

L. A concrete thrust block shall be cast over the anchor plate and conduit, large enough for firm anchorage into undisturbed trench sidewalls and/ or bottom. The concrete block shall be at least 36" in length and extend a minimum of 12" beyond the top and bottom of the anchor plate.

M. Wall sleeves with leak plates shall be provided at all building and manhole entries to provide an effective moisture barrier. The space between the conduit and wall sleeve shall be made watertight by use of Link-Seal® pipe penetration seals or equal assemblies, which will also provide electrical isolation.

N. The steel conduit for the steam and condensate shall be insulated with polyurethane foam insulation to a minimum thickness of 1". Insulation shall be rigid, 90% closed cell polyurethane with a minimum 2.4 lbs. per cubic foot density, compressive strength of 30 psi @ 75°F, and coefficient of thermal conductivity (K factor) not higher than .16 @ 75°F per ASTM C518. Maximum conduit interface

temperature shall not exceed 212°F.

O. Jacketing material shall be extruded, black, high density polyethylene (HDPE), having a minimum wall thickness of 200 mils. The inner surface of the HDPE jacket shall be oxidized by means of corona treatment, flame treatment (patent pending), or other approved methods. This will ensure a secure bond between the jacket and foam insulation preventing any ingression of water at the jacket/ foam interface.

P. Straight run joints are insulated using a wrap around HDPE jacket placed over the field joint and insulated with polyurethane foam. The HDPE jacket is sealed with a heat shrink sleeve, as recommended by the manufacturer.

Q. Conduit fittings are factory pre-fabricated and pre-insulated with urethane to the thickness specified and jacketed with a molded, extrusion welded, or butt fusion welded PE jacket. NO TAPING OR HOT AIR WELDING SHALL BE ALLOWED.

R. The installing contractor shall be responsible to excavate, string conduit, weld test, place in trench, backfill, or otherwise treat and install the system as per the specifications and the directions furnished by the manufacturer and approved by the design engineer in accordance with plans and specifications.

S. The conduit shall be air tested at 15 psi. Test pressure shall be held for two hours. Repair any conduit leaks and retest prior to making joint closures.

T. Pre-engineered systems shall be provided with all straight pipe and fittings factory pre-insulated and pre-fabricated to job dimensions.

U. Underground systems shall be buried in a trench not less than two feet deeper than the top of the pipe and not less than eighteen inches wider than the combined O.D. of all piping systems. A minimum thickness of 24 inches of compacted backfill placed over the top of the pipe will meet H-20 highway loading.

V. Trench bottom shall have a minimum of 6” of sand, pea gravel, or specified backfill as a cushion for the piping. All field cutting of the pipe shall be performed in accordance with the manufacturer’s installation instructions.

W. A hydrostatic pressure test of the carrier pipe shall be performed per the engineer’s specification with a factory recommendation of one and one-half times the normal system operating pressure for not less than two hours. Care shall be taken to insure all trapped air is removed from the system prior to the test. Appropriate safety precautions shall be taken to guard against possible injury to personnel in the event of a failure.

2.6 **VALVES:**

B. All valves shall be located such that the removal of their bonnets is possible. All flanged valves shown in horizontal lines with the valve stem in a horizontal position shall be positioned so that the valve stem is inclined one bolt hole above the horizontal position. Screw pattern valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. All valves must be true and straight at the time the system is tested and inspected for final acceptance. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings. All valves must be of threaded or flanged type. No solder connected or grooved fitting valves shall be used on this project. Allbronze and iron body gate and globe valves shall be the product of one manufacture for each project. Manufacturers of other types may not be mixed on the same project; i.e., all butterfly valves shall be of the same manufacture, all ball valves shall be of the same manufacture, etc.

C. All valves used in circulating systems, plumbing and steam systems (low and medium pressure) shall be Class 150 SWP. Class 300 valves shall be constructed of all ASTM B-61 composition. All gate, globe and angle valves shall be union bonnet design. Metal used in the stems of all bronze gate, globe and angle valves shall conform to ASTM B371 Alloy 694, ASTM B99 Alloy 651, or other corrosion resistant equivalents. Written approvals must be secured for the use of alternative materials. Alloys used in all bronze ball, gate, globe, check, or angle valves shall contain no more than 15% zinc. No yellow brass valves will be allowed.

D. All iron body valves shall have the pressure containing parts constructed of ASTM designated of 126 class B iron. Stem material shall meet ASTM B16 Alloy 360 or ASTM 371 Alloy 876 silicon bronze or its equivalent. Gates and globes shall be bolted bonnet with OS&Y (outside screw and yoke) and rising stem design. A lubrication fitting is preferred on yoke cap for maintenance lubrication of the yoke bushing.

E. All cast steel body valves shall have the pressure containing parts constructed of ASTM designation A-216-GR-WCB carbon steel. Gate and globe valves shall be bolted bonnet outside and screw and yoke design with pressure-temperature rating conforming to ANSI B16-34-1977. Stems shall meet ASTM designation A-186-F6 chromium stainless steel. Wedge (gate valves) may be solid or flexible type and shall meet ASTM A-182-F6 chromium stainless steel on valves from 2" to 6". Sizes 8" and larger may be A-216-WCB with forged
rings or overlay equal to 182-F6. Seat ring shall be hard faced carbon steel or 13% chromium A-182-F6 stainless. Handwheels shall be A47 Grade 35018 malleable iron or Ductile Iron ASTM A536.

F. All forged steel body valves shall have the pressure containing parts constructed of ASTM 105, Grade 2 forged carbon steel. Seat and wedges shall meet ASTM A-182-F6 chromium stainless steel. Seat rings shall be hard faced. Valves shall conform to ANSI B16-34
pressure-temperature rating.

G. All valves shall be repackable, under pressure, with the valve in the full open position. All gate valves, globe valves, angle valves and shutoff valves of every character shall have malleable iron hand wheels, except iron body valves 2-1/2" and larger which may have either malleable iron or ASTM A-126 Class B, gray iron hand wheels.

H. Packing for all valves shall be free of asbestos fibers and selected for the pressure-temperature service of the valve. It is incumbent upon the manufacturer to select the best quality, standard packing for the intended valve service. At the end of one year, period spot checks will be made, and should the packing show signs of hardening or causing stem corrosion then all valves supplied by the manufacturer shall be repacked by the Contractor, at no expense to the Owner, with a packing material selected by the Owner.

I. Valves 12" and larger located with stem in horizontal position shall be drilled and tapped in accordance with MSS-SP-45 to accommodate a drain valve and equalizing by-pass valve assembly.

J. Balancing and/or Shutoff Valves for Hot Water Systems: Two inches and smaller, three piece full port bronze body ball valve, stainless steel ball and stem. Teflon seats, packing and gasket, bronze gland follower, adjustable stuffing box, steel lever type handle, with plastic sheathed operating handle, adjustable memory stops, and shall be class 150 SWP/600 WOG, screwed pattern. Manufacturer shall certify ball valves for use in throttling service. Stem extensions shall be furnished for use in insulated lines. Cold water service valves shall be as above,
except two piece construction. All valves 2 1/2" and larger shall be tapped full lug butterfly valves with aluminum bronze discs of ASTM B148 Alloy C955 and 316, 416, or 420 stainless steel shafts. Design must incorporate bushing between shafts and body of material suitable to provide a bearing surface to eliminate seizing or galling. Valve must be capable of providing a bubble tight seal at 200 psi for valves up to 12" (150 psi for larger valves) when used for end of

line service without requiring the installation of a blind flange on the downstream side. Liners shall be resilient material suitable for 225 °F temperature and bodies of ductile iron. Butterfly valves 8" and larger and butterfly valves used for balancing service, regardless of size, shall have heavy duty weather proof encased gear operators, with malleable iron handwheel or crank. Valves 2 1/2" through 6" shall have lever handles which can be set in interim positions
between full open and full closed. All butterfly valves shall be absolutely tight against a pressure differential of 150 psi.

K. Check Valves for Water Systems: Bronze body, 2" and smaller, bronze body regrinding disc and seat with screw-in cap. Iron body, 2 1/2" and larger, bronze disc and seat or non slam wafer type with stainless pins and springs, and bronze plate. Forged steel lift check valves, 2" and smaller shall be bolted cap and body, screwed end connections and conform to ANSI B16.34 and pressure temperature rating.

L. Standards of Quality for Valves:
   1. Valves 8” and larger, and valves used for balancing service regardless of size, shall have heavy-duty weatherproof encased gear operator.
   2. 2" & Smaller Gate Valve
      a. Use: L.P. Steam
      b. Class: 150
      c. Model Numbers
         1) Milwaukee 1151
         2) Nibco T-134
         3) Stockham B-105
      d. Class: 300
         1) Milwaukee 1186
         2) Nibco T-174SS
         3) Stockham B-145
   3. 2-1/2" & Larger Gate Valve
      a. Use: L.P. Steam
      b. Class: 125
      c. Model Numbers
         1) Milwaukee F-2885
         2) Nibco F-617-0
         3) Stockham G-623
      d. Class: 150
      e. Model Numbers
         1) Milwaukee 1550CB2
   4. 2" & Smaller Ball Valve for Shut-off
      a. Use: Re-circulating Chilled Water
      b. Requires extended stems in insulation lines with adjustable memory stops.
      c. Class: 150
      d. Model Numbers
         1) Nibco T-585-70
         1) Apollo 77-100
         2) Milwaukee BA400S
   5. 2" & Smaller Ball Valve
      a. Use: Re-circulating Heating Water
      b. Requires extended stems in insulation lines with adjustable memory stops.
      c. Class: 150
      d. Model Numbers
         1) Nibco T-585-Y-66
         2) Apollo 77-140
         3) Milwaukee BA400
   6. 2" & Smaller Globe, Angle & Balancing Valve
      a. Use: Chilled Water, L.P. Steam
      b. Class: 150
      c. Model Numbers
         1) Milwaukee 590T
         2) Nibco T-235
         3) Stockham B-22
   7. 2-1/2" & Larger Globe, Angle & Balancing Valve
      a. Use: Chilled Water, L.P. Steam
      b. Class: 125
      c. Model Numbers
         1) Milwaukee F-2981

2) Nibco F-718-B
3) Stockham G-514-T

8. 2-1/2" & Larger Butterfly Valve for Shutoff
   a. Use: Re-circulating Chilled and Heating Water
   b. Class: 150
   c. Model Numbers
      1) Milwaukee ML233
      2) Nibco LD2000
      3) DeZurik 632,L,D,RS66,6
9. 2-1/2" & Larger Butterfly Valve for Shutoff
   a. Use: Re-circulating Chilled and Heating Water
   b. Class: 150
   c. Model Numbers
      1) Milwaukee ML333
      2) Nibco LD2000
10. 2" & Smaller Check Valve
   a. Use: All Water Systems
   b. Class: 150
   c. Model Numbers
      1) Milwaukee 510
      2) Nibco T-433
      3) Stockham B-345
11. 2-1/2" & Larger Check Valve
   a. Use: All Water Systems
   b. Class: 150
   c. Model Numbers
      1) Milwaukee 1400 Series
      2) Nibco W-920-W
      3) Stockham 'Duo-Check'
12. 2" & Smaller Globe Valve
   a. Use: Primary Hot Water
   b. Class: 300
   c. Model Numbers
      1) Milwaukee 572
      2) Nibco T-276-AP
      3) Stockham B-74
13. 2-1/2" & Larger Globe Valve
   a. Use: Primary Hot Water
   b. Class: 300
   c. Model Numbers
      1) Milwaukee F-2983-M
      2) Nibco F-768-B
14. 2" & Larger Gate Valve
   a. Use: High Pressure Steam
   b. Class: 300
   c. Model Numbers
      1) Stockham 30-OF
      2) Milwaukee 3050CB2

2.7 UNIONS:

B. Provide and install unions at proper points to permit removal of pipe and various equipment and machinery items without injury to other parts of the system. No unions will be required in welded lines or lines assembled with solder joint fittings except at equipment items, machinery items and other

special pieces of apparatus. Unions in 2" and smaller in ferrous lines shall be Class 300 AAR malleable iron unions with iron to brass seats, and 2 1/2" and larger shall be ground flange unions. Unions in copper lines shall be Class 125 ground joint brass unions or Class 150 brass flanges if required by the mating item of equipment. Companion flanges on lines at various items of equipment, machines and pieces of apparatus shall serve as unions to permit removal of the particular items. See particular Specifications for special fittings and pressure.

C. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to Epco.

D. In all water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

2.8 FLANGES:

B. All 150 lb. and 300 lb. ANSI flanges shall be weld neck and shall be forged carbon steel, conforming to ANSI B16.5 and ASTM A-181 Grade I or II or A-105-71 as made by Tube Turn, Hackney or Ladish Company. Slip on flanges shall not be used. Each fitting shall be stamped as specified by ANSI B16.9 and, in addition, shall have the laboratory control number stenciled on each fitting for ready reference as to physical properties and chemical composition of the material. Complete test reports may be required for any fitting selected at random. Flanges shall have the manufacturer's trademark permanently identified in accordance with MSS SP-25. Contractor shall submit data for firm certifying compliance with these Specifications. Bolts used shall be carbon steel bolts with semi-finished hexagon nuts of American Standard Heavy dimensions. Allthread rods will not be an acceptable for flange bolts. Steam system flange bolts shall have a tensile strength of 105,000 psi and an elastic limit of 81,000 psi and rated at least ANSI Grade V. Other bolts shall have a tensile strength of 80,000 psi and an elastic limit of 36,000 psi and rated at least ANSI Grade I.

C. Flat faced flanges shall be furnished to match 125 lb cast iron flanges on pumps, check valves, strainers, etc. with full flange gaskets. Bolting of raised face flanges to flat faced flanges is not allowed.

D. FLANGE GASKETS

1. Gaskets shall be placed between the flanges of all flanged joints.
2. Gaskets for steam piping - All steam flange joints shall use Flexitallic Class 150 spiral wound for low pressure applications and Flexitallic Class 300 spiral wound gaskets for medium or high pressure applications. Raised and flat face flange gaskets shall be Flexitallic compression gauge (CG) style. External ring shall be Type 304 stainless steel and color coded yellow. Filler material shall be Flexite Super and color coded with pink stripe. Equivalents may be submitted with all design data so that an evaluation of the gasket can be made.
3. Gaskets for all other applications: Gaskets shall be ring form gaskets fitting within the bolt circle of their respective flanges. Gaskets shall be 1/16” thick asbestos free material recommended for service by Anchor, Garlock, or John Crane. The inside diameter of such gaskets shall conform to the nominal pipe size and the outside diameter shall be such that the gasket extends outward to the studs or bolts employed in the flanged joint.
4. Spares - Contractor shall provide ten spares for every flange size and rating.

E. Flange Bolt Installation:

1. Bolt Lubrication: Bolts shall be well lubricated with a heavy graphite and oil mixture.

Nominal Bolt Diameter (Inch)	Torque (Ft-Lbs)
0.25	6
0.3125	12
0.375	18
0.4375	30
0.5	45

0.5625	68
0.625	90
0.75	150
0.875	240
1.0	368
1.125	533
1.25	750
1.375	1020
1.5	1200

2. Torque shall be checked with a calibrated breaking action torque wrench on the final torque round. Bolts shall be cold and hot torqued.
3. Torque Pattern - Shall be a cross or star pattern with at least four passes. Limit each pass to 30% of full torque increases.
4. Hot Torque - Re-torque the flange bolts with system at normal operating pressure and temperature for at least four hours.
5. Inspection - Owner shall verify hot torquing of all medium and high pressure steam flange bolts.

PART 3 EXECUTION.

3.1 **PREPARATION**

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 **INSTALLATION**

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Route piping in orderly manner and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Provide clearance for installation of insulation and access to valves and fittings.

G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

I. Provide support for utility meters in accordance with requirements of utility companies.

J. Install bell and spigot pipe with bell end upstream.

K. Install valves with stems upright or horizontal, not inverted.

3.3 **ERECTION TOLERANCES**

A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.

B. Slope water piping and arrange to drain at low points.

END OF SECTION 23 21 00