

**SECTION 15106**  
**CHILLED WATER, CONDENSER WATER, COOLING TOWER WATER, HEATING HOT WATER**  
**CONDENSATE and PROCESS WATER PIPING, INCLUDING HYDRONIC SPECIALTIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawing and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

**1.2 SUMMARY**

- A. This section includes the following piping system materials:
  - 1. Chilled Water Supply and Return (CHWS, CHWR): Piping systems for chilled water service with 150°F (66°C) maximum temperature and 150-psig maximum pressure.
  - 2. Heating Water Supply and Return (HWS, HWR): Piping system for heating hot water service with 250°F (107°C) maximum temperature and 150-psig maximum pressure.
  - 3. Condensate (condensation) drainage water from cooling coil drain pans (PD) above grade and within buildings: Piping systems for condensate drain service with 77°F (25°C) maximum temperature and 15-psig maximum pressure.
  - 4. Process Water (PW) (Not-Potable Water): Piping systems for process water service with 150°F (66°C) maximum temperature and 150-psig maximum pressure.
  - 5. Hydronic specialties: Backpressure/Relief Regulator, Pressure reducing valves, Automatic air vent, Expansion Tanks, Air separators with strainer, By-pass chemical feeders, In-line Strainers and Flexible connectors.
- B. This Section also includes Chilled Water Supply and Return (CHWS & CHWR), Condensate Drain (COND) piping materials and related isolation valve restrictions when installed in the LINAC Tunnel.
- C. Related Sections:
  - 1. Division 2, Section 02222, Excavation for Utilities
  - 2. Division 2, Section 02667, Water Lines
  - 3. Division 7, Section 07841, Through-Penetration Firestop System
  - 4. Division 15, Section 15050, Piping Systems
  - 5. Division 15, Section 15072, Cleaning
  - 6. Division 15, Section 15073, Pressure/Leak Testing
  - 7. Division 15, Section 15074, Identification and Labeling.
  - 8. Division 15, Section 15100, Valves
  - 9. Division 15, Section 15250, Mechanical Insulation
  - 10. Division 18, Section 18100, General Welding Requirements

**1.3 REFERENCES**

- 1. American Society of Mechanical Engineers (ASME)
- 2. ASME B1.1-89, Unified Inch Screw Threads (UN & UNR Thread Form)
- 3. ASME B16. 1-98, Cast Iron Pipe Flanges and Flanged Fittings.
- 4. ASME B16.3-99, Malleable Iron Threaded Fittings Classes 150 and 300 (1985).
- 5. ASME B16.5-96, Pipe Flanges and Flanged Fittings; Addenda B16.5A-92.
- 6. ASME B16.9-93, Factory-Made Wrought Steel Buttwelding Fittings.
- 7. ASME B16.11-96, Forged Fittings, Socket-Welding and Threaded.
- 8. ASME B16.21-92, Nonmetallic Flat Gaskets for Pipe Flanges.
- 9. ASME B16.39-98, Malleable Iron Threaded Pipe Unions Classes 150, 250 and 300.
- 10. ASME B31.3-99, Chemical Plant and Petroleum Refinery Piping.
- 11. ASME B31.9-96, Building Services Piping.

12. ASME B36.10M-96, Welded and Seamless Wrought Steel Pipe.
- B. American National Standards Institute (ANSI)
1. ANSI B1.20.1-83, Pipe Threads, General Purpose (inch)
- C. American Society for Testing and Materials (ASTM)
1. ASTM A53-00, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  2. ASTM A105-00, Standard Specification for Carbon Steel Forgings for Piping Applications
  3. ASTM A126-95e1, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  4. ASTM A134-96, Standard Specification for Pipe, Steel, Electric-Fusion (Arc)-Welded (Sizes NPS 16 and over).
  5. ASTM A181-00, Standard Specification for Forgings, Carbon Steel, for General Purpose Piping.
  6. ASTM A197-00, Standard Specification for Cupola Malleable Iron (R 1992).
  7. ASTM A234-00, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
  8. ASTM A-269-66, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing – General Service.
  9. ASTM A307-00, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
  10. ASTM A563-00, Standard Specification for Carbon and Alloy Steel Nuts.
  11. ASTM D2000-00, Standard Classification System for Rubber Products in Automotive Applications (SAE Recommended Practice J200).
  12. ASTM F104-00, Standard Classification System for Nonmetallic Gasket Materials.
- D. American Water Works Association (AWWA)
1. AWWA C200-91, Steel Water Pipe – 6 in. (150 mm) and Larger.
  2. AWWA C207-86, Standard for Steel Pipe Flanges for Waterworks Service – Sizes 4 in. through 144 in.
  3. AWWA C208-83, Dimensions for Fabricated Steel Water Pipe Fittings.
- E. Federal Standard (FS)
1. FS WW-U-531, Class 1, Pressure requirements of soldered joints.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves. See section 15100.
- B. Submit six (6) copies of the following to the Construction Manager:
1. Design Data: Indicate in sufficient detail to verify that products meet or exceed specified performance requirements.
  2. Certificates: Indicate in sufficient detail to verify that products do meet (or exceed) specified requirements.
  3. Manufacturer's Instructions: Indicate installation and support requirements.
  4. Shop drawings: Provide large-scale (Scale of  $\frac{1}{4}$ " = 1'-0" minimum) layout drawings, indicating all relevant equipment associated with routing of piping. Shop drawings shall be "spool" type that includes all piping connection joints, fittings, hangers, supports required and relevant details as required. Detail location of anchors, alignment guides, and expansion joints and loops.
  5. Shop drawings as described in Paragraph 2.1.B and 2.1.C for piping underground and exterior to buildings.

6. Coordination Drawings: As required in Section 15050, paragraph 1.5.D. Include relationship to other services that serve same work areas.
  7. Certificates of Shop Inspection and Data Report: As required by ASME Boiler and Pressure Vessel Code.
  8. Maintenance Data: For equipment to include in the maintenance manuals as specified in General and Supplementary Conditions.
- C. Welding Certificates: As required in Section 18100.
- D. Field Test Reports: Provide written reports of tests specified in Part 3 of this Section.
- E. Report shall include the following:
1. Summary of "holiday" test results.
  2. Test procedures used.
  3. Test results that comply with requirements.
  4. Failed test results and corrective action taken to achieve requirements.
- F. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in General and Supplementary Conditions.

## 1.5 QUALITY ASSURANCE

- A. Welding: As required in Section 18100.
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

## 1.6 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related Sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

## PART 2 - PRODUCTS

### 2.1 PIPING, FITTINGS, AND ACCESSORIES

- A. For the following services: Chilled water (CHWS, CHWR), Condenser Water (CNDS, CNDR), Tower Water (TWS, TWR), Process Water (PW), and Heating Water (HWS, HWR) above grade and within buildings, provide piping materials as follows:
1. Sizes ½ to 1½ inches: Piping materials and dimensions shall conform to ASME B31.9.
    - a. ASTM A53 Grade A or B, CW (Continuously Welded), Schedule 40 black steel, or
    - b. ASTM A106 Grade B, Seamless, Schedule 40 black steel, or
    - c. ASTM B 88, Type L, Hard drawn copper tubing, or

- d. "Victaulic", "Vic-Press 304", Stainless Steel piping with 0.049" wall thickness.
  2. Sizes 2 to 4 inches: Materials and dimensions shall conform to ASME B31.9.
    - a. ASTM A 53 Grade A or B, ERW, or Seamless, Schedule 40 black steel, or
    - b. ASTM B 88 Type L, Hard drawn copper tubing.
    - c. 2" only: "Victaulic", "Vic-Press 304", Stainless Steel piping with 0.049" wall thickness.
  3. Sizes 6 to 10 inches: Steel, ASTM A53 Grade A or B, ERW or seamless, ASME B36.10, Schedule 40.
  4. Sizes 12 to 24 inches: Steel, ASTM A53 Grade A or B, ERW or seamless, ASME B36.10, Standard weight for size designated.
  5. Sizes 30 inches and larger: Steel, ASTM A106 Grade A or B, ERW or seamless, ASME B36.10, Standard weight for size designated.
- B. Cooling Tower water (TWS, TWR), Chilled water (CHWR), and Condenser water (CNDS, CNDR) piping underground:
1. Piping for sizes up to 10 inches to be ASTM A53 (up to 24") and A106 (for 30" and above) Grade A or B Schedule 40 carbon steel in accordance with ASME B31.9, with factory applied protective coating. Piping 12-inches and larger may be standard weight, in accordance with ASME B31.9, with factory applied protective coating .
  2. Piping shall be a factory prefabricated system. All straight sections, fittings and other accessories shall be factory prefabricated to job dimensions and designed to minimize the number of field connections.
  3. Contractor fabricated systems, whether fabricated on site or off site, shall not be acceptable.
  4. Trained facility representatives of the piping supplier shall provide technical field support and assembly training prior to piping installation to insure that field applied protective coating, applied at assembly joints, is installed to factory standards.
  5. The contractor shall supply a complete proposed installation submittal including layout drawings and catalog sheets. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresser and movement of the service pipe. Submittal shall detail location of assembly joints, pipe elevations, pipe anchor locations, details for field applied protective coatings at assembly joints, fittings and anchor plates.
    - a. Any proposed installation which indicates deviation in the pipe length, installed elevation, routing or anchor location, from that which is detailed in the construction documents, shall be accompanied by pipe stress and end load calculations. Calculations shall show compliance with loading and stress requirements outlined in ASME B31.9.
    - b. Calculations and proposed design documents, which show deviation from the construction documents, shall be prepared and sealed by a registered professional engineer, registered in the state of Tennessee, at the contractors expense.
  6. The carbon steel pipe shall have either a factory applied HDPE or reinforced polyester (FRP) external cladding.
  7. Fiberglass jacket:
    - a. All carrier pipes shall have a fiberglass overwrap that is minimum 0.10 inch thick. The carrier pipe shall be shot blasted to near white per SSPC-10 prior to installation of the jacket. The fiberglass jacket on the straight sections of pipe shall be manufactured in accordance with the following. The winding process shall be ASTM D-2996; the glass fiber shall be continuous E-glass fibers with a polyester compatible binder and coupling agent. The resin shall be polyester resin as manufactured by DOW Chemical or Ashland chemical. The winding pattern shall be no less than 58 degrees helix angle, using individually tensioned, and continuous single strand E-glass. The outer surface of the jacket shall have a resin veil applied. The glass to resin ratio shall be a minimum of 65/35.



- Calculations shall show compliance with loading and stress requirements outlined in ASME B31.9.
- b. Calculations and proposed design documents, which show deviation from the construction documents, shall be prepared and sealed by a registered professional engineer, registered in the state of Tennessee, at the contractors expense.
6. The piping shall have a factory-applied insulation and protective filament wound, polyester resin/fiberglass reinforcement composite FRP or HDPE outer-jacket.
- a. Insulation shall be a rigid 90 to 95% closed cell polyurethane with 1.9 to 2.1 pounds per cubic foot density and maximum thermal conductivity (K) of .14 Btu/(hr) (Sq ft)(F/in)
  - b. Jacket shall be FRP with a minimum wall thickness of 0.055 inch thickness up to 15 inches diameter, 15 to 24 inches = 0.85 inches, 24 to 30 inches = 0.110 inches and 30 to 48 inches = 0.140 inches or HDPE conforming to ASTM D1248, Type III, Category 5, Class C and Grade P23/P34 with a minimum thickness as follows: Up to 6-inches = 50 Mils, 8 to 12—inch = 175 Mils, above 14-inch = 200 Mils.
  - c. Insulation thickness shall be 1 ½” for nominal pipe sizes less than 4”, 2” thick for nominal pipe sizes 4” to 6”, 2 ½” for nominal pipe sizes 8” to 14” and shall be 3” thick for nominal pipe sizes 16 inch and larger.
- D. Condensate (COND, condensation water) gravity drainage from AHU cooling coil drain pans and miscellaneous HVAC piping systems to Sump Pump:
1. Above grade installation: 2 ½” diameter or smaller shall be Drawn-Temper Copper Tubing ASTM B88, type L.
  2. Underground installation: 2 ½” diameter or smaller shall be Annealed-Temper Copper Tubing ASTM B88, type K.
    - a. Three (3) inch diameter and larger shall be steel pipe, ASTM A53, Type E (electric-resistance welded) Grade A. Schedule 40, black steel, plain ends.
- E. Fittings and flanges for steel piping.
1. Sizes up to 2 inches: steel fittings, ASME B16.11, socket welding type, Class 3000, or threaded type Class 2000; malleable iron fittings, ASME B16.3, threaded type.
  2. Sizes 2-1/2 inches to 24 inches: steel fittings, ANSI B16.9, butt-welding type, or ASME B16.5, flanged type, or convoluted steel flanges conforming to ASME BPVC SEC VIII D1; cast iron fittings, ASME B16.1, flanged type.
  3. Fittings (30 in. to 36 in.): Steel, fabricated from ASTM A-53, Grade B pipe, butt-weld ends, AWWA C-208; Wall thickness: Match mating pipe thickness.
  4. Flanges (to 24 in.): Steel, ASTM A-105 or A-181, 150 lb, slip-on or welding-neck type, ANSI B16.5.
  5. Flanges (to 26 in.): Steel, ASTM A-105 or A-181, Class 60, manufactured: AWWA C-207, Class E, hub type, drilling and outside diameter: ASME B16.1, Class 125 dimensions for cast iron flanges.
  6. Flanges (to 36 in.): Steel, ASTM A-181, Class 125, manufactured: similarly as above: AWWA C-207-54T, Class E, hub type, dimensions and drillings to match: ASME B16.1, Class 125 dimensions for cast iron flanges.
- F. Fittings for copper tubing:
1. Fittings for copper tubing shall be cast copper alloy solder-joint type conforming to ANSI B16.18 or wrought copper solder-joint type conforming to ASME/ANSI B16.22.
- G. Mechanical Pipe Coupling System (optional - for above ground installation only):
1. Couplings may be provided for steel piping for water temperatures not to exceed 230 degrees F. Couplings shall be self centering and shall engage and lock in place the grooved or shouldered ends of pipe and pipe fittings in a positive watertight couple. Couplings shall be designed to permit some angular pipe deflection, contraction, and expansion. Coupling

- clamp shall be ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be molded rubber conforming to ASTM D 2000; the "line call-out" number shall be suitable for a water temperature of 230 degrees F. Coupling nuts and bolts shall be steel conforming to ASTM A 183. Fittings shall be grooved ductile malleable iron conforming to ASTM A 395, Grade 65-45-15 or ductile iron conforming to ASTM A 536, Grade 65-45-12. Mechanical couplings and fittings shall be of the same manufacturer and shall be complete with ISO-9001 certification.
2. Before assembling couplings, coat pipe ends and outsides of gaskets with lubricant approved by the coupling manufacturer to facilitate installation.
  3. Groove end check valves: grooved end, dual disc, spring loaded, non-slam check valves with ductile iron, Type 316 stainless steel or aluminum bronze discs and EPDM rubber seats, seal or coating. Maximum rated working pressure of 300 psi dependent on size.
  4. Butterfly valves: grooved end butterfly valves with ductile iron body and disc core shall conform to ASTM A 536. Disc rubber coated with EPDM rubber. Maximum rated working pressure of 300 psi.
  5. Strainers: include grooved end T-type strainers with steel or ductile iron bodies, Type 304 removable strainer baskets with 4, 6, or 12 mesh screens and 57 percent open area. Maximum rated working pressure of 300 psi dependent on size.
- H. Vic-Press 304 Stainless Steel Piping System (1/2" to 2"):
1. Pipe: Victaulic stainless steel Vic-Press 304 pipe, ASTM A-269, grade 304/304L, .049 wall, certified for use with Vic-Press 304 stainless steel products.
  2. Fittings: Victaulic stainless steel Vic-Press 304 fittings, formed from austenitic stainless steel.
  3. Couplings: Housing body precision cold drawn austenitic stainless steel with self-contained o-ring seals in the coupling ends.
  4. Flanges: 304 stainless steel ends with DI backing ring, Victaulic Style 565 Van Stone flange adapter, class 150.
  5. Valves: Brass body forged to ASTM B-16, chrome plated brass ball, with TFE seat. Victaulic Series 589 ball valve.
- I. Dielectric-Waterway (Dielectric-Union).
1. Provide insulated union of galvanized steel and female threaded on end. Solder joints conforming to Federal Standard FS WW-U-531, Class 1 dimensional strength and pressure requirements. Union shall have water impervious insulation barrier capable of limiting galvanic current to one percent of short circuit current in a corresponding bimetallic joint. When dry, insulation barrier shall be able to withstand a 600-volt breakdown test.
  2. Steel Unions (up to 2 inches): malleable iron, ASTM A197, threaded, brass-to-iron seats, ASME B16.39 Class 150.
- J. Steel Piping and End Connections: 2 inches and smaller shall be threaded or socket welded; 2-1/2 inches and larger shall be flanged, mechanical pipe coupling system (above ground) or butt-welded.
1. Threaded Joints: thread in accordance with ANSI B1.20.1.
  2. For Vic-Press 304 alternate, refer to Vic-Press 304 SS piping section paragraph H above.
  3. Flanged Joints:
    - a. Bolting of flanges: material used for bolts and studs shall conform to ASTM A 307, Grade B, and material for nuts shall conform to ASTM A 563, Grade B. Dimensions of bolts, studs, and nuts shall conform to ANSI B18.2.1 and ASME/ANSI B18.2.2 with threads conforming to ASME B1.1 coarse type with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or studs shall extend through nuts and may have reduced shanks of a diameter not less than diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads ASTM A307 Grade B and shall have American Standard heavy, semi-finished hexagonal nuts ASTM A563, Grade B.

- b. Gaskets: ASTM D 2000 M2AA 507 A13, 1/16-inch thick fluorinated elastomers, suitable for pressure and temperature ranges encountered, and compatible with grooves in flange faces. Dimensions for nonmetallic gaskets shall conform to ASME B16.21, SEPCO Style 20.
  - 4. Butt Weld Joints: As required in Section 18100.
  - 5. Socket Weld Joints: As required in Section 18100.
  - 6. Mechanical Pipe Coupling System: refer to grooved piping section previously specified.
- K. Joints for Copper Tubing
- 1. Solder conforming to ASTM B 32 alloy grade Sb5 or Sn96. Solder and flux shall be lead free (less than 0.2 percent of lead).
  - 2. Copper Tube Extracted Joint: an extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to assure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.
  - 3. Joint Compound (water service): Rectorseal No. 5, Rectorseal Corporation; Key-Tite, Cooper Industries; Tyte Unyte, J.C. Whitlam Manufacturing Company; or PTFE thread seal tape, Sealing Equipment Products Company.
- L. Plugs (up to 3 inches): steel, ASTM A105 or ASTM A181 Class 70, solid, square head, threaded, ANSI B16.11.
- M. Strainers
- 1. Strainers (to 1 ½ in.): cast iron body, ASTM A126 Class B, Y type, threaded, 125 lb ANSI, threaded cap, removable 20 mesh monel screen.
  - 2. Strainers (2 in. and larger): cast iron body, ASTM A126 Class B, Y type, ANSI B16.1 Class 125 flanges, 125 lb ANSI, bolted cap, removable 20 mesh monel screen.
- N. Valve Vaults (within buildings): For specific dimensions see Architectural drawings. Cover shall be suitably marked "Chilled Water" or "Heating Hot Water" etc.
- O. Valve Vaults (exterior to buildings): For specific dimensions see Mechanical drawings. Cover shall be marked "Utility Isolation Valves."
- P. Expansion Joints: Steel, packed, sleeve type, Dresser Manufacturing Division Style 63, Type I.
- Q. Valves: See Division 15, Section 15100 "Valves" for more precise description of materials of construction, pressure and temperature requirements.

<u>Shutoff</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Butterfly	1/2" to 2"	V-6472, V-6474	Screwed
Butterfly	2" to 24	V-6199-1, V-6199-2	Wafer-Flange
Butterfly	3" to 6"	V-6431	Flanged
Butterfly	3" to 6"	V-6489A (Special)	Flanged
Butterfly	2 1/2" to 12"	V-6483	Grooved
Butterfly	14" to 24"	V-6476	Grooved
Ball	1/4" to 2"	V-6468	Screwed
Ball	1/4" to 2"	V-1181A (Special)	Flanged
Ball	1/2" to 2"	V-6470	Vic-Press 304
Ball	3' TO 16"	V-6189	Flanged
Ball (CS)	1/2" to 2"	V-6168A	Flanged/Welded

<u>Control</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
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Globe	1/4 to 2	V-6036	Screwed
Globe	2 1/2 to 10	V-102	Flanged
Angle	1/4 to 2	V-6089	Screwed
Angle	2 1/2 to 14	V-6050	Flanged
<u>Check</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Swing	1/4 to 2	V-201	Screwed
Swing	2 1/2 to 24	V-204	Flanged
Spring	2 1/2 to 14	V-205	Grooved
<u>Press. Relief</u>	<u>Size</u>	<u>Number</u>	<u>End type</u>
Globe (SS)	1 1/2" & 3"	V-512	Screwed
Globe (DI or Brnz.)	4" & larger	V-512	Flanged

R. Valve Stem Packing (for repacking only): non-asbestos, John Crane Incorporated K-1730 or Garlock Incorporated Style No. 8922.

S. Hydronic Specialties.

1. Back-Pressure/Relief Regulator (BPRV) V-502: As manufactured by "CASHCO", Model 8311HP with double-seat design. Diaphragm shall be suitable for up to 200 psig (13.8 Barg) relief, and shall be isolated from fluid velocity effects. Valve size shall be "line-size" or as indicated on drawings. End connections for sizes 2" and smaller shall be threaded and for larger than 2 1/2" valve sizes shall be flanged (150# RF). Inlet temperature range shall be -20 to 450 deg F (-29°C to + 232°C). Valve body and spring shall be carbon steel CS/CS, complete with O-ring or TFE gasket to meet ANSI B16.104, Class II seat leakage rates. Valve exterior surfaces shall be painted with manufacturer's #S-1547 EPOXY finish.
2. Excess Pressure Relief Valve (EPRV) V-512.
  - a. General: Excess Pressure Relief Valve (EPRV) shall be a hydraulically operated, globe-style, pilot controlled modulating valve for a by-pass function. Such valve is designed to provide protection for the system, against high-pressure surges when control valves close, or pumps shut down. The valve shall be capable to open fast and close slowly as the relief valve dissipated the excess pressure.
  - b. Manufacturer / Model No: For sizes 6" and larger, select CLA-VAL, Model 50-01 / 650-01 or approved equal
3. Pressure-Reducing Valves: dead-end service, manufactured by Fisher, Masoneilan, Leslie, or Kiely-Mueller.
4. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
5. Expansion Tanks:
  - a. General: Welded carbon steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity by a flexible diaphragm securely sealed into tank. Include drain fitting and taps for pressure gage and air-charging fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Factory fabricate and test tank with taps and supports installed and labeled according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
  - b. Specific: Chilled water system expansion tank (ET-CU-01) shall be as required in part (a) and installed and labeled for a working pressure of 150-psig according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
6. Tangential-Type Air Separators:

- a. General: Welded black steel; ASME constructed and labeled for 125-psig minimum working pressure and 375 deg F maximum operating temperature; perforated stainless-steel air collector tube designed to direct released air into expansion tank; strainer, tangential inlet and outlet connections; threaded connections for NPS2 and smaller; flanged connections for NPS 2-1/2 and larger; threaded blowdown connection. Provide units in sizes for full-system flow capacity.
  - b. Specific: Chilled water system air separator (AS-CU-01) shall be as required in part (a) and installed and labeled for a working pressure of 150-psig according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
7. Bypass Chemical Feeder: Welded steel construction, 125-psig working pressure, capacity as scheduled on the construction drawings, with fill funnel inlet, outlet, isolation valves, pressure reducing valves and drain valves (as indicated on the construction drawings). Chemicals by others.
  8. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger; threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection. Use grooved end strainers in grooved end systems, refer to grooved piping section previously specified.
  9. Basket Strainers: 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.
  10. Duplex Basket Strainers: Sliding gate type, 125-psig working pressure; high-tensile cast-iron body (ASTM A 126, Class B), flanged-end connections, bolted cover, perforated stainless-steel basket, and bottom drain connection.
  11. Flexible Connectors: Stainless steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket, 150-psig minimum working pressure and 250 deg F maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment. Flexible grooved couplings arranged three consecutively on grooved components may be substituted in lieu of flexible connectors up to 230 deg F.
  12. Spherical Rubber Flexible Connectors: Fiber-reinforced rubber body with steel flanges that are drilled to align with Classes 150 and 300 steel flanges; and operating temperatures of up to 250 deg F. Flexible grooved couplings arranged three consecutively on grooved components may be substituted in lieu of flexible connectors up to 230 deg F.
  13. Non-metallic Elastomeric Expansion joints: Fabricated from synthetic elastomers and fabric, reinforced with metal to relieve movement, stress, reduce noise, vibration and compensate for mis-alignment of piping. Location, size and capacity as indicated on drawings. Operating temperatures and pressures shall not exceed 250 deg F and 200 psig. Flanges shall be drilled to align with Class 150 pound standard configuration. Tie-rod assembly (if required) and gusset-plates shall be the manufacturer's standard for specific sizes as manufactured by The Metraflex company or approved equal. Expansion joints locations and length shall be pre-engineered and evaluated to include the entire piping span. Installation of expansion joints shall include pipe-guides and pipe-anchors as required to for a complete protection of the piping system.
  14. Suction Diffuser: Double type, angle type body with replaceable straightening vanes, permanent magnet and a combination Diffuser-Orifice-Cylinder with drilled openings for pump protection. The orifice cylinder shall be equipped with a disposable fine mesh strainer that shall be removed after start-up. Orifice cylinder shall be capable to withstand a pressure differential equal to the pump suction head. And shall have a free area equal to five times the cross section area of the pump suction opening. The assembly shall be provided with adjustable support foot to carry the weight of suction piping. Use grooved end suction diffusers in grooved end systems, refer to grooved piping section previously specified.

### PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install piping up to 30-inch diameter per requirements of ANSI B31.9 and Section 15050. For pipe sizes larger than 30 inches, install system per Category D Fluid Service requirements of ASME B31.3 and Section 15050.
- B. Provide flat-face flanges for connections to Gate Valve V-4, Gate Valve V-5, Globe Valve V-102, Angle Valve V-6050, and Swing Check Valve V-204, Butterfly Valve V-6431, Ball Valve V-6189, and other special valves as required by valves and as designated within section 15100.
- C. Perform welding activities per Sect. 18100 and following:
- D. Do not perform welding within 24 inches of any installed valve.
- E. For chilled water and heating hot water systems, above grade and within buildings, insulate piping system per Spec Section 15250 with insulation thickness specified on drawing.
- F. Identification/Labeling: Section 15074.
- G. Where pipes pass through fire rated partitions (floors, walls, ceilings, etc.) furnish and install fire-stop system, as required in section 07841, to maintain partition fire rating.

### 3.2 FIELD QUALITY CONTROL

- A. Pressure/Leak Test (water service): Section 15073, Class B.
- B. Weld Examination: Section 18100.
- C. Installer shall perform random "holiday" testing as specified prior to installation of piping.
- D. Installer shall perform continuous "holiday" testing as specified after installation of piping systems.

### 3.3 CLEANING

- A. Post-installation Cleaning (water service): Section 15072, Type II.

**END OF SECTION OF 15106**