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| **EDIT NOTES:**  **BOLDED TEXT IS A DESIGN GUIDELINE AND MUST BE EDITED TO REFLECT PROJECT.**  **DELETE THE APPLICATION AND EDIT NOTES.**  **WHERE THE SPECIFICATION IDENTIFIES VARIOUS TYPES OF THE SAME PRODUCT BY NUMBER, DELETE THE ITEMS NOT USED, BUT DO NOT RENUMBER THE ITEMS. RETAIN THE ORIGINAL NUMBERS OF THE ITEMS THAT ARE IN THE PROJECT. GAPS IN THE NUMBERING SYSTEM ARE EXPECTED. COORDINATE DRAWINGS WITH THE NUMBERING IN THE SPECIFICATION.**  **Condensate drains from HVAC equipment shall not be connected to any portion of science classroom acid waste drainage system.** |

**PART 1 – GENERAL**

**1.01 SUMMARY**

A. Section Includes:

1. This Section prescribes basic materials and methods generally common to the Work of Division 23.

B. Related Requirements:

1. Division 01: General Requirements.
2. Division 07: Thermal and Moisture Protection: Polyvinyl-Chloride Roofing.
3. Division 23: Heating, Ventilating, and Air-Conditioning.
4. Division 26: Electrical.
5. Section 31 2323: Excavation and Fill for Utilities.

**1.02 SUBMITTALS**

A. Provide in accordance with Division 01, Section 23 0500 and specific requirements of each section of Division 23.

**1.03 QUALITY ASSURANCE**

A. Standards: Comply with applicable national, state, and local codes and standards: ASTM, ASME, and ANSI. Federal Specifications, AWWA, CISPI, NFPA, FM Global, UL, CPC (California Plumbing Code), CMC (California Mechanical Code), CSA.

B. Qualifications of Manufacturer: Products used in the Work of this Section shall be produced by manufacturers regularly engaged in manufacture of similar items and with a history of successful production as reviewed by the Architect.

**1.04 COORDINATION**

A. Coordinate related Work in accordance with provisions of Section 01 3113: Project Coordination.

**PART 2 – PRODUCTS**

**2.01 GENERAL**

A. Provide the following products if they are indicated in the Contract Documents or if they are required for the proper installation, function or operation of equipment, systems or components indicated in the Contract Document.

B. Provide the following products as a complete assembly with required accessories for a complete and functioning entity in compliance with governing codes and applicable standards as specified in Section 23 0500, manufacturer’s instructions or as required.

1. Omission of minor details in the Contract Documents does not waive and/or otherwise relinquish compliance with the above requirements.

**2.02 MANUFACTURERS AND MATERIALS**

A. Air Compressor:

ACA-1 Electric motor-driven, air-cooled, duplex, air compressor, installed on a horizontal air storage tank, of the size and capacity indicated on the Drawings, with multiple V-belt drive, totally enclosed crankcase and required accessories such as pressure regulating stations, gravimetric moisture separators, on/off controls and safety controls for a complete pneumatic control air or laboratory instrument air station.

Gardner-Denver DeVilbiss Curtis Champion

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| **EDIT NOTE:** **APPLICATION:** **COMPRESSED AIR SYSTEM FOR PNEUMATIC CONTROL EQUIPMENTS FOR HVAC SYSTEM. INDICATE CAPACITY ON DRAWINGS** |

B. Air and Dirt Separators:

AS-1 Furnish Spirotherm, Bell and Gossett, or Wessels air and dirt separation fitting on the hot water heating system, chilled water system, and closed loop fluid cooler system. Fittings shall be fabricated steel, rated for 150 psig design pressure and selected for less than one foot of water pressure drop and entering velocity not to exceed 4 feet per second at specified GPM. Performance curves from the unit manufacturer shall be furnished as part of the submittal for each unit. Units shall be furnished with internal copper coalescing medium to facilitate maximum air and dirt separation and suppress turbulence. Units shall be furnished with galvanized steel strainer and stainless steel collector tube. Provide integral high capacity float actuated air vent at top fitting of tank. Furnish cast iron float actuated air vent rated at 150 psig, threaded to the top of the fitting. Unit shall be furnished with the bottom of the vessel extended for dirt separation with the system connection nozzles equidistant from the top and bottom of the vessel and shall include a blowdown connection and valve.

Bell and Gossett, Spirotherm, Wheatley

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| **EDIT NOTE: APPLICATION: FOR HVAC SYSTEM ONLY.** |

C. Balancing Valves:

BBV-1 Dual purpose, balancing and shut-off:

1. Direct operated Pressure Regulator: Class 200# SAG duct iron body, silicone chrome spring, stainless steel 316L Bellows/push rod.

2. Pilot operated Pressure Regulator Class 250# SAG cast iron body, cast iron cover, stainless steel valve stem, valve seat.

Sarco Type BRV 2, 71, 25P Armstrong GD 45 GP 28

Hoffman series 754

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| **EDIT NOTE:** **APPLICATION: Pressure reducing/regulating and shut-off equipment only for boiler steam system and compressed air system.** |

D. Boiler Blow-Off Valve:

BOV-1 Boiler blow-off (drain): Refer to Section 23 5000.

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| **EDIT NOTE:** **APPLICATION: Drain valves for boiler steam system and compressed air system**. |

E. Ball Valves: Bronze, 2 inches and smaller:

BV-1 Class 150, 600 psi, CWP, 2 piece construction reinforced Teflon seats, full port, adjustable packing gland, stainless ball and stem, threaded or solder ends with extended solder cups.

Threaded: Stockham S-216-BR-RT, Crane 9302, Worcester 4112 RT, Jamesbury 11 1100TT, Apollo 70-100.

Solder: Stockham S-216-BR-RS, Crane 2192 H, Apollo 70-200.

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| **EDIT NOTE:** **APPLICATION: SHUT-OFF AND ISOLATION OF SMALL PIPE APPLICATION FOR COMPRESSED AIR, CHILLED WATER AND CONDENSER WATER SYSTEMS. RECOMMENDED FOR FREQUENT OPERATION READILY ADAPTABLE TO AUTOMATION, IDEAL FOR INSTALLATION WHERE SPACE IS LIMITED. PROVIDE AT AIR COMPRESSOR DISCHARGE LINE, DISCHARGE SIDE OF AIR RECEIVER, COMPRESSED AIR OUTLETS IN SHOP BUILDINGS.**  **NOTE: VALVE HANDLE SHALL BE STAINLESS STEEL WHEN VALVE IS INSTALLED BELOW GRADE OR IN THE GROUND VALVE BOX.** |

BV-2 Class 150, 600 psi CWP, 2-piece construction, bronze body, reinforced Teflon seats, adjustable packing gland, (no threaded stem designs allowed), threaded ends.

Hammond UP8301A, NIBCO T-585-70, Milwaukee BA-400, or equal.

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| **EDIT NOTE: BV-2 TO BE USED ONLY WHERE WATER IS NOT USED FOR HUMAN CONSUMPTION.** |

Ball Valves in Insulated Piping: Use extended operating handle of non-thermal conducive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied. NIBCO Nib-Seal Handle.

F. Butterfly Valves:

BFV-1 Centerline Series A, 200 psi CWP tight shut-off.

1. Body: Lug type ductile iron. Suitable for bi-directional dead-end service at rated pressure without use of downstream flange.

2. Disc: Bronze, or aluminum bronze.

3. Stem: One or two-piece, 400 series stainless steel.

4. Seat and O-Rings: EPDM.

5. Upper and Lower Stem Bearings: Copper alloy or non-metallic material.

6. Operators: Valves 6 inches and smaller, with lever handle. Valves 8-inch and larger, with manual gear operator and disc position indicator.

7. Manufacturers:

a) Milwaukee, Centerline, Stockham, Crane or DeZurik.

8. Grooved ends: Valves 6 inches and smaller, Victaulic No. 700 or NIBCO No. GD-4765-3 with lever handles. Valves 8 inches and larger, Victaulic VIC-300 Masterseal Series 761, NIBCO No. GD-4765-5, Gruvlok Fig. 7700 Series, or equal, with manual gear operator and disc position indicator.

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| **EDIT NOTE: APPLICATION: SHUT-OFF AND ISOLATION OF LARGE PIPE APPLICATION FOR CHILLED WATER, CONDENSER WATER AND SPACE HEATING HOT WATER SYSTEM. RECOMMENDED FOR FREQUENT OPERATION AND ADAPTABLE TO AUTOMATION WHERE SPACE IS LIMITED.** |

G. Check Valves:

1. Bronze, 2-inch and smaller:

CHV-1 Class 125, threaded or solder ends body and caps shall be of ASTM B 62 swing check, Teflon disc.

Threaded: Stockham, Hammond, Crane, Powell.

Solder: Stockham, Hammond, Crane, Powell.

Class 150 valves meeting above Specifications may be furnished where pressure requires: Stockham B321, threaded.

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| **EDIT NOTE: APPLICATION: PROVIDE WHERE BACKFLOW PREVENTION IS REQUIRED FOR CHILLED WATER AND CONDENSER WATER SYSTEM AND SPACE HEATING HOT WATER SYSTEM. USUALLY RECOMMENDED FOR LINES WHERE FLOW VELOCITIES ARE LOW AND SHOULD NOT BE USED ON LINES WITH PULSATING FLOW. RECOMMENDED FOR HORIZONTAL INSTALLATION OR IN VERTICAL LINES ONLY WHERE FLOW IS UPWARD. PROVIDE AT MULTIPLE HOT AND CHILLED WATER PUMP DISCHARGE LINES, MAKE UP WATER LINES.** |

2. Cast Iron 2-1/2 and larger:

CHV-2 shall be iron body, bronze mounted with body and cap conforming to ASTM A 126; class B, cast iron, flanged ends, swing type disc:

Stockham G-931, Hammond IR 1124, Crane 373, Powell 559.

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| **EDIT NOTE: APPLICATION: SAME AS CHV-1 EXCEPT FOR LARGER SIZES. PROVIDE ON MULTIPLE STEAM BOILER RETURN LINES FROM STEAM TRAP.** |

Alternative check valve 2-1/2 and larger:

CHV-3 Class 125/250, iron bronze, wafer check valves, with ends designed for flanged type connection, aluminum bronze disc, EPDM seats, 316 stainless steel torsion spring and hinge pin:

Stockham WG-931, Center Line CLC, Mission K12 HMP, Marlin A125 HZDSF.

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| **EDIT NOTE: APPLICATION: SAME AS CHV-2.** |

CHV-4 Non-Slam Check Valves (Pump Discharge): Miller No. 162, with semi-steel body, bronze trim, top and bottom center guide, stainless steel spring and 125 lb flanged ends. Williams, Hager or Muessco.

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| **EDIT NOTE: APPLICATION: SAME AS CHV-3.** |

Air Vents: Crane No. 712 or No. 744, manual type, of size for proper venting. Install at high points of systems.

H. Earthquake Valve:

EQV-1 Mechanically triggered by seismic movement, complying with state of California seismic response specifications, UL listed and certified.by D.S.A. Size and pressure as required or indicated on Drawings. Minimum ¼ psi, maximum 10 psi.

Earthquake valve shall shut off gas automatically during an earthquake to prevent an explosion or fire. Valve shall be Koso California seismic valve, or equal.

* + - 1. Not sensitive to vibrations caused by passing trucks or accidental bumping.
      2. Sensitive to wide amplitude G's only. Preset at factory for the correct G- rating.
      3. Positive sealing from -10 degrees F. to 150 degrees F.
      4. Visual open-close indicator.
      5. Manual reset.
      6. Plumb line for mounting.
      7. Tripping mechanism has non-creeping rolling latch.

1. Expansion Tank:

ET-1 Pressurized, vertical, steel expansion tank for non-potable water systems with a replaceable, heavy duty, Butyl rubber bladder, 1 inch or 1 ½-inch NPT system connection, 3/4 inch drain, 0.302 inch-32 standard automobile tire valve type charging connection, lifting rings and a floor mounting skirt for vertical installation. The tank must be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code and stamped for 125 psi working pressure. The tank must be also rated for a continuous working temperature of 240 degrees F. Provide weather and rust resistant coating.

Bell and Gossett, Wheatley, Taco, Amtrol, or equal.

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| **EDIT NOTE: APPLICATION: PRESSURIZED NON-POTABLE WATER SYSTEM APPLICATIONS SUCH AS CHILLED WATER SYSTEM AND SPACE HEATING HOT WATER SYSTEM. PROVIDE AT EACH CHILLED WATER OR HEATING HOT WATER SYSTEM.** |

J. Flow Control Valve; Automatic:

FC-1 To control flow rates with plus 5 percent accuracy. Device shall consist of inline pipe section with internal stainless steel variable self-positioning orifice assembly with built-in strainer. Device shall be factory set, tamper-proof and require no external adjustment. Provide 2 body pressure taps suitable for differential pressure connections. Body material shall conform to system piping material. The flow rate and pressure drop shall be stamped on a tag, which shall be chained and riveted to the device.

Griswold Controls, or equal.

**APPLICATION: Flow control application for heating or cooling coils for chilled water system and space heating hot water system. Provide at each heating or cooling coil.**

K. Flow Control Valve – Manual:

FC-1 Flow control valves: Bell and Gossett Series CB circuit setter balancing valve, line size, with integral pointer (to register degree of valve opening), differential pressure meter connections with built-in check valves and lockable memory stops. Armstrong Series CBV circuit-balancing valves, Illinois Series 6000, or Victaulic/TA Hydronics.

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| **EDIT NOTE: BALANCING AND CONTROLLING OF FLOW FOR DIFFERENT CIRCUITS AT CHILLED WATER SYSTEM, SPACE** **HEATING HOT WATER SYSTEM. PROVIDE AT EACH PUMP AND AIR HANDLING UNIT HEATING OR COOLING COIL.** |

K. Venturi Flow Measuring Device:

FMD-1 Preso B-plus Series, Victaulic “Style 733”, Griswold QuickSet Metering Stations, or equal, venturi type flow measuring device. Provide on the main heating hot water and chilled water lines and other locations as required for balancing, as indicated, between straight sections of pipe. Upstream pipe section shall be not less than 5 diameters in length and downstream section shall be not less than 2 diameters in length. Venturis shall be furnished complete with quick disconnect valves, safety shut-off with memory valves and attached metal identification tag.

1. 2-inch or smaller shall be furnished with threaded connections.

2. 2 ½-inch or larger shall be furnished with flanged or grooved connections.

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| **EDIT NOTE: FLOW MEASURING APPLICATION FOR CHILLED WATER SYSTEM AND SPACE HEATING HOT WATER SYSTEM.** |

L. Electronic Flow Readout Meter:

FM-1 Flow meter shall combine the functions and ranges of several gages into a single board range meter. Meter shall function as a compound pressure gage measuring the high side and low side pressure simultaneously and display each reading in sequence. Meter shall be furnished complete with a shut-off, bypass, and blow down valve network installed on a portable meter panel. A carrying case shall be provided with storage for accessories. Meter shall automatically select the proper range, compensate for temperature, and reset itself. Memory function shall store up to 90 sets of pressure and temperature. Pressure reading shall be accurate to plus or minus 2 percent of reading from 0.01 to 150 psi. Temperature readings shall be accurate to plus or minus 0.5 degrees F and plus or minus 1.0 degree F. from minus 65 degrees F to 250 degrees F. The flow metering device shall be Hydrodata Multimeter HDM-250 as manufactured by Shortridge Instruments Inc., or equal, and shall be furnished with pressure gage, portable meter panel and with valve network, carrying case, battery charger, instruction manual and certificate of calibration, two 6 feet long by 1/2 inch OD pressure hoses with quick disconnects, two 8 foot by 1/4 inch OD drain hoses, and a set of adapters.

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| **EDIT NOTE: APPLICATION: SAME AS FMD-1.** |

M. Gate Valves:

1. Bronze, 2 inches and smaller:

GV-1 Class 125, 200 psi CWP, bronze body and bonnet non-rising stem, inside screw, screw-in bonnet, solid disc, threaded ends:

Stockham B100 (RS) or B103 (NRS), Crane 428 or 438, Hammond IB 640 (RS).

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| **EDIT NOTE: APPLICATION: SHUT-OFF AND ISOLATION OF EQUIPMENT AND DEVICE FOR CONDENSER WATER, CHILLED WATER AND SPACE HEATING HOT WATER SYSTEMS AND GAS SYSTEM.** |

GV-2 Same as GV-1, except solder ends:

Stockham B104 (NRS) or B108 (RS), Milwaukee 11.5 (NRS) or 149 (RS).

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| **EDIT NOTE: SAME AS GV-1. PROVIDE IN YARD BOX, TO EACH GROUP OF FIXTURES BEHIND ACCESS PANELS, WHERE VALVES ARE LOCATED NEAR CEILING AND BEAMS.** |

2. Iron Body Gate Valves; 2 1/2 inches and larger:

GV-7 Class 125, O S and Y, IBBM, bolted bonnet, solid disc, flanged ends:

Hammond IR1140 or IR1138, Stockham G623 (RS) or G612 (NRS), Crane 465-1/2 or 461.

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| **EDIT NOTE: APPLICATION: SHUT OFF AND ISOLATION OF EQUIPMENT WITH LARGE PIPE SIZES FOR SPACE HEATING HOT WATER SYSTEM, COMPRESSED AIR AND LOW PRESSURE STEAM SYSTEMS. THIS TYPE OFFERS A VISUAL INDICATION OF WHETHER THE VALVE IS CLOSED OR OPEN. PROVIDE AT HEATING HOT WATER BOILERS AND LOW PRESSURE STEAM BOILER SUPPLY HEADERS, COMPRESSED AIR OUTLETS, RECEIVER TANKS, HOT WATER STORAGE TANKS ETCETERA.** |

N. Globe Valves:

1. Bronze, 2-inch and smaller:

GLV-1 Class 125, 200 psi, CWP, screw-in bonnet, Teflon disc, threaded ends:

Hammond IB440, Milwaukee 502, Stockham B-BT (Bronze Disc), Stockham B-16, Crane 108, Powell 650, Hammond IB 440.

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| **EDIT NOTE: APPLICATION: COMBINATION OF BALANCING AND SHUT-OFF APPLICATION FOR CONDENSER WATER AND CHILLED WATER SYSTEMS AND SPACE HEATING HOT WATER SYSTEM. THE SEAT MUST BE COMPATIBLE WITH THE FLUID IN SERVICE. PROVIDE ON BYPASS LINE FOR WATER PRESSURE REDUCING VALVE ARRANGEMENT, ON THERMOSTATIC MIXING VALVE ARRANGEMENT.** |

GLV-2 Class 125, 200 psi, CWP, screw in bonnet, Teflon disc, solder ends.

Hammond B-14T (Bronze Disc), Stockham B-17, Crane 1310, Powell 1823, Hammond IB-418.

1. Plug Valves: 2-inch and smaller: Rockwell No. 114, lubricated plug type, 200 lb., water operating gage pressure iron body and plug, regular pattern, threaded, with indicating arc. Walworth, Homestead, or WKM.
2. Plug Valves: 2-1/2 inch and Larger: Rockwell No. 115 and No. 165, lubricated plug type, 200 lb., water operating gage. Iron body and plug, regular pattern, flanged, with indicating arc. Walworth, Homestead, or WKM.
3. Iron Globe Valves, 2 ½-inch and larger:

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| **EDIT NOTE: APPLICATION: For Victaulic piping 2 ½” and larger use the appropriate Owner specified flange valve, along with the Vic-Flange adapter style 641 for copper tubing.** |

GLV-5 Class 125, 200 psi, CWP, OS&Y, IBBM, renewable seat and disc, bolted bonnet, flanged ends:

Hammond IR116, Stockham G-512, Stockham G514T, Crane 351 or 359, Powell 241 or 301.

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| **EDIT NOTE: APPLICATION: SAME AS GLV-1 EXCEPT FOR LARGER PIPE AND LOW PRESSURE STEAM SYSTEM. PROVIDE ON BYPASS LINE FOR LOW PRESSURE STEAM MODULATING VALVE TO HEAT EXCHANGER, ON BYPASS LINE FOR STEAM TRAP, ETCETERA.** |

O. Heater Vent Pipe:

1. Schedule Number:

HVP-1 Shall be UL approved for service specified. Concealed heater vent pipe, including pipe in or through attic spaces, shall be Fontana City approved double wall metal vent pipe. For recessed wall heaters, furnish B.W. type. All others may be Type B, or B.W. Clearances must comply with Fontana City code and conditions of UL listing.

American Metal Products Co., Inc., Simpson Dura-Vent, AmeriVent, Hart & Cooley Mfg. Co., Metalbestos, or equal.

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| **EDIT NOTE: COMPONENT PARTS OF A VENT ASSEMBLY, INCLUDING VENT CAP, SHALL BE COMPANION ITEMS OF SAME MANUFACTURER. EACH ITEM SHALL BE UL-APPROVED AND LISTED**. |

P. Liquid Level Gage:

LLG-1 Refrigerant type, carbon steel with stainless steel trim or all forged steel construction, back-seating standard design. Upper and lower valve furnished with ball check valves; 1/2 inch diameter glass on center. Four 3/16 inch diameter gage glass guard rods or slotted steel guard.

Peneberthy, Henry, Conbraco, or equal.

Q. Magnetic Lever Valves:

MLV-1 Bronze, stainless steel and bronze trim, 2-way, packless normally closed, metal seat.

General Controls, K-10AA2030 or equal.

**APPLICATION: Can washing system. Provide for can washing installation.**

R. Piping:

1. Piping shall be continuously and permanently marked with manufacturer's name, type of material, size, pressure rating, and the applicable ASTM, ANSI, UL, or NSF listing. On plastic pipe, date of extrusion must also be marked.

2. Underground non-ferrous pressure pipes shall be installed with proper color tracer wires. Refer to color code provisions in Section 23 0553: HVAC Identification.

3. Refer to HVAC Piping: Section 23 2013 for heating and chilled water piping and fittings.

1. Schedule Number: Description
   1. Cast iron – Hubless, service weight, . ASTM A888, CISPI 301, conforming to CISPI 310 and installed in accordance to IAPMO 1S 06. American Foundry, Tyler, or AB & I or equal.
   2. Galvanized steel, Schedule 40, ASTM A53., US Steel or equal.
   3. Copper drainage tube, underground, type L hard, ASTM B 88, Mueller, Cerro Brass or equal.
   4. Copper drainage tube, inside structure and above grade. Type DWV hard temper, ASTM B 306, Mueller, Anaconda, Cerro Brass, Cambridge-Lee, Halstead or equal.
   5. Purple pipe, PVC, schedule 40 for reclaimed or recycled water (below ground only for non-potable irrigation systems), type 1, grade 1, PVC- 1120, Cell Class 12454 B.
   6. Copper water tube, Type L hard, ASTM B88. Mueller, Cambridge-Lee, Halstead or equal. (when used above ground only)
   7. Copper water tube, Type K hard, ASTM B88, by Mueller, Cerro Brass, Cambridge-Lee, Halstead or equal.
   8. Polyethylene plastic pipe, ASTM D 2513, standard dimension ratio. 11, rated at 80 psi working pressure at 73 degrees Fahrenheit (F). for 3 inches and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4 inches and above, butt or socket type fittings, joined by heat fusion, orange or yellow color.

CPCHEM (Chevron Phillips Chemical Company LP) PE 2406, or equal.

**(Furnished for natural gas below grade only) Transition to anodeless steel riser at meter, regulator, or building wall.**

* 1. Red seamless brass, 85-5-5-5, iron pipe size (IPS), threaded pipe, ASTM B43

Mueller, Cerro Brass, Cambridge-Lee, Halstead or equal.

* 1. Black steel pipe, Schedule 40, ASTM A53, Type E, ERW by US Steel, or equal.
  2. Seamless copper tubing, tempered drawn, Type M, ASTM B88 by Mueller, Cerro Brass or equal.
  3. High Silicon Iron Casting, 1-1/2 inches and 2 inches, threaded for Science Room Vents when ferrous waste piping is provided, ANSI-A21.10, WWP- 356-36, ASTM D1784-699, by Duriron or equal.
  4. PVDF (Polyvinylidene Fluoride) schedule 40 pipes, conforming to ASTM F1673, ASTM D3222 and complying with UL723 (ASTM E84). The joints may be no-hub or electro-fusion type. Installer shall be certified by manufacturer for joint installation. Orion, Fuseal or equal

**Provide fireproof wrapping where the corrosive waste piping passes through air plenums as defined by CMC. This type may be used for underground.**

**This type may be used for installations where the corrosive waste piping passes through air plenums as defined by California Mechanical Code (CMC) and underground.**

* 1. Polypropylene chemical waste, flame retardant pipe, conforming to ASTM F1412 and ASTM D4101. The joints may be no-hub or electro-fusion type. Installer shall be certified by the manufacturer for joint installation. Orion, Fuseal or equal.
  2. PVC, thick wall, cast-iron OD sized, UL listed, AWWA listed, NSF listed, Class 200 with tracer wire, Blue Brute, or equal.

**APPLICATION: Domestic water, Irrigation and main fire line below ground only (4” inch and over).**

* 1. Type 316L Stainless steel chemical waste pipe, marked with manufacturer's identification and fittings. Mechanical press fit joints with EPDM seals Manufacturer's representative shall instruct installers and certify them for joint installation. Piping system shall be provided with a 5- year manufacturer’s material warranty.

Blucher-Josam or equal. .

**(This type shall not be used for underground installations. Only where the corrosive waste piping passes through air plenums as defined by CMC.**

* 1. 304 / 304L Stainless Steel, .049 wall, ASTM A312. Pipe must be certified for use with the Vic-Press 304TM piping system. By Trent Tube, Victaulic or equal.

**(This type shall not be used for underground installations. Only where the corrosive waste piping passes through air plenums as defined by CMC.**

* 1. CPVC (Chlorinated polyvinyl Chloride) schedule 40 pipe, conforming to ASTM D1784 and complying with UL723 (ASTM E84). The joints shall be of solvent cement type conforming to ASTM F493. Installer shall be certified by the manufacturer for this type of joint installation. Spears, Corzan, Charlotte or equal.
  2. PVC, schedule 40, extruded from 100 percent virgin Polyvinyl Chloride (PVC) compound, meeting requirements of class 1254-13 of ASTM D1784.

1. Pipe Fittings:

NOTE: All pipe fittings in a domestic plumbing system intended to convey water for human consumption shall comply with Quality Assurance, article 1.03.C of this specifications.

PF-1 Cast iron, soil or waste no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 2 bands for size 1 ½” thru 4”, IAPMO, ASTM C 564 and CISPI 310.

American Foundry, Tyler, or equal.

PF-2 Cast iron, soil or waste, Heavy-duty no-hub coupling with neoprene gaskets, stainless steel corrugated shields and stainless steel clamps. 4 bands for size 5” thru 10”. IAPMO, ASTM C564 and CISPI 310.

American Foundry, Tyler, or equal.

**Provide with P-1 and as Required By Engineer due to site specific conditions**

PF-3 Malleable iron, Class 150, threaded, galvanized, beaded, ANSI B 16.3. P-2 Stockham, Stanley Flagg, Grinnell Or eual.

**Provide with P-2**

PF-4 Cast brass drainage fittings ASA B 16.23, ASTM B 42. Provide with copper drainage tube.

Mueller Brass, Nibco, Stanley Flagg, Lee Brass Or equal.

**Provide with P-3 and P-4.**

PF-5 Wrought copper - solder type ANSI B 16.22 Mueller Brass, Nibco, Lee Brass or equal.

PF-6 Polyethylene plastic fittings, ASTM D 3261 and D 2683, standard dimension ratio 11, rated at 80 psi working pressure at 73 degrees F. for

3 inches and smaller, SDR 11.5 rated at 76 psi at 73 degrees F. for 4 inches and above, butt or socket type fittings, joined by heat fusion, color orange or yellow,

CPCHEM, (Chevron Phillips Chemical Company LP) or equal.

**(Provide with P-8)**

PF-7 Polyethylene transition risers, for Pf-6 above, Transition fitting must have a minimum vertical height of 36” from the horizontal connection which will allow for a 6” steel riser above ground. Polyethylene transition risers shall be anodeless

Central Plastics Company or equal.

**APPLICATION: installed in a gas piping system for the purpose of providing a transition from horizontal below ground (polyethylene) to a vertical above ground (steel). Transition must be made on the horizontal side of the gas piping system and meet ASTM standards for Polyethylene plastic pipe and fittings**

PF-8 Bronze and brass, 250 psi, threaded, ASA B16.17 and F S WW-P-460

**Provide with P-9.**

Mueller Brass, Lee Brass Or equal.

PF-9 Malleable iron, Class 125, ANSI B 16.3, threaded or welded Schedule 40 black steel for 2 inches and below and welded for 2-1/2 inches and above, by Stockham or equal.

**Provide with P-10.**

PF-10 Cast iron, threaded, Class 125, ANSI B 16.1

**Provide with P-12.**

Stockham or equal.

PF-11 Cast-iron OD sized, bell and spigot gasket joints. PF-12 Steel butt weld type, ASTM A 234WPB.

**Provide with P-10.**

PF-13a No-hub couplings for factory grooved PVDF or polypropylene, schedule 40 piping. The coupling shall be of the same material and gauge as the pipe. Each coupling shall have 300 series stainless steel outer band and 5/16” bolts, nuts and washers plated to meet a 100- hour salt spray test per ASTM B117. Installer shall be certified by the manufacturer for this type of joint installation. Orion, Fuseal or equal.

**Provide with P-13.**

# PF-13b The pipe and fitting shall be joined using the socket fusion system conforming to ASTM 2657. Installer shall be certified by the manufacturer for this kind of joint installation. Orion, Fuseal or equal.

**Provide with P-14.**

PF-13c CPVC (Chlorinated Polyvinyl Chloride) schedule 40 pipe and fittings, conforming to ASTM D1784 and complying with UL723 (ASTM E84), shall be joined using solvent cement conforming to ASTM F493. Installer shall be certified by the manufacturer for this kind of joint installation. Spears, Corzan or equal.

**Provide with P-18.**

PF-14a Drains, bottle traps and similar devices for CPVC, PVDF or polypropylene, schedule 40 piping, shall be of same material and gauge as the pipe with mechanical joints. Installer shall be certified by the manufacturer for this kind of joint installation. Orion, Fuseal or equal.

**Furnish with matching pipe only. Provide fireproof wrapping where the polypropylene piping passes through air plenums as defined by CMC.**

PF-14bType 316L Stainless steel joint for chemical waste piping systems including drain or bottle traps . Blucher-Josam or equal.

**Furnish when used with matching pipe only. This type shall not be used for underground installations and only where the corrosive waste piping passes through air plenums and the available space is not sufficient for fire proof wrapping of polyethylene piping.**

PF-15 Precision cold drawn austenitic 304/304L stainless steel, with elastomer O-rings

**Grade to suit intended service. Provide with piping schedule P-16**

Victaulic Vic Press 304TM or equal.

PF-16 Grooved end type– ASTM A395 and A536 ductile iron; ASTM A234 WPB forged steel; fabricated from ASTM A53 carbon steel. Couplings shall be supplied with angle-pattern bolt pads for rigidity, except in locations where flexibility is desired. Gaskets shall be pre- lubricated. Galvanized or painted, by Victaulic or equal.

**Grade to suit the intended service. Provide with piping schedule number P-2 or P-10**

PF-17 Grooved end type– ASTM B75 or B152 and ANSI B16.22 wrought copper, bronze sand casting per ASTM B584-87 copper alloy CDA 836 per ANSIbB16.18. Couplings shall be CTS style 606 supplied with angle pattern bolt pads for rigidity, coated with copper coated alkyd enamel. Gaskets shall be pre-lubricated Flush seal type by Victaulic or equal.

**(For domestic Hot and cold water 2 ½” and larger copper applications). Provide with piping schedule number P-6.**

PF-18 CPVC fittings must conform to ASTM D2846 specification for chlorinated polyvinylchloride (CPVC) plastic for hot and cold water distribution system.

PF-19 Plastic fittings, schedule 40 molded from PVC type I compound, conforming to the requirements of specification ASTM D2466.

T. Pipe Isolators:

PLA-1 Absorption pad shall be not less than 1/2 inch thick, unloaded. Pad shall completely encompass pipe.

Holdrite, LSP, Stoneman, Potter-Roemer, Trisolator, PR-Isolator, or equal.

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| **EDIT NOTE: APPLICATION: FOR COPPER PIPING.** |

PLA-2 Plastic cushion to form an insulating liner and eliminate metal to metal contact when securing copper tubes and pipes in air conditioning and refrigeration insulation preventing galvanic erosion. (Acoustical Type for Sound Absorption)

Hydra-Zorb Cushion Clamps, LSP Products Group Acousto Clamp, or equal.

U. Pressure Gage: Aluminum or steel case, minimum 4-1/4 inches dial; pressure type or combination vacuum-pressure type, with provisions for field calibration. Dial indicator to indicate pressure in psi with accuracy to within plus or minus 0.5 percent of maximum dial reading. Furnish gages with restriction screw, size 60, to eliminate vibration impulses. Black case and ring, bourdon tube of seamless copper alloy with brass tip and socket. Three way gage cock, constructed of brass with stuffing box, 1/2 inch couplings, with fixed or movable cap nut to shut off pressure gage.

PG-1 Pressure type, black drawn steel case, 4 ½-inch glass dial, range approximately twice line pressure.

Marsh Keckley, Trerice, Weksler, Weiss.

V. Plug Valves:

PV-1 2 inches and smaller: Rockwell No.114, lubricated plug type, 200 lb., water operating gauge pressure iron body and plug, regular pattern, threaded, with indicating arc; by Walworth, Homestead, WKM, or equal.

**APPLICATION: Isolation and on-off application for gas system.**

PV-2. 2-1/2 inches and larger: Rockwell No.115 and No.165 lubricated plug type, 200 lb. water operating gauge. Iron body and plug, regular pattern, flanged, with indicating arc. Walworth, Homestead, WKM, or equal.

**APPLICATION: Same as PV-1.**

W. Safety Relief Valves:

SRV-1 Combination temperature and pressure relief type. CSA approved. Set to open at 125 psi pressure.

Watts 40L, Cash-Acme NCLX-1, Wilkins TP220, or equal.

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| **EDIT NOTE: APPLICATION: STEAM SYSTEM, HOT WATER SYSTEM.** |

SRV-2 Same as SRV-1, except provide on storage type water heater with anode in dip tube.

Watts 10 x L, CashAcme NCLX-1, Wilkins TP220, or equal.

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| **EDIT NOTE: APPLICATION: SAME AS SRV-1.** |

SRV-3 Spring pop type, ASME and/or NB stamped and certified with manual lifting device for low-pressure steam boilers not exceeding 15 psig, and for hot water boilers and heaters operated at pressure not exceeding 160 psi or temperature not exceeding 250 degrees F. Outlet shall be one pipe size larger than inlet.

Crane, Bailey, Cash-Acme, Keckley, or equal.

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| **EDIT NOTE: APPLICATION: LOW PRESSURE STEAM AND HOT WATER SYSTEM.** |

X. Strainers:

STR-1 Description: Wye type with monel or stainless steel strainer cylinder (manufacturer's standard mesh), and gasketed machine strainer cap. Where indicated on Drawings, provide with valved (globe valve) blowout piping, same size as blowout plug.

1. 2-inch and smaller:

C.M. Bailey No.100-A, 250 lb., cast iron body, threaded, Keckley 'B'.

2. 2 ½-inch and larger:

C.M. Bailey No.100-A, 125 lb., cast iron body, flanged, or Victaulic style 732, 300 psi, ductile iron body, grooved, fusion bonded epoxy coated.

C.M.Bailey Armstrong Muessco Keckley 'A'

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| **EDIT NOTE: APPLICATION: STEAM SYSTEMS AND CHILLED WATER AND CONDENSER WATER SYSTEM AND SPACE HEATING HOT WATER SYSTEM.** |

STR-2 Y pattern cast iron bodies, 125 psi, monel screen. Open area at least twice the cross-sectional area of IPS pipe in which strainer is installed and may be woven wire or perforated type. Screwed ends for sizes up to 2 inches, flanged ends fusion bonded epoxy coated for 2 1/2 inches and larger perforations, in accordance with the following:

1. Steam service - 40 square mesh.

2. Other services - 16 square mesh.

Bailey No.100, Armstrong, RP&C, Keckley.

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| **EDIT NOTE: APPLICATION: SAME AS STR-1.** |

STR-3 Flanged, bucket type, semi-steel body, 125 psi, stainless steel screen with 1/8 inch diameter perforations. All sizes.

Bailey No.1 Zurn 150 Series RP&C Keckley GFV

**APPLICATION: Domestic cold and hot water system. Mount above grade for water service)**

STR-4 Grooved, T-pattern, ductile iron body, 300 psi, stainless steel frame and mesh basket, grooved ends.

**APPLICATION: Domestic hot and cold water system except for high pressure system.**

Y. Temperature Control Valves:

TCV-1 Motor-operated valve, Forged brass bodies rated at no less than 400 psi working pressure; Chrome plated brass ball and stem, female NPT union ends, dual EPDM lubricated O-rings and TEFZEL characterizing disc.

Operated by Electronic Valve Actuator, manufactured, brand labeled or distributed Honeywell Barber-Colman

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| **EDIT NOTE: APPLICATION: CHILLED WATER SYSTEM AND SPACE HEATING HOT WATER SYSTEM.** |

TCV-2 Valves, automatic, electric, 3-way control.

Packed type bronze body and trim. Metal-to-metal seats designed for tight shut-off. Constant total flow throughout full plug travel. Valve designed for 150 psig steam working pressure. Valve operated by spring return motor with gear train. Valves screwed for sizes 2 inches and smaller.

Honeywell Johnson Robert Shaw Powers, Leonard

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| **EDIT NOTE: APPLICATION: STEAM SYSTEM.** |

TCV-3 Valves, automatic, electric, 3-way control.

Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, NPT female end fittings, with dual EPDM O-ring packing design, fiberglass reinforced Teflon flow characterizing disc. **[NPS ¾ inch and Smaller for Terminal Units: Nickel plated forged brass body rated at no less than 600 psi, chrome plated brass ball and blowout proof stem, NPT female fiberglass reinforced Teflon flow charactering disc.]**

Honeywell Barber-Colman Powers

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| **EDIT NOTE: APPLICATION: CHILLED WATER AND SPACE HEATING HOT WATER SYSTEM.** |

TCV-4 Same as TCV-2, except with American Standard B16.1 flanged ends and cast iron bodies for valves 2-1/2-inches and larger.

Honeywell, Johnson, Powers, Robert Shaw, Leonard

**APPLICATION: Same as TCV-2**.

TCV-5 Valves, automatic, electric, 3-way control .

Packed type bronze body and trim. Metal-to-metal seats designed for tight shut- off. Constant total flow throughout full plug travel. Valve designed for 150 psig steam working pressure. Valve operated by spring return motor with gear train. Valves screwed for sizes 2 inches and smaller.

Honeywell PowersBarber-Colman Leonard

**APPLICATION: Domestic hot water, chilled water and space heating hot water system and steam system.**

TCV-6 Valves, automatic, pneumatic, 3-way control .

Diaphragm-type of metal construction, brass trim. Valves of single seat type with bronze discs especially designed for the control of water. Pneumatic actuator diaphragm suitable for 250 degrees F.

Honeywell Johnson Powers Robert Shaw Leonard

**APPLICATION: Same as TCV-4.**

TCV-7 Same as TCV-4, except with American Standard B16.1 flanged ends and cast iron bodies for valves 2-1/2 inches and larger.

**APPLICATION: Same as TCV-4.**

TCV-8 Same as TCV-5, except with American Standard B16.1 flanged ends and cast iron bodies for valves 2-1/2 inches and larger.

**APPLICATION: Same as TCV-5.**

Z. Thermometers

1. Industrial:

T-1 Straight type with fixed or ratable stem, extruded or cast brass or cast aluminum case and brass separable well 6 inches minimum scale, angle or straight type range 30 degrees - 240 degrees F.

Weksler, Trerice, Weiss

T-2 Round type 3 ½-inch minimum dial range of 100 between 30 degrees and 155 degrees F, color coded red above 150 degrees F. Brass chrome plated case.

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| **EDIT NOTE: APPLICATION: PROVIDE AT MIXING VALVES.** |

Ashcroft, U.S. Gage, Marsh, Weiss, or equal.

2. Remote:

T-3 Liquid-filled capillary type with bulbs as required for remote and insertion mounting dials of 3 ½-inch minimum diameter, non-ferrous internal parts, external means for re-calibration, glass or plastic lens and steel or non-ferrous case suitable for wall, duct or panel mounting range 30 degrees to 240 degrees F.

Marsh Trerice U.S. Gauge Weiss

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| **EDIT NOTE: APPLICATION: PROVIDE FOR MEASURING DUCT, PLENUM, AND OTHER AIR TEMPERATURES.** |

AA. Traps:

TP-1 Steam, low-pressure (15 psig) float and thermostatic without strainers and with brass body (DZR) P-CuZn35Pb2 valves and Tefzel seats, for drips into gravity return, coils, etcetera.

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| Illinois | Hoffman | Sarco | Armstrong |  |  |
| 50 Series | 860 Series |  |  |  |  |

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| **EDIT NOTE: APPLICATION: LOW PRESSURE STEAM SYSTEM.** |

TP-2 Steam, low-pressure (15 psig), thermostatic for radiators and convectors, brass body (DZR) P-CuZn35Pb2 valves and Tefzel seats, cast iron body

Webber Series 5 Sarco 17C, 8C, 9C Hoffman Armstrong

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| **EDIT NOTE: APPLICATION: SAME AS TP-1.** |

BB. Vent Assemblies:

VA-1 4 inches oval type for clothes dryer. American Metal Products

**APPLICATION: Low pressure steam system.**

CC. Vent Caps:

VC-1 Vandal-proof hood type, for plumbing vent lines. Stoneman Engineering and Mfg.Semco 1550

**APPLICATION: Sanitary drainage system.**

DD. Valves (Air Vent):

VAV-1 Hot or chilled water air release valves shall be cast brass rated for 150 psig design pressure and 270 F operating temperature.

Spirotherm, Bell & Gossett, Taco.

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| **EDIT NOTE: APPLICATION: CHILLED WATER AND CONDENSER WATER SYSTEM AND SPACE HEATING HOT WATER SYSTEM.** |

VAV-2 Hot or chilled water space heating system air valve, brass with nickel trim 1/4 inch connection, disc type for manual or automatic venting.

Hoffman 500, Spirotherm, Watts, or equal.

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| **EDIT NOTE: APPLICATION: SAME AS VAV-1.** |

VAV-3 Brass petcock, 1/4 inch connection by 1/4 inch copper tube to high point of coil or line by means of a tapped cap on top of 6 inches vertical nipple. Petcock to be installed approximately 5 feet 6 inches above finish floor.

Amtrol, Watts, Dole, or equal.

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| **EDIT NOTE: APPLICATION: SAME AS VAV-1.** |

EE. Vacuum Valves:

VV-1 Vacuum valves; for vacuum serve, 125 psig working pressure, cast iron body, spring loaded lubricated plug type.

General Controls, Honeywell.

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| **EDIT NOTE: APPLICATION: CHILLED WATER, CONDENSER WATER AND SPACE HEATING HOT WATER SYSTEMS.** |

FF. Protective Coating for Underground Steel Piping Applied to Underground Automotive:

1. Black steel or galvanized steel piping indicated for below grade installation, shall be protected as specified prior to delivery to the Project site:
   1. Sandblast black steel pipe to a gray finish. Sandblast galvanized steel pipe lightly only.
   2. Install one coat of cut back asphalt to galvanized pipe immediately after sandblasting. Pre-heat black pipe to 180 degrees F. immediately before coating.
   3. Install one coat of high-temperature (melting point of 240 degrees F. minimum) Grade B asphalt enamel.
   4. Install one wrapping of 20 mils thick glass, fiber mat, Owens- Corning Coromat or L.O.F. Blueflag with 1/4 inch overwrap. Glass fiber shall be dry at time of installation.
   5. Install a second coat of asphalt enamel as specified above. Glass fiber mat shall be centered in the asphalt enamel.
   6. Install an overwrap of Kraft ripple paper.
2. Total thickness of pipe wrapping shall be not less than 1/8 inch. Entire coating operation shall be accomplished by mechanical means in a continuous operation. Hand installation of protective coating is not permitted.
3. Each piece of wrapped pipe shall be legibly identified at no greater than 5 feet intervals by fabrication company. Each material submittal shall include the name of the fabrication company. Maintain one reviewed Sample on the Project Site.
4. Acceptable manufacturers of wrapping are: Hunt, Mobile, Conway
5. Fittings (including couplings), unprotected pipe adjacent to fittings, and damaged pipe protection shall be wrapped at Project site as follows:
   1. Fittings and pipe to be wrapped shall be thoroughly cleaned of material foreign to pipe manufacturer.
   2. Install one coat of Plicoflex No. 105 or Protecto Wrap No. 1170 adhesive primer to metal.
   3. Wrap pipe and fittings with a minimum thickness of 3/32 inch of Plicoflex No. 310 pipe line butyl molding tape, or Protecto Wrap No.

200 molding tape. Install 3 layers, each layer overlapping next approximately 2/3 width of tape, without stretching. Tape and primer shall be of the same manufacturer.

* 1. Wrap vinyl tape, 10 mil thickness, over molding tape with 1 inch minimum overlap.

J.M. Trantex 3M Scotchwrap

1. Pipe and fittings specified to be wrapped shall be tested with a holiday detector, after pipe has been installed in trench and before backfilling, in presence of the PI. Furnish a Tinkler and Raser model E-P holiday detector, or similar equipment for this test. Work, which is deemed defective, shall be repaired and/or replaced. PI may test for damaged pipe wrapping after backfilling.
2. Instead of wrapping underground steel pipe as specified above, pipe may be machine-wrapped before delivery to the Project site as follows:
   1. Pipe shall be cleaned of moisture, oil, grease, scale, and other foreign material by cleaning with non-oily solvent and wire brushing. Remove metal burrs and projections.
   2. Install one coat of Plicoflex No.105 adhesive primer to cleaned pipe. If thinning is required, furnish only non-oily thinners as recommended by tape manufacturer.
   3. Wrap coated pipe with Plicoflex No.340-25 tape (15 mil butyl and 10 mil vinyl laminate) Tape shall be installed by machine wrapping at approved plant only. Maintain tension (minimum of 5 pounds per inch of width) on tape over entire diameter of pipe. Tape shall be permanently identified and visible on vinyl side.
   4. Fittings, unprotected pipe, and damaged pipe protection shall be wrapped as indicated above.

GG. Flanges: Flanges shall be furnished and installed at each flanged connection of each type of equipment, tanks, and valves. Faces of flanges being connected shall be furnished alike. Connection of a raised face flange to a flat-faced flange is not permitted. Flanges shall conform to following schedules:

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| TYPE OF PIPE | FLANGE |
| Screwed black or galvanized grooved steel pipelines. | 125 pound black cast iron screwed flange, flat faced or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal. |
| Welded or grooved steel pipe, except high pressure steam lines. | 150 pound black forged steel welding flanges, 1/16 inch raised face ASTM A105, Grade II or grooved flange adapters, Victaulic Style 741, Tyco-Grinnell Fig. 71, Gruvlok Fig. 7401, or equal. |
| Copper and brass pipe or tubing. | 150 pound cast bronze, flat-faced flange with solder end or grooved flange adapters, Victaulic Style 641, Tyco-Grinnell Fig. 61, Gruvlok Fig. 6084, or equal. |

1. Gasket material for flanged connections shall be full faced or ring type to suit facing on flanges and shall be furnished in accordance with following schedule

SERVICE TYPE

Cold water 1/16 inch thick neoprene

Steam, hot water 1/l6 inch Teflon

Grooved end flange adapters supplied with pressure responsive elastomeric Gaskets supplied with grooved flange adapters shall be pre-lubricated by the manufacturer. Grade of gasket to suit intended service.

FF. Unions:

1. Unions shall be furnished and installed in accordance with the following requirements (unless flanges are furnished):

a. At each threaded or soldered connection to equipment and tanks, except in Freon or fuel gas, piping systems, whether indicated or not.

b. Immediately downstream of any threaded connection to each manually operated threaded valve or cock, and each threaded check valve, yard box or access box except those in Freon piping systems, whether indicated or not.

c. At each threaded connection to threaded automatic valves (except those in Freon piping systems) such as reducing valves and temperature control valves, whether indicated or not.

d. If grooved piping is used, couplings shall serve as unions. Additional unions are not required

2. Unions shall be located so that piping can be easily disconnected for removal of equipment, tank, or valve.

1. Condensate Drain Piping, from Air Handling Units:
   * + 1. Pipe: Type M tempered copper tube.
       2. Fittings: Wrought copper. Refer to Section 15050. Furnish copper to threaded international pipe size adapters at threaded connections.
       3. Joints:
          1. Soldered: 95-5 solder.
          2. Threaded: Pipe joint compound equivalent to WKM Key-Tite or equal.
2. Flexible Metal Connectors:
   * + 1. Provide vibration elimination flexible metal connectors on chilled and hot water supply and return piping where rigidly supported pipes connects to unit housing coil attachments and units are supported by vibration isolators.
       2. Schedule Numbers:
          1. FMC-1: Corrugated bronze metal hose with outer bronze braid in tubular sheath of woven metal wires. Connector with female copper tube ends for copper piping. Metraflex model BBS, or equal.
          2. FMC-2: Corrugated stainless steel metal hose with outer stainless steel braid in tubular sheath of woven metal wires. Connector with male pipe threads (NPT) for threaded piping. Metraflex model SST, or equal.
          3. FMC-3: Corrugated Bronze Metal Hose with outer bronze braid in tubular sheath of woven metal wires. Connector with female copper tubes ends for refrigeration piping. Metraflex model RAF, or equal.

**2.03 EQUIPMENT**

* + 1. Furnish centrifugal pumps capable of delivering rated capacity against total dynamic head as indicated on schedule and as specified for following:
       1. Condenser Water Pump:
          1. Single stage base mounted, vertical split case, cast iron, bronze fitted construction. Pump impeller, casing bearings, capable of being serviced without disturbing piping connections.
          2. Impeller, enclosed type, hydraulically and dynamically balanced and keyed to shaft and secured with a suitable locknut.
          3. Pump shall employ a mechanical seal, with a carbon seal ring and ceramic (or tungsten carbide) seat. A shaft sleeve furnished under complete wetted area of mechanical seal.
          4. Bearing frame assembly of pumps fitted with oil lubricated bronze journal bearings and a hardened alloy steel shaft.
          5. Flexible coupling to absorb torsion vibration between pumps and motor.
          6. Motor: Resilient mounted, furnished with oil lubricated journal bearings.
          7. Pump: Factory tested, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. A set of installation instructions to be furnished with pump at time of shipment.
          8. Acceptable manufacturers: Paco, Bell and Gossett, or Wienman.
       2. Chilled Water Pumps:
          1. Horizontal, split case, fitted same as above, or end suction similar to that indicated below.
          2. Frame mounted with flexible coupling on shaft.
          3. Manufacturers: Paco, Bell and Gossett, or Weinman.
       3. Hot Water Pumps: End suction, centrifugal, vertical split case, cast iron base mounted. Paco type L, Bell and Gossett, or Weinman.
       4. Boiler Feed Pump: Two-stage, bronze fitted mechanical seals, double suction, regenerative turbine type with cast iron housing. Construction shall permit disassembly of pump without disturbing suction and discharge pipe connections. Pump impeller shall be bronze, mounted on stainless steel shaft supported by ball bearing on each side of pump casing. Pump shall be directly connected with a flexible coupling to an open drip-proof motor and mounted on a common steel base. Pump shall be operated from a boiler water level controller mounted on boiler. Pump shall be Roth Series C100, Skidmore, or Aurora and Pacific. Pumps shall be electrically interlocked to 24-hour day/night operating boiler controls.
       5. Vacuum Pump:
          1. Vacuum pump shall be the packaged duplex-type with common base and be furnished with receiving tank, 2 pumping units, alternator, accessories, and controls. Huffman HVD series, or equal.
          2. Receiving tank shall be cast iron and be furnished with inlet strainer, gage glass, air discharge separator, and automatic ball float operated valve.
          3. Pumping units shall be bronze fitted throughout and rotating parts shall be dynamically balanced. Receiving tank, pumping units and motors shall be assembled by manufacturer to form an integral unit. Unit shall be furnished with condensate and air discharge valves, vacuum relief valve, compound gage, thermometer, and companion flanges for connections.
          4. Unit shall be pre-wired and be furnished with magnetic motor starters; overload protection for motors; float switch; vacuum switch; 3-position selector switch for automatic control, control by float only, or continuous operation; and an electrical alternator to automatically transfer operating sequence of pumps. Unit shall be electrically interlocked to 24-hour day/night operating boiler controls.

**PART 3 – EXECUTION**

**3.01 EXAMINATION**

A. Examine areas and conditions under which Work of this Section shall be performed. Correct conditions detrimental to proper and timely completion of Work. Do not proceed until unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

A. Provide all materials and equipment for the Work. Furnish and install necessary apparatus, parts, materials, and accessories.

B. Pipe Installation:

1. Install piping parallel to wall and provide an orderly grouping of proper materials and execution.

2. Piping shall clear obstructions, preserve headroom, provide openings and passageways clear, whether indicated or not. Verify the Work of other Divisions to avoid interference.

3. If obstructions or the Work of other Divisions prevent installation of piping or equipment as indicated by the Drawings, perform minor deviations as required by the Architect.

4. Install piping after excavation or cutting has been performed. Piping shall not be permanently enclosed, furred in, or covered before required inspection and testing is performed.

5. Exposed polished or enameled connections from fixtures or equipment shall be installed with no resulting tool marks or threads at fittings. Residue or exposed pipe compound shall be removed from exterior of pipe.

6. Piping shall be concealed in chases, partitions, walls, and between floors, unless otherwise directed or specifically noted on Drawings. When penetrating wood studs, joists, and other wood members, provide such members with reinforcement steel straps of Continental Steel & Tube Co., ULINE, Independent Metal Strap, or equal.

7. Reduce fitting where any change in pipe size occurs. Bushings shall not be furnished unless specifically reviewed by the Architect, or indicated on Drawings.

8. Piping subject to expansion or contraction shall be anchored in a manner, which permits strains to be evenly distributed. Swing joints or expansion loops shall be installed. Seismic restraints shall be installed so as not to interfere with expansion and contraction of piping. Seismic loops required at all building separations.

9. Immediately after lines have been installed, openings shall be capped or plugged to prevent entrance of foreign materials. Caps shall be left in place until removal is necessary for completion of installation.

10. Couplings shall not be installed except where required pipe runs between other fittings are longer than standard length of type of pipe being installed and except where their installation is specifically reviewed by the Architect.

11. Water piping shall be installed generally level, free of traps, unnecessary offset, arranged to conform to building requirements, clear of ducts, flues, conduits, and other Work. Piping shall be arranged with valves installed to provide for complete drainage and control of system. Piping shall not be installed which causes an objectionable noise from flow of water therein under normal conditions. Refer to Section 23 0500: Common Work Results for HVAC.

12. Water lines may be installed in same trench with sewer lines, provided bottom of water line is 12 inches minimum above top and to the side of sewer line.

13. Hot and chilled water circulating piping installed for space heating or cooling shall pitch up to a high point at a slope of 1/4 inch in 10 feet in the direction of flow. Where supply and return lines are exposed, both lines shall pitch in same direction. Otherwise, where possible, lines shall pitch up toward compression tank.

14. Changes in pipe sizes shall be furnished with eccentric reducers, flat on top. Offsets to clear obstruction shall not be installed so as to produce air pockets.

C. Pipe Sleeves and Plates:

1. Provide and install pipe sleeves of Schedule 40 black steel pipe or Schedule 40 PVC plastic pipe in concrete or masonry walls, footings, and concrete floors below grade. Provide and install adjustable submerged deck type sleeves at locations where pipes pass through concrete floors, except concrete slab floors on grade, and at locations where soil pipe for floor type water closets passes through concrete floors.

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| **EDIT NOTE: FOR FIRE RATED WALL PENETRATIONS FOLLOW THE CALIFORNIA Building Code.** |

2. Sleeves shall provide 1/2 inch clearance around pipes, except plastic pipe shall have 1-inch clearance. Caps of deck type sleeves shall be removed just prior to installation of pipe. Area around sleeves shall be smooth and without high or low spots. Sleeves in walls shall not extend beyond exposed surface of wall. Sleeves in concrete floors and walls shall be securely fastened to forms to prevent movement while concrete is being placed.

3. Piping installed on a roof shall clear the roof surface by 10 inches minimum, with or without insulation. Bottom of individual fittings may infringe on 10 inches clear space but not groups of fittings or fittings located within 27 inches of each other.

4. Stiles shall be provided to facilitate crossing of piping when parallel piping runs are laterally greater than 12 inches out-to-out, or any pipe is higher than 18 inches, and more than 40 feet long or runs between 2 or more major pieces of equipment or housings greater than 20 feet apart. Stiles shall be not less than 20 inches wide with a minimum tread depth of 10 inches. Where stiles are required, they shall be located so greatest obstructed distance is 30 feet.

5. Where pipes pass through waterproofed walls, floors, or floors on grade, sealant with Link-Seal Modular Seals, or equal, between pipe and sleeve to provide a waterproof joint. Where earth is in contact with pipe on both sides of a wall or foundation, the waterproof joint is not required. Commercial rubber compression units may be furnished instead of sealed sleeves if reviewed by the Architect.

6. A swing joint, or other required device, shall be furnished and installed in hot water lines with 10 feet of sealant or compression joint to allow for expansion.

7. Pipe sleeves shall be provided where pipes intersect footings or foundation walls and sleeve clearances shall provide for footing settlement, but not less than one inch all around pipe.

D. Welding of Pipe and Qualifications of Welder:

1. Joints above grade or accessible conduit or tunnels in steel piping may be either welded or screwed unless specifically indicated otherwise on Drawings or specified. Joints in below grade steel piping, whether in insulation or not, shall not be welded, unless otherwise indicated.

2. Welded joints in pipe shall be continuous around pipe and shall comply with ASME B31: Code for Pressure Piping, unless otherwise specified.

3. Each pipe weld shall be stamped with welder's identification mark. Welding shall be performed by welders possessing a valid certificate of qualification for welding carbon steel welding pipe in horizontal position (2G) and horizontal fixed position (5G) in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code, by an Owner-recognized, DSA approved testing laboratory.

4. Before any welder performs welding on the Work, furnish the Project Inspector with a copy of welder's valid qualification papers and obtain verification. Welder qualification is not valid unless it has been issued while welder was performing work for current employer, and has performed type of work described by qualification in the preceding 3 months.

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| **EDIT NOTE: REFERENCE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-29 TESTS OF WELDERS AND WELDING OPERATORS.** |

5. Welding performed under these Specifications is subject to special tests and inspections including rigid Ultra Sonic Testing (UT) and radiographic inspection at random, in accordance with Technique for Radiographic Examination of Welded Joints by an Owner recognized, DSA approved testing laboratory.

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| **EDIT NOTE: ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-51 RADIOGRAPHIC EXAMINATION OF WELDED JOINTS.** |

E. Unacceptable Welds and Repairs to Welding:

1. Welds containing any of the following types of imperfections shall be deemed defective Work:

a. Cracks of any type.

b. Zones of incomplete (in excess of 1/32 inch) fusion or penetration.

c. Elongated slab inclusions longer than 1/4 inch.

d. Groups of slag inclusions in welds having an aggregate length greater than thickness of parent metal in a length 12 times the thickness of the parent metal.

e. Undercuts greater than 1/32 inch.

f. Overlaps, abrupt ridges or valleys.

2. When a defective weld is detected by examination as outlined above, two additional welds shall be radiographed at locations selected by the Project Inspector. If the two selected welds demonstrate compliant welding, then the two tested welds shall be deemed to be in compliance. Welding revealed by radiographs to be defective Work shall be removed, repaired, and tested by radiograph.

3. If either of the two selected welds demonstrates welding deemed to be defective Work, all welding in that portion of the Work shall be deemed defective Work and either: all welds shall be cutout, prepare new ends for welding and weld to comply with this Specification, or radiograph all welds, removing and repairing only such welding deemed to be defective Work.

4. Repair welding shall be performed in a manner in full compliance with ASME B31. The welded joints or repairs shall be spot examined with UT or radiographic tests in accordance with foregoing requirements.

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| **EDIT NOTE: REFERENCE, ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, UW-52.** |

5. Owner shall cause to be performed additional random UT and radiographic examinations of welds. Owner shall be responsible for the costs of any UT and radiographic examinations found to be in compliance with specified requirements.

6. Installer shall be responsible for the costs of UT and radiographic re-examinations of welds deemed defective Work and not in compliance with this Specification, and shall repair or replace said welds in accordance with specified requirements.

F. Welding Rods: Submit a written list of materials and proposed type of welding rods for review by the Architect.

G. Backing Rings: Backing rings may be submitted for installation provided the Product Data is submitted with the material list.

H. Qualification Tests for Low-pressure Welding:

1. Tests shall be performed on 3-inch standard weight pipe ASTM A53, Grade A, and shall be welded by acetylene and electric arc. Each sample shall consist of two pieces, each 10 inches long, with 30-degree bevel at point weld.

2. Two 20-inch samples shall be performed in the 2G and two 20-inch samples in the 5G positions, with positions defined in Section IX, ASME Boiler and Pressure Vessel Code. Welds shall have the reinforcement ground or machined flush to the surface of the pipe before testing. Samples shall be tested as full section tensile.

3. Weld shall develop a load of 90 percent of 50,000 psi, i.e., 45,000 psi or shall develop a fracture in parent metal.

4. Each qualified welder shall carry an identification card listing welder's name, date of test, and type of welding tests passed; signed by the welder and the laboratory.

5. A valid certificate of qualification issued in compliance with requirements of the ASME Boiler Pressure Vessel Code Section IX shall qualify a welder for issuance of a certificate for low-pressure pipe welding.

I. Certificates of Qualification for Welding of Unfired Pressure Vessels:

1. Certificates of qualification shall be issued by a laboratory recognized by the Owner in compliance with the requirements of the ASME Boiler Pressure Vessel Code Section IX. Qualifications shall be for both acetylene and arc welding of Schedule 40 ASTM A53, Type B, steel welded or seamless pipe in the Horizontal Position (2G) and the Horizontal Fixed Position (5G) as defined by said code.

NOTE: Certificate described above is not valid unless it has been issued while welder was working for his current employer, and unless welder has performed type of work described by certificate in the preceding three months. Requirements for possession of a valid certificate shall not be waived for welders fabricating unfired pressure vessels when the Specifications require compliance with ASME code or when welding pipe carries working pressures greater than 75 psi and temperatures greater than 250 degrees F.

J. Pipe Joints and Connections:

1. Pipe and tubing shall be cut per IAPMO Installation Standards. Pipe shall have rough edges or burrs removed so that a smooth and unobstructed flow shall be provided.

2. Threaded Pipe: Joints in piping shall be installed according to the following service schedule:

a. Refrigerant and Soap Piping: Litharge and glycerine, or Expando, Gasoila, or equal.

b. All other services Furnish sealant, suitable and as reviewed by the Architect.

3. Threads on pipe shall be cut with sharp, clean, unblemished dies and shall conform to ANSI/ASME B1.20.1 for tapered pipe threads.

4. Joint compounds shall be smoothly placed on male thread and not in fittings. Threaded joints shall be installed tight with tongs or wrenches and sealant of any kind is not permitted. Failed joints shall be replaced with new materials. Installation of thread cement or sealant to repair a leaking joint is not permitted.

5. Sharp-toothed Stillson, or similar wrenches, is not permitted for the installation of brass pipe or other piping with similar finished surfaces.

K. Copper Tubing and Brass Pipe with Threadless Fittings:

1. Silver brazed joints shall be used for attaching fittings to non-ferrous metallic refrigerant piping.

2. Non-pressure gravity fed condensate lines may be soldered with 95/5 solder.

3 Silver brazing alloy, Class BCUP-5. Surfaces to be joined shall be free of oil, grease, and oxides. Socket of fitting and end of pipe shall be thoroughly cleaned with emery cloth and wiped to remove oxides. After cleaning and before assembly or heating, flux shall be installed to each joint surface and spread evenly. Heat shall be applied in accordance with instructions in the Copper Tube Handbook issued by Copper Development Associates. Joints constructed of rough bronze fittings shall be provided as recommended by manufacturer.

4. Do not overheat piping and fittings when installing silver brazing.

5. Joints in non-ferrous piping for services not covered above shall be installed with solder composed of 95/5 tin/antimony, ASTM B32, Grade 5A. Surfaces to be jointed shall be free of oil, grease, and oxides. Sockets of fitting and end of pipe shall be thoroughly cleaned with emery cloth to remove oxides. Solder flux shall be sparingly installed and solder added until joint is completely filled. Do not overheat. Excess solder, while plastic, shall be removed with a small brush in order to provide an uninterrupted fillet completely around joint. Random inspection of joints shall be conducted by Project Inspector to ensure joints are lead-free.

6. Grooved end joints for copper piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

L. Ring-Type Pipe: Joints shall be installed in accordance with manufacturer's instructions with grooved couplings, fittings and rubber rings. Couplings and pipe shall be compatible and of the same manufacturer. Rings shall be accurately located and installed by grooves in coupling. Pipe shall be installed with zero deflection unless otherwise specified. Pressure pipe shall be furnished with thrust blocks at each offset point.

M. Welded Pipe Joints:

1. Joints in welded steel pipelines shall be installed by oxyacetylene or electric arc process. Welding shall be continuous around pipe and provided as specified.

2. Butt welds shall be of the single V-type, with ends of pipe and fittings beveled approximately 37 ½ degrees. Piping shall be aligned before welding is started with the alignment maintained during welding.

3. Welds for flanges and socket fittings shall be of the fillet type with a throat dimension not less than pipe wall thickness.

N. Grooved End Pipe Joints: Grooved end joints for carbon steel piping shall be assembled in accordance with the latest manufacturer recommendations. Pipe ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to grove for proper gasket sealing. Grooving tools shall be as manufactured by Victaulic, RIDGID, MAG Tool, or equal.

O. Joints shall be Vic-Press 304TM, or equal, made with Victaulic Series ‘PFT’ tools and the appropriate sized jaw. Pipe shall be certified for use with Vic-Press 304TM system, and shall be square cut, properly deburred and cleaned, and marked at the required location to insure full insertion into the fittings and/or couplings.

P. Valves: Valves shall conform to the following:

1. Piping systems shall be furnished with valves at points indicated on Drawings and specified, arranged to provide complete regulating control of piping system throughout building and the Project site.

2. Valves shall be installed in a neat grouping, so that parts are easily accessible and maintained.

3. Pressure Independent Characterized Control valve type shall be suitable for service on which installed.

4. Valves shall be full size of line in which they are installed, unless otherwise indicated on Drawings or otherwise specified, and shall be one of types specified.

5. Provide chain operators on valves 2-inch and larger located 7 feet or more above the servicing floor level.

6. Valves for similar service shall be of one manufacturer.

7. Except where otherwise specified, valves shall be Belimo, Victaulic, Stockham, Crane, Jenkins, Milwaukee, Hammond, American Valve, NIBCO, Hoffman, or equal.

8. Ball valves below grade in yard boxes shall have stainless steel handles.

9. Temperature relief valves and combination temperature and pressure relief valves shall be as specified and furnished as set forth in this Section. Discharge pipe from relief valves shall be not less than discharge area of valve or valves it connects, based on discharge area of valves, and shall terminate as indicated and free of any traps. Valves shall be installed at following locations:

a. A combination temperature and pressure relief valve or combination of valves on each heating hot water boiler. Temperature sending element shall extend into water inside boiler.

10. Manual air vent valve assemblies shall be installed at each high point of hot water space heating and chilled water piping systems. Valves shall discharge through 1/4 inch diameter copper tubing and drain to nearest floor sink. Automatic type air vent valve shall only be installed where specifically indicated. Radiator, convectors, and finned pipe convectors shall be fitted with packless radiator valves, angle or straight pattern. Each convector or radiator installed as part of a space hot water heating system shall be furnished with a manual-type air vent valve.

Q. Strainers: Strainers shall be installed on each water main (except for fire line) downstream of the meter, above grade, when a pressure regulator assembly is not installed. Main strainer shall be of Y-flange or groove type. On closed loop chilled and heating hot water systems pump systems, a strainer shall be installed at each pump inlet and upstream of each flow control valve assembly. The control valve assembly may include a modulating temperature control valve and a flow-limiting valve, manufactured by Griswold, AutoFlow, Flow Control Industries, Inc., or equal.

R. Hangers and Supports:

1. Piping shall be securely fastened to building structure by approved iron hangers, supports, guides, anchors, and sway braces to maintain pipe alignment to prevent sagging and to prevent noise or excessive strain on piping due to uncontrolled or seismic movement under operating conditions. Hangers and supports shall conform to Manufacturer’s Standardization Society Specification SP-69. Hangers shall be relocated as required to correct unsatisfactory conditions that may become evident when system is placed into operation. Appliances, heat exchangers, storage tanks, and similar equipment shall be securely fastened to structure in accordance with seismic requirements. Outdoor metal hangers and supports shall be hot-dipped galvanized steel, unless otherwise specified.

2. Piping shall not be supported by wire, rope, wood, plumbers' tape, or other non-recognized devices.

3. Hangers and supports shall be designed to support weight of pipe, fittings, weight of fluid and weight of pipe insulation, and shall have a minimum factor of safety of 5, based on ultimate tensile strength of material installed.

4. Burning or welding of any structural member under load is not permitted. Field welding not specified on Drawings or reviewed Shop Drawings is not permitted without review by Architect and DSA.

5. Burning holes in beam flanges or other structural members is not permitted without review by the Architect and DSA.

6. Pipe hangers on piping covered with low temperature insulation shall be installed on outside of insulation and not in contact with pipe unless otherwise detailed on Drawings. Insulation shall be protected by 18 gage galvanized steel shield, with a minimum length of 10 inches, installed completely around pipe covering between covering and hanger. Installing hangers directly on pipe and butting adjoining sections of insulation against hanger is permitted provided void and hanger rod are properly insulated and sealed so that no sweating occurs at hangers.

7. Hanger rods shall be fastened to structural steel members with suitable beam clamps. Clamps shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

a. Tolco I beam, Fig.62 for maximum 1000 lbs.

b. Tolco I or WF beam, Fig. 329, for maximum of 1290 lbs.

8. Hanger rods shall be fastened to concrete inserts in concrete slabs or beams. Inserts shall be Tolco, Carpenter & Patterson, Fee and Mason, or equal, as follows:

a. Tolco Fig.310 for maximum of 600 lbs.

b. Tolco Fig. 309 for maximum of 1140 lbs.

9. For fastening to wood ceilings, beams, or joists, furnish Anvil Fig. 128R, Anvil Fig. 153, Tolco 78, or equal pipe hanger flange fastened with drive screws. Under wood floors, 3/8 inch hanger rods shall be hung from 2-inch by 2-inch by 1/4 inch angle clips 3-inch long, with two staggered 10d nails, clinched over joist.

10. Hanger rod sizes for copper, iron, or steel pipe: 3/8 inch for pipe sizes 1/2 inch through 2-inch, 1/2 inch for pipe sizes 3-inch, 4-inch and 5-inch, 5/8 inch for pipe size 6-inch, and 3/4 inch for 8-inch and 10-inch pipe.

11. Turnbuckles, if furnished, shall provide a load carrying capacity equal to that of the pipe hanger with which they are being installed.

12. Pipe hangers shall be of same size, or nearest larger manufactured size available, as pipe or tubing on which they are being installed.

13. Hangers, clamps, and guides furnished for support of non-metallic pipe shall be padded with 1/8 inch thick rubber, neoprene, or soft resilient cloth.

14. Where special pipe-supporting requirements in the Specifications conflict with any standard requirements specified herein, the Specification requirements shall govern.

15. Vertical Piping:

a. Vertical pipe risers shall be securely supported with riser clamps of recognized type. Risers in reinforced concrete buildings shall be furnished with extension clamps fastened to pipe above each concrete floor slab with extended arms of clamp to rest on slab. Clamps shall be provided with lead or Teflon liners when installed on copper tubing. Clamps shall be plastic-coated when installed on non-ferrous pipe or tubing.

b. Copper tubing in sizes 1 ½-inches and larger and steel pipelines passing up through building shall be supported at each floor of building or every 15 feet whichever is less.

c. Copper tubing sizes 1 ¼-inch and smaller shall be supported at not intervals not more than 6 feet on center. Special provisions shall be installed for vertical lines subject to expansion and contraction caused by operating temperature differences.

d. Vertical cast iron pipelines shall be supported from each floor and at its base. Malleable iron or steel pipe clamps with minimum thickness of 1/4 inch shall be furnished and fastened around pipe for support.

16. Horizontal Piping:

a. Roof Mounted Piping: Pressure and non-pressure piping shall be supported from channels, stands, clamps, trapezes, rollers, or structures mounted on 100% rubber, UV resistant rooftop supports with reflective strips, Dura-Block, or equal. Roller type supports shall be provided below and above pipe to prevent its dislodgement. Bottom of pipes shall clear the roof surface by 10 inches.

1. At PVC roofing provide walk tread, polyester reinforced, UV resistant, with surface embossment at rooftop supports. Heat welding of walk pads shall only be done by manufacturer certified installers.
2. Sika-Sarnafil and Carlisle: Walk tread shall be no more than one inch larger than the plan area of the pipe support blocks and adhered to the roof membrane with Sika 1A or Carlisle Universal Single-Ply sealant, as applicable.
3. Johns Manville: Walk tread shall be installed under the pipe support blocks and adhered to the blocks, if possible, and left loose laid on top of the PVC roof system. Walk-pad shall have a minimum of 4 inches of material past perimeter on all 4 sides of block.
4. Built-up roofing: Provide APP granulated modified torch-down at each pipe support block. Torch-down shall extend 2 to 4 inches beyond the edges of the block and adhered by torch application over existing cap sheet membrane. This work shall be performed by a certified roofer.

b. Piping Mounted to Underside of Roof and Decks and from Structure:

1. Insulated steam and space heating hot water supply and return piping shall be supported with Tolco Figure 4, B-Line Figure B3140, Anvil Figure 212, or equal, steel hangers with welded eye rods to permit hinge movement at point of attachment of hangers. Hinge movement at point of support shall be provided by welded eye linked rods Tolco Figure 101L, B-Line Figure B3211X, Anvil Figure 278X, or equal.

2. Chilled water supply and return piping, condenser water piping, insulated refrigerant piping may be supported with Tolco Figure 1, B-Line Figure B3100, Anvil Figure 260, or equal, hangers with rods, turnbuckles and inserts suitable for above hangers.

c. Maximum hanger and support spacing shall conform to CPC schedule for horizontal piping installed above grade.

17. A hanger or support shall be installed close to the point of change in direction of a pipe run, in either a horizontal or vertical plane.

18. When practicable, supports and hangers for cast iron soil pipe shall be installed as close as possible to joints and when hangers or supports are not located within one foot of a branch line fitting, an additional hanger or support shall be installed at fitting.

19. In systems where grooved piping is used, couplings shall be provided with angle pattern bolt pads to comply with support and hanging requirements of ANSI/ASME B31.1, ANSI/ASME B31.9, and NFPA Pamphlet 13.

S. Flashings:

1. Each pipe, duct, or gas-fired equipment vent passing through roof shall be installed with waterproof flashing.

2. Flashing or flanges on pipes, vents, and ducts passing through a tile or slate roof shall be constructed of sheet lead. Flashing for pipes and heater vents passing through a roof shall be 4 pound soft sheet lead. Flashing and flanges for ducts and heater vents passing through exterior walls shall be 22 gage sheet metal. Flanges and flashing shall be installed waterproof at point of connection with pipe or duct. No soldered joints on roof flashings will be allowed.

3. Lead flashing and flanges shall be constructed of 4 pound sheet lead with burned joints. Flange of lead flashing or lead flange on a duct shall extend out onto roof a minimum of 12 inches from pipe or duct. Lead flashing shall extend up the pipe or duct not less than 7 inches.

4. Sheet metal flashing shall be constructed of 24 gage galvanized sheet steel. Flanges on these flashings shall extend out onto roof a minimum of 10 inches from pipe or duct. Flanges on ducts through exterior walls shall extend out from duct a minimum of 2 ½ inches. Flanges on gas-fired equipment single-wall vents shall be of ventilated type. Type B gas vents through a roof shall be furnished with non-ventilated flashing as per NFPA Pamphlet 211.

5. Cast iron, steel, brass, and copper pipe, which terminate less than 18 inches above roof, shall be furnished with a combination counter-flashing and vandal-proof hood for protection against water, birds and foreign matter. Cast iron, steel, brass and copper pipe, which does not terminate within 18 inches of roof, shall be furnished with a counter-flashing sleeve. Pipe, which terminates more than 18 inches above roof, shall be furnished with protection against entrance of water, birds, and foreign matter.

6. Counter-flashing and combination counter-flashing sleeves and vandal-proof hoods shall be cast iron, vandal-proof, threaded, sealed or approved gas-heated sleeve type. Counter-flashing sleeves on each of these items shall extend down over flashing a minimum of 3/4 inch.

7. Flashing and flanges on ducts shall be installed waterproof at point of connection to the duct by riveting and soldering. Storm collars shall be securely screwed and installed waterproof around appliance vent pipe immediately above flashing.

8. Vent piping above roof shall be furnished with a combination counter-flashing sleeve and vandal-proof hood.

T. Equipment Installation: Install roof or floor mounted equipment on level platforms, housekeeping pads or curbs and provide sound, vibration and seismic control measures per Section 23 0548, unless indicated otherwise whether indicated on drawings or not.

END OF SECTION