



HVAC Piping and Pumps Specification

Specification 23 20 00

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Amendment Record Sheet

Amendment in Clause No.	Date of Amendment	Description of Changes
Various	Sept 2018	Revised to coordinate with corresponding specifications.
Various	June 2022	Revised sentence structure to coordinate with Commercial Quality Assurance, added requirements for mechanical lifting devices in boiler room, warranty section modified to point to contract warranty

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1. GENERAL

1.1. SCOPE OF WORK

- 1.1.1. This Section 23 20 00 specifies the Contractor requirements to provide HVAC piping and pumps as required, scheduled, and specified herein.

1.2. DESIGN REQUIREMENTS

- 1.2.1. Pump motors are to comply with requirements of Section 20 05 10.
- 1.2.2. Mechanical means are required for pump motor replacement, where pump is floor mounted.
- 1.2.3. Design requirements are based on Part 2 specified requirements of products.

1.3. RELATED WORKS

- 1.3.1. Section 20 05 05 - Mechanical Work General Instructions.
- 1.3.2. Section 20 05 10 - Basic Mechanical Materials and Methods.
- 1.3.3. Section 20 05 40 – Mechanical Work Commissioning.
- 1.3.4. Section 23 21 12 – Hydronic Radiant Floor Heating
- 1.3.5. Section 23 21 18 – Glycol Solution Snow Melting System

1.4. REFERENCE STANDARDS

- 1.4.1. Standards and codes to be latest editions at the time of contract formation.
- 1.4.2. ANSI B16.22 Cast Copper Alloy Solder Joint Pressure Fittings.
- 1.4.3. ASTM A105 Standard Specification for Carbon Steel Forgings for Piping Applications.
- 1.4.4. ASTM A536, Standard Specification for Ductile Castings.
- 1.4.5. ASTM B88 Standard Specification for Seamless Copper Water Tube.
- 1.4.6. ANSI Series 150 System of dimensional standards for weld neck, threaded, slip-on, lap joint, socket weld and blind flanges.
- 1.4.7. ANSI/ASME B16.4, Grey Iron Threaded Fittings (Classes 125 and 250).
- 1.4.8. ASME Boiler and Pressure Vessel Code.
- 1.4.9. ASME Code for Unfired Pressure Vessels.

2. TRAINING

- 2.1.1. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.
- 2.1.2. The Contractor shall include for 2 training sessions of maximum 7 hours duration per session for 10 Metrolinx people per session.
- 2.1.3. The Contractor shall refer to Section 20 05 05 for additional general requirements.

2.2. WARRANTY

- 2.2.1. Warranty shall be in line with Contractual Requirements.

2.3. DELIVERY, STORAGE AND HANDLING

- 2.3.1. The Contractor shall handle and store products in accordance with manufacturer's instructions, in locations approved by Metrolinx. Include one copy of these instructions with product at time of shipment.

2.4. SUBMITTALS

- 2.4.1. The Contractor shall comply with submittal requirements in Section 20 05 05 in respect of the submittals identified in this Section 23 20 00.
- 2.4.2. The Contractor shall submit motor product data sheets and certified performance curves with all pump shop drawings.
- 2.4.3. The Contractor shall submit with delivery of each unit, a copy of factory inspection and test report, and include a copy of each report with O & M Manual project close-out data.
- 2.4.4. The Contractor shall submit a site inspection and start-up report from manufacturer's representative as ~~per~~ in Part 3 of this Section.
- 2.4.5. Prior to Substantial Performance of the Work, the Contractor shall submit a spare seal flush line filter for each pump equipped with a seal flush line.
- 2.4.6. Shop drawings for piping anchors must be prepared and stamped by a professional Structural Engineer registered in the jurisdiction of the work. Refer to requirements for Contractor retained engineers specified in Section 20 05 05.
- 2.4.7. The Contractor shall submit a letter stating pipe anchor design engineer has visited site to examine installation of pipe anchors and pipe anchor installation is in accordance with reviewed anchor shop drawing.
- 2.4.8. The Contractor shall submit shop drawings/product data sheets as follows:
 - a) to regulatory authority for review and approval prior to submitting to Consultant;

- b) for all products specified in this Section except piping and unions; and
- c) copies of all calculations, stamped and signed by same engineer who signs layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing requirements.

2.4.9. Product Data

- a) The Contractor shall submit product data sheets indicating:
 - 1) technical data, supplemented by bulletins, component illustrations, detailed views, technical descriptions of items, and parts lists;
 - 2) performance criteria, compliance with appropriate reference standards, characteristics, limitations, and troubleshooting protocol;
 - 3) product transportation, storage, handling, and installation requirements; and
 - 4) product identification in accordance with Metrolinx requirements.

2.4.10. Shop Drawings

- a) The Contractor shall submit shop drawings indicating:
 - 1) capacity and ratings;
 - 2) mounting details to suit locations shown, indicating methods and hardware to be used; and
 - 3) applicable control components and control wiring schematic.

2.4.11. Commissioning Package

- a) The Contractor shall submit the following in accordance with Sections 20 05 05 and 20 05 40:
 - 1) Commissioning Plan;
 - 2) Commissioning Procedures;
 - 3) Certificate of Readiness;
 - 4) complete test sheets specified in Section 20 05 40 and attach them to the Certificate of Readiness; and
 - 5) Source Quality Control inspection and test results and attach to the Certificate of Readiness.

2.4.12. Commissioning Closeout Package:

- a) The Contractor shall submit the following in accordance with Section 20 05 05:
 - 1) Deficiency Report;

- 2) Commissioning Closeout Report;
- 3) submit the following for each Product for incorporation into the Operation and Maintenance Manuals in accordance with Section 20 05 05:
 - i) identification: manufacturer's name, type, year, serial number, number of units, capacity, and identification to related systems;
 - ii) functional description detailing operation and control of components;
 - iii) performance criteria and maintenance data;
 - iv) safety precautions;
 - v) operating instructions and precautions;
 - vi) component parts availability, including names and addresses of spare part suppliers;
 - vii) maintenance and troubleshooting guidelines/protocol;
 - viii) product storage, preparation, handling, and installation requirements; and
 - ix) Commissioning Report.

2.5. QUALITY ASSURANCE

- 2.5.1. The Contractor shall ensure HVAC piping and pumps comply with codes, regulations and standards listed ~~about~~ at 1.4 and applicable local codes and regulations.
- 2.5.2. The Contractor shall ensure site personnel are to be licensed in jurisdiction of the work and under continuous supervision of a foreman who is an experienced system installer.
- 2.5.3. Manufacturers Qualifications
 - a) Manufacturer shall be ISO 9000, 9001 or 9002 certified. Manufacturer of product shall have produced similar product for a minimum period of five years. When requested by Consultant, an acceptable list of installations with similar product shall be provided demonstrating compliance with this requirement.
 - b) Where manufacturers provide after installation onsite inspection of product installations, the Contractor shall include for manufacturer's authorized representative to perform onsite inspection and certificate of approvals.

2.5.4. Installers Qualifications

- a) Installers for work to be performed by or work under licensed Mechanical Contractor.
- b) Where manufacturers provide training sessions to installers and certificates upon successful completion, the Contractor shall ensure installers to have obtained such certificates and submit copies with shop drawings.

2.5.5. Regulatory Requirements

- a) The Contractor shall ensure products and work comply with applicable local governing authority regulations, bylaws, and directives.
- b) The Contractor shall include for required inspections and certificate of approvals of installation work from local governing authorities.

3. PRODUCTS

3.1. PIPE, FITTINGS AND JOINTS

3.1.1. Black Steel - Screwed Joint

- a) Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.

3.1.2. Black Steel - Welded Joint

- a) Mild black carbon steel, Grade B, ASTM A53, mill or site beveled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.

3.1.3. Black Steel - Grooved End Mechanical Joint

- a) Mild black carbon steel, Grade B, ASTM A53, factory or site roll grooved, complete with cast ductile iron grooved end fittings, including full flow elbows, and conforming to ASTM A536.
- b) Standard of quality assurance manufacturers are:
 - 1) Victaulic Style 107 "QuickVic" or approved equivalent, rigid couplings for sizes 50 mm (2") to 200 mm (8"), Style 07 "Zero-Flex" rigid couplings for sizes 250 mm (10") to 300 mm (12"), Style W07 AGS rigid couplings for sizes 350 mm (14") to 1525 mm (60");
 - 2) Gruvlok Fig. 7402 "SlideLOK" or approved equivalent, for sizes 50 mm (2") to 200 mm (8"), Fig. 7401 "Rigidlok" for sizes 250 mm (10") to 610 mm (24");
 - 3) or approved equivalent.

3.1.4. Soft Copper Pipe

- a) Type "L" seamless soft copper to ASTM B77.

3.1.5. Hard Copper - Solder Joint

- a) Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin / 5% Antimony solder joints.

3.1.6. Hard Copper - Pressure Coupled Joint

- a) Type "L" hard drawn seamless copper to ASTM B88, complete with Viega "ProPress with Smart Connect feature" or approved equivalent, system copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

3.2. PIPING UNIONS

3.2.1. Screwed Piping

- a) Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).

3.2.2. Flanged Piping

- a) Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

3.3. SHUT-OFF VALVES

3.3.1. Ball Type

- a) Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle.
- b) Standard of quality assurance products are:
 - 1) Toyo Valve Co. Fig. 5044A;
 - 2) Watts Industries (Canada) Inc. #FBV-3;
 - 3) Kitz Corp. Code 58;
 - 4) Victaulic Co. of Canada Ltd. Series 722;
 - 5) or approved equivalent.

3.3.2. Apollo Valve #77-100 or approved equivalent, butterfly type:

- a) Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile iron disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with valve closed and either side of connecting piping removed.
- b) Standard of quality assurance products are:
 - 1) DeZurik of Canada Ltd., Figure No. 632;
 - 2) Victaulic Co. of Canada Ltd. Vic-300 MasterSeal or AGS Vic-300;
 - 3) Apollo Valve 143 Series;
 - 4) Watts Industries (Canada) Inc. #BF-03;
 - 5) Kitz Corp. 6112 Series;
 - 6) Toyo Valve Co. 918DESL/G2;
 - 7) or approved equivalent.

3.3.3. Gate Valve

- a) 50 mm (2 inches) and smaller: MSS SP80, Bronze, 1034 kPa (150 lb.), wedge disc, rising stem, union bonnet.
- b) 65 mm (2½ inches) and larger: Flanged, outside screw and yoke.
- c) MSS SP 70, iron body, bronze mounted, 861 kPa (125 psig) wedge disc.
- d) Standard of quality assurance manufacturers are:
 - 1) Watts Industries (Canada) Inc Series 408;
 - 2) Toyo Valve Co. Fig 421A;
 - 3) Kitz Corporation;
 - 4) or approved equivalent.

4. SWING CHECK VALVES

4.1.1. Bronze – Screwed:

- a) Class 125, 1380 kPa (200 psi) WOG rated horizontal swing check valves, each complete with a "Y" pattern bronze body, hinged brass disc, easy access screw-in cap, and screwed ends.

b) Standard of quality assurance products are:

- 1) Toyo Valve Co. Fig. 236;
- 2) Nibco #T-433;
- 3) Kitz Corp. Code No. 22;
- 4) or approved equivalent.

4.1.2. Steel - Grooved Ends

a) Victaulic Co. of Canada Ltd. Series 716, 779 or W715 or approved equivalent, grooved end carbon steel check valves suitable for mounting horizontally or vertically.

4.1.3. Cast Iron - Screwed and Flanged

- a) Cast iron, bronze trim, 1380 kPa (200 psi) rated swing check valves, each complete with a bronze disc and seat, malleable iron hinge, bolted cover, and screwed or flanged ends as required.
- b) Standard of quality assurance products are:
- 1) Toyo Valve Co. Fig. 435A;
 - 2) Watts Industries (Canada) Inc. #F-511;
 - 3) Kitz Corp. Code No. 78;
 - 4) or approved equivalent.

4.2. VERTICAL LIFT CHECK VALVES

4.2.1. Class 150, 1380 kPa (200 psi) WOG rated bronze vertical lift check valves, each complete with screwed ends and a bronze disc.

4.2.2. Standard of quality assurance products are:

- a) Toyo Valve Co. Fig. 231;
- b) Watts Industries (Canada) Inc. #600;
- c) Kitz Corp. Code No. 36;
- d) or approved equivalent.

4.3. WAFER CHECK VALVES

- 4.3.1. Threaded lug body type, full bore, ANSI Series 150, 1965 kPa (285 psi) rated at 38°C (100°F), non-slam wafer check valves, each complete with a carbon steel body, stainless steel discs, a shaft, springs, disc stop and thrust bearings constructed of type 316 stainless steel, and seat materials to suit the application. The inside diameter of the valve must equal the inside diameter of the connecting pipe.
- 4.3.2. Standard of quality assurance products are:
- a) Gulf Valve Co. "WAFER CHECK";
 - b) Watts Industries (Canada) Inc. Series ICV-125;
 - c) The Metraflex Co. Style CVXX;
 - d) or approved equivalent.

4.4. DRAIN VALVES

- 4.4.1. Minimum 2070 kPa (300 psi) WOG rated, 20 mm (¾") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm (¾") diameter hose, and a cap and chain.
- 4.4.2. Standard of quality assurance products are:
- a) Toyo Valve Co. Ltd. Fig. 5046;
 - b) Watts Industries (Canada) Inc. #B-6000-CC;
 - c) Kitz Corp. Code No. 68AC;
 - d) Apollo Valves #78-104-01;
 - e) or approved equivalent.

4.5. CIRCUIT BALANCING VALVES

- 4.5.1. Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.
- 4.5.2. Standard of quality assurance products are:
- a) S.A. Armstrong Ltd. Series "CBVI" screwed or "CBVII" flanged;
 - b) Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, and 789 grooved end, and Series 78K "Koil Kit" valves;
 - c) or approved equivalent.

4.6. RADIATOR SHUT-OFF AND BALANCING VALVES

- 4.6.1. Heavy pattern, straight, 1750 kPa (250 psi) rated at 120°C (250°F) bronze radiator valves, each complete with composition disc, spring loaded packing, and union. Equip inlet valves with a handle for shut-off. Equip outlet valves with a lockshield for shut-off and balancing.
- 4.6.2. Standard of quality assurance products are:
- a) Dahl Brothers Canada Ltd. #11042 and #13013;
 - b) Spirax Sarco Ltd. Type R;
 - c) or approved equivalent.

4.7. PRESSURE RELIEF VALVES

- 4.7.1. ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each capable of relieving full output of equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified.
- 4.7.2. Standard of quality assurance products are:
- a) ITT Bell & Gossett 3301/4100, or 790/1170;
 - b) Dresser Industries "CONSOLIDATED";
 - c) Spirax Sarco Ltd. SVI Series;
 - d) McDonnell & Miller Models 250 and 260;
 - e) Conbraco 10-600 Series;
 - f) Watts Industries (Canada) Inc. 174A or 740;
 - g) or approved equivalent.

4.8. AIR VENTS

- 4.8.1. Manual Air Vents:
- a) Conbraco 27 Series or approved equivalent, 3.2 mm ($\frac{1}{8}$ ") diameter with a key handle.
- 4.8.2. Automatic Air Vents
- a) Float actuated air vents, each complete with a semi-steel body and cap, a stainless-steel float assembly and seat, and a neoprene head.

- b) Standard of quality assurance products are:
 - 1) Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);
 - 2) Armstrong International Inc. No. 1-AV;
 - 3) or approved equivalent.

4.9. STRAINERS

4.9.1. Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping.

4.9.2. Standard of quality assurance products are:

- a) Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;
- b) Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;
- c) Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";
- d) Armstrong International Inc. A1 Series;
- e) Watts Industries (Canada) Inc. #77SCI;
- f) Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged;
- g) or approved equivalent.

4.10. PIPING EXPANSION JOINTS

4.10.1. Steel Piping Mains

- a) Controlled flexing, flanged expansion joints, 2070 kPa (300 psi) rated, with corrugated stainless-steel bellows with closely matched neck rings and reinforcing or control rings and selected for operating pressure plus 25% safety factor.
- b) Standard of quality assurance products are:
 - 1) Senior Flexonics Ltd. Series CSF "High-Corr";
 - 2) Victaulic Co. of Canada Ltd. Style 155 with Style 07 or 107 "Zero-Flex" couplings on each side of assembly and a full-length steel "V" shaped support trough with hangers;
 - 3) The Metraflex Co. Model MC;
 - 4) or approved equivalent.

4.10.2. Steel or Copper Branch/Runout Piping

- a) Externally pressurized, 1380 kPa (200 psi) rated expansion joints with a stainless-steel bellows and shroud, welding or threaded steel nipple ends for steel piping, and copper sweat nipple ends for copper piping.
- b) Standard of quality assurance products are:
 - 1) Senior Flexonics Ltd. Series "H";
 - 2) The Metraflex Co. Model "HP";
 - 3) or approved equivalent.

4.11. PIPING ALIGNMENT GUIDES

4.11.1. Prime coat painted black carbon steel pipe alignment guides sized and fabricated to suit pipe size and pipe insulation thickness.

4.11.2. Standard of quality assurance products are:

- a) Senior Flexonics Ltd. Series PGT;
- b) E. Myatt & Co. Ltd. Fig. 1267;
- c) Empire Tool & Mfg. Inc. Fig 256;
- d) The Metraflex Co. Style IV;
- e) or approved equivalent.

4.12. PIPE ANCHORS

4.12.1. Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% of axial thrust, and, as specified in Part 1 of this Section, is to be designed and detailed by a Professional Structural Engineer.

5. FLEXIBLE PUMP CONNECTIONS

5.1.1. Flexible metal hose assemblies, each complete with annular corrugated unbraided type 321 stainless steel inner core, braided type 321 stainless steel hose, and a collar and flange at each end, all suitable for twice the working pressure of the system.

5.1.2. Standard of quality assurance products are:

- a) Senior Flexions' Inc. A1 and A6 Series;
- b) The Metraflex Co. Model SST and "METRA-MINI";
- c) or approved equivalent.

5.2. AIR SEPARATOR

- 5.2.1. Vortex type vertical air separator with side tangential inlet and outlet connections, a top air outlet connection, and bottom drain connection. Separator is to be constructed of cast iron or fabricated steel for a pressure of 1105 kPa (160 psi) at 180°C (350°F) in accordance with Section VIII, Division 01 of the ASME Boiler and Pressure Vessel Code.
- 5.2.2. Standard of quality assurance products are:
- a) S.A. Armstrong Ltd. Model "VA";
 - b) ITT Bell & Gossett "Rolairtrol";
 - c) Taco Canada Ltd. "Vortech";
 - d) or approved equivalent.

5.3. EXPANSION TANK

- 5.3.1. Furnish and install, as shown on the drawings an ASME pre-charged diaphragm expansion tank, stamped 125 psi (862 kPa) working pressure. Each tank will be supplied with a heavy-duty butyl diaphragm. Tank shall be supplied with a ring base, lifting rings, NPT system connection. An air charging valve connection (standard tire valve) shall be provided to facilitate adjusting pre-charge pressure to meet actual system conditions.
- 5.3.2. ASME Code Section VIII, Division 1, stamped 1034 kPa (150 psi) working pressure, heavy duty FDA approved butyl diaphragm NSF/ANSI Standard 61.
- 5.3.3. Standard of Acceptance
- a) Armstrong AX-V series, Amtrol.
 - b) ARMSTRONG Model AST-5 to AST-210.

6. GLYCOL SOLUTION MIXING AND STORAGE TANK

- 6.1.1. Package type glycol solution mixing, storage and automatic feed assembly designed to maintain minimum system pressure levels and complete with:
- a) round, polyethylene, or polypropylene tank sized to suit system capacity, complete with a solution level scale in litres and Imperial gallons, removable cover, and a welded steel angle stand assembly with legs, pump shelf, and control panel bracket, all factory finished with enamel;
 - b) 120 volt, 1-phase, 60 Hz electrical connection;
 - c) factory pre-piped rotary bronze gear pump with capacity and pressure differential to suit system requirements, factory wired to control panel, mounted on a shelf integral with steel stand assembly, and complete with shut-off valve and strainer;

- d) tank pressure relief valve with discharge piped back into tank;
- e) tank low level switch;
- f) pressure gauge;
- g) Honeywell #L404A "Pressurtrol" or approved equivalent, pipe mounting differential pressure switch with a 100 to 1000 kPa (15 to 150 psi) range;
- h) factory mounted and pre-wired control panel with a minimum NEMA 2 enameled steel enclosure, designed to control and operate pump either manually or automatically to pump glycol solution into system, and to stop pump and initiate an audible/visual alarm if a low glycol solution level occurs in tank, and complete with:
 - 1) terminal blocks for power and control wiring connections;
 - 2) H-O-A switch with green "Power On" indicator light;
 - 3) 120 volt/12 volt control transformer;
 - 4) low glycol solution level alarm buzzer with silencing switch, an alarm light which remains illuminated until low-level switch is reset, and an alarm push-to-test button;
 - 5) dry contacts for building automation system alarm annunciation.
- i) factory secured seismic restraint connection hardware.

6.1.2. Standard of quality assurance products are:

- a) Calefactio Solutions Series GMP;
- b) ITT Bell & Gossett Series GMU;
- c) S. A. Armstrong Ltd. GLA Series;
- d) or approved equivalent.

6.2. GLYCOL

6.2.1. Propylene glycol blended with Nitrite based corrosion inhibitors.

6.2.2. Standard of quality assurance manufacturers are:

- a) DOW;
- b) or approved equivalent.

6.3. GENERAL RE: CIRCULATING PUMPS

- 6.3.1. Pumps are to be cast iron, 175 psig working pressure at 65°C (150°F), bronze fitted centrifugal pumps in accordance with drawing schedule, complete with:
- a) non-overloading under all operating conditions and factory tested at specified operating conditions;
 - b) dynamically balanced bronze impeller, secured to a stainless-steel shaft equipped with a stainless-steel shaft sleeve;
 - c) watertight equal to John Crane Inc. JC2, OPID1 carbon rotating face type mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure the stationary seat.

6.4. SPLIT COUPLED VERTICAL IN-LINE PUMP

- 6.4.1. Cast iron, 175 psig working pressure at 65°C (150°F), split coupled, single stage, vertical in-line pump complete with:
- a) radially split, gasketed cast iron volute with equally sized suction and discharge flanged connections, tapings for gauge, drain and flush line connections, and a cast iron motor mount bracket;
 - b) dynamically balanced cast bronze impeller secured to a type 416 stainless steel shaft which is connected to motor by means of a high tensile strength aluminum bar split type spacer coupling with guard designed to permit servicing of mechanical seal without disturbing pump, motor, or electrical wiring;
 - c) TEFC vertical mount motor;
 - d) watertight equal to John Crane Inc. #JC8B2, XP1D1 or Durametallic #RA EU5-FV or approved equivalent, carbon rotating face type outside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure stationary seat;
 - e) factory installed seal flush line tubing with 50 micron Cuno or approved equivalent, cartridge type filter with two extra cartridges, a sight flow indicator, air vent, and valved tubing;
 - f) for pump(s) with a pressure differential exceeding 30 psi, in lieu of a flush line filter, factory installed valved seal flush line tubing with cyclone type separator and sight flow indicator.
- 6.4.2. Standard of quality assurance products are:
- a) S.A. Armstrong Ltd.;
 - b) ITT Bell & Gossett;

- c) Grundfos CBS Inc. PACO;
- d) Patterson Pump Company;
- e) or approved equivalent.

6.5. CLOSE COUPLED VERTICAL IN-LINE PUMP

6.5.1. Cast iron, 175 psig working pressure at 65°C (150°F), close coupled, single stage vertical in-line pump complete with:

- a) radially split, gasketed cast iron volute with equally sized suction and discharge flanged connections, and tappings for gauge, drain and flush line connections;
- b) dynamically balanced bronze impeller with bronze shaft sleeve, secured to motor shaft;
- c) face mounted TEFC vertical motor;
- d) watertight equal to John Crane Inc. #JC 8B2, XP1D1 or Durmetallic #RA EU5-FV or approved equivalent, carbon rotating face type inside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure stationary seat.

6.5.2. Standard of quality assurance products are:

- a) S.A. Armstrong Ltd.;
- b) ITT Bell & Gossett;
- c) Grundfos CBS Inc. PACO;
- d) Patterson Pump Company;
- e) or approved equivalent.

6.6. SPLIT COUPLED, DUAL VERTICAL IN-LINE PUMP

6.6.1. Cast iron, 175 psig working pressure at 65°C (150°F), split coupled, single stage, vertical in-line pump assemblies incorporating two radially split pumps, complete with:

- a) cast iron volute with equally sized suction and discharge flanged connections, tappings for gauge, drain and flush line connections, and cast iron motor mount brackets;
- b) for each pump, dynamically balanced cast bronze impeller secured to a type 416 stainless steel shaft which is connected to motor by means of a high tensile strength aluminum bar split type spacer coupling with guard designed to permit servicing of mechanical seal without disturbing pump, motor, or electrical wiring;

- c) for each pump, a TEFC vertical mount motor;
- d) for each pump, a watertight equal to John Crane Inc. #JC8B2, XP1D1 or Durametallic #RA EU5-FV or approved equivalent, carbon rotating face type outside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure the stationary seat;
- e) factory installed seal flush line tubing with 50 micron Cuno or approved equivalent, cartridge type filter with two extra cartridges, a sight flow indicator, air vent, and valved tubing;
- f) for pump(s) with a pressure differential exceeding 30 psi, in lieu of a flush line filter, factory installed valved seal flush line tubing with cyclone type separator and sight flow indicator.

6.6.2. Standard of quality assurance products are:

- a) S. A. Armstrong Ltd.;
- b) ITT Bell & Gossett;
- c) Grundfos CBS Inc. PACO;
- d) Taco Comfort Solutions;
- e) or approved equivalent.

7. SPLIT COUPLED, DUAL, VFD DRIVE VERTICAL IN-LINE PUMP

7.1.1. Cast iron, 175 psig working pressure at 65°C (150°F), split coupled, single stage, vertical in-line pump assemblies incorporating 2 radially split pumps, complete with:

- a) cast iron volute with equally sized suction and discharge flanged connections, tappings for gauge, drain and flush line connections, and cast iron motor mount brackets;
- b) for each pump, a dynamically balanced cast bronze impeller secured to a type 416 stainless steel shaft which is connected to motor by means of a high tensile strength aluminum bar split type spacer coupling with guard designed to permit servicing of mechanical seal without disturbing pump, motor, or electrical wiring;
- c) for each pump, a TEFC vertical mount motor;
- d) for each pump, a watertight equal to John Crane Inc. #JC8B2, XP1D1 or Durametallic #RA EU5-FV or approved equivalent, carbon rotating face type outside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure stationary seat;

- e) factory installed seal flush line tubing with 50 micron Cuno or approved equivalent, cartridge type filter with two extra cartridges, a sight flow indicator, air vent, and valved tubing;
- f) for each pump, a factory mounted VFD pre-wired to pump motor, capable of operating in any of following control modes:
 - 1) duty/standby pumps with sensorless control;
 - 2) duty/standby pumps with remote sensor or building automation system control;
 - 3) parallel pumps with single or multiple sensor(s) system control with IPS controller.
- g) for pump(s) with a pressure differential exceeding 30 psi, in lieu of a flush line filter, factory installed valved seal flush line tubing with cyclone type separator and sight flow indicator.

7.1.2. Standard of quality assurance products are:

- a) S. A. Armstrong Ltd.;
- b) ITT Bell & Gossett;
- c) Grundfos CBS Inc. PACO;
- d) Taco Comfort Solutions;
- e) or approved equivalent.

7.2. CLOSE COUPLED, DUAL VERTICAL IN-LINE PUMP

7.2.1. Cast iron, 175 psig working pressure at 65°C (150°F), close coupled, single stage, vertical in-line pump assemblies incorporating two radially split pumps, complete with:

- a) cast iron volute with equally sized suction and discharge flanged connections, tappings for gauge, drain and flush line connections, and cast iron motor mount brackets;
- b) for each pump, a dynamically balanced cast bronze impeller secured to a type 416 stainless steel shaft which is connected to motor by means of a high tensile strength aluminum bar split type spacer coupling with guard designed to permit servicing of mechanical seal without disturbing pump, motor, or electrical wiring;
- c) for each pump, a TEFC vertical mount motor;

- d) for each pump, a watertight equal to John Crane Inc. #JC8B2, XP1D1 or Durametallic #RA EU5-FV or approved equivalent, carbon rotating face type outside mechanical seal with tungsten carbide stationary seat, Viton secondary seal and alloy 20 springs, and bronze gland plate with stainless steel gland bolts to secure stationary seat;
- e) factory installed seal flush line tubing with 50 micron Cuno or approved equivalent, cartridge type filter with two extra cartridges, a sight flow indicator, air vent, and valved tubing;
- f) for pump(s) with a pressure differential exceeding 30 psi, in lieu of a flush line filter, factory installed valved seal flush line tubing with cyclone type separator and sight flow indicator.

7.3. VERTICAL IN-LINE PUMP VARIABLE FREQUENCY DRIVES

- 7.3.1. Variable frequency drives for vertical in-line pumps as scheduled are to be in accordance with Electrical Division section on variable frequency drives.

7.4. CIRCULATING PUMP SUCTION AND DISCHARGE CONNECTION ACCESSORIES

- 7.4.1. Circulating pump manufacturer supplied suction guides with a cast iron body, stainless steel strainer screen, removable fine mesh start-up strainer screen and steel guide vanes, and cast iron body, angle, or straight type control valve assemblies, each acting as a check valve, balancing valve, and shut-off valve. Unless otherwise shown or specified, suction and discharge connection accessories are to be piping line size.
- 7.4.2. Standard of quality assurance products are:
 - a) S.A. Armstrong Ltd. Type "SG" suction guides and "Flo-Trex" triple duty valve assemblies;
 - b) ITT Bell & Gossett Bulletin B-820D suction guides and Bulletin B-821F triple duty valve assemblies;
 - c) or approved equivalent.

7.5. HORIZONTAL IN-LINE PUMP

- 7.5.1. Horizontal, in-line pump complete with:
 - a) cast iron casing with flanged in-line pipe connections;
 - b) alloy steel shaft with integral thrust collar, copper shaft sleeve, and oil lubricated bronze bearings;
 - c) balanced, corrosion resistant steel, cast bronze, or stamped brass impeller;
 - d) motor connected to pump by means of a 4-spring coupling with guard;
 - e) mechanical seal.

7.5.2. Standard of quality assurance products are:

- a) S.A. Armstrong Ltd.;
- b) ITT Bell & Gossett;
- c) Grundfos Canada Inc;
- d) or approved equivalent.

8. EXECUTION

8.1. DEMOLITION

8.1.1. The Contractor shall perform required hydronic piping system demolition/revision work. Refer to demolition requirements specified in Section 20 05 35.

8.2. PIPING INSTALLATION REQUIREMENTS

8.2.1. The Contractor shall provide required hydronic piping. Pipe, unless otherwise specified, is to be:

- a) for pipe to and including 65 mm (2-½") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;
- b) for pipe 65 mm (2-½") to 300 mm (12") dia. and larger, Standard weight grooved end black steel (10 mm [0.375"] thickness) pipe with grooved end fittings and couplings, or Standard weight black steel (10 mm [0.375"] thickness) pipe with welding fittings and welded joints; and
- c) for short branch connections to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.

8.2.2. The Contractor shall slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m. Leave sufficient room at high points for installation and maintenance of air vents.

8.2.3. The Contractor shall install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control work. Refer to drawing control diagrams and details.

8.2.4. The Contractor shall connect equipment provided as part of the work of other Sections with piping as indicated and/or required. Refer to pipe connection details on drawings.

- 8.2.5. The Contractor shall provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at equipment connections, in runs of piping exceeding 9 m at 4.5 m regular intervals to permit removal of sections of piping, and wherever else indicated on drawings.
- 8.2.6. The Contractor shall provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on drawings. Valves in piping to and including 50 mm (2") dia. are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate valves so they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.
- 8.2.7. The Contractor shall provide a check valve in discharge piping of every pump, and elsewhere in piping where shown on drawings. Where check valves are required in vertical piping, ensure they are suitable in all respects for the application. Check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.
- 8.2.8. The Contractor shall provide a drain valve at base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified in drawings.
- 8.2.9. The Contractor shall provide circuit balancing valves in piping generally where shown on drawings but with exact locations in accordance with instructions of personnel doing system flowbalancing work. Confirm locations prior to installation.

9. INSTALLATION OF PRESSURE RELIEF VALVES

- 9.1.1. The Contractor shall provide factory set pressure relief valves. Pipe discharge of each water piping relief valve to drain unless otherwise shown or specified.
- 9.1.2. The Contractor shall pipe discharge of each glycol solution piping relief valve back to system expansion tank or return piping.
- 9.1.3. The Contractor shall confirm relief valve settings in accordance with drawing and specification.

9.2. INSTALLATION OF AIR VENTS

- 9.2.1. The Contractor shall provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with drawing detail.
- 9.2.2. The Contractor shall provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so discharge is visible. Identify drain piping.

9.3. INSTALLATION OF STRAINERS

- 9.3.1. The Contractor shall provide strainers in piping. Locate strainers so baskets are easily accessible and removable. Clean strainer baskets during and after piping system flushing and cleaning is complete, and before water quantity balancing commences.

9.4. INSTALLATION OF EXPANSION COMPENSATORS

- 9.4.1. The Contractor shall provide expansion compensation in piping.
- 9.4.2. The contractor shall locate expansion compensation where shown, but with exact locations to suit piping as installed.
- 9.4.3. The Contractor shall provide double pipe alignment guides in horizontal piping at each side of expansion compensation facilities to permit movement in axial direction only. Secure guides to building structure only.
- 9.4.4. The Contractor shall provide a pipe guide at each side of expansion joints in vertical risers.

9.5. INSTALLATION OF PIPING ANCHORS

- 9.5.1. The Contractor shall provide anchors to secure piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.
- 9.5.2. The Contractor shall When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a signed letter with engineer's stamp from design engineer confirming each anchor is properly installed.

10. INSTALLATION OF AIR SEPARATOR

- 10.1.1. The Contractor shall provide an air separator in piping and connect with valved inlet and outlet piping.
- 10.1.2. The Contractor shall extend valved blowdown piping from bottom pipe connection tapping to nearest floor drain location.
- 10.1.3. The Contractor shall equip top pipe connection tapping with an automatic air vent and piping as detailed.

10.2. INSTALLATION OF EXPANSION TANK

- 10.2.1. The Contractor shall provide an expansion tank.
- 10.2.2. The Contractor shall secure horizontal expansion tank in place by means of properly sized galvanized steel hanger rods and support saddles supplied with tank.
- 10.2.3. The Contractor shall secure expansion tank stand to a concrete housekeeping pad by means of machine bolts.

- 10.2.4. Where required by local governing codes, the Contractor shall brace and secure tank in accordance with requirements for seismic control and restraint.
- 10.2.5. The Contractor shall connect tank with system piping. Extend a drain line from tank piping and terminate drain line with a drain valve. Provide an air vent.
- 10.2.6. The Contractor shall provide a water make-up connection line complete with relief valve and pressure gauge and connect to system piping. Terminate make-up piping for connection to domestic cold-water piping as part of the work of Section 22 11 00. Check relief valve operation and adjust as required.
- 10.2.7. The Contractor shall check tank air charge and adjust to suit system.

10.3. INSTALLATION OF GLYCOL SOLUTION MIXING AND STORAGE TANK

- 10.3.1. The Contractor shall provide a mixing and storage tank and feed assembly for each glycol solution circulating system.
- 10.3.2. The Contractor shall secure tank stand to a concrete housekeeping pad. Connect with system piping.
- 10.3.3. Where required by local governing codes, the Contractor shall brace and secure each unit in accordance with requirements for seismic control and restraint.
- 10.3.4. The Contractor shall fill tank with, unless otherwise specified, a solution of 50% water, 50% propylene glycol, and test solution to confirm proper concentrations.
- 10.3.5. When installation is complete, the Contractor shall test operation of assembly, including alarms, and adjust as required. Adjust pressure switch to suit glycol solution circulating system pressure.

11. INSTALLATION OF FLEXIBLE PIPING CONNECTIONS

- 11.1.1. The Contractor shall provide flexible connections in piping connections to equipment.
- 11.1.2. The Contractor shall install flexible piping connections in accordance with manufacturer's instructions.

11.2. INSTALLATION OF CIRCULATING PUMPS

- 11.2.1. The Contractor shall provide centrifugal circulating pumps.
- 11.2.2. The Contractor shall secure base mounted pumps in place on seismic rated structural steel bases with vibration isolators. Where required by local governing codes, brace and secure each unit in accordance with requirements for seismic control and restraint. Provide flexible connectors in pump suction and discharge piping 450 mm (18") from suction and discharge connection accessories.

- 11.2.3. The Contractor shall provide floor mount vertical inline pumps with seismically rated neoprene vibration isolators. Where required by local governing codes, the Contractor shall brace and secure each unit in accordance with requirements for seismic control and restraint, with seismically rated steel pump mounting brackets custom welded to suction and discharge connections of pump. Provide flexible connectors in vertical suction and discharge piping 450 mm (18") above suction and discharge connection accessories.
- 11.2.4. The Contractor shall secure vertical inline pumps in place and provide flexible piping connections in vertical suction and discharge piping approximately 450 mm (18") above suction and discharge connection accessories.
- 11.2.5. The Contractor shall provide a shut-off valve and suction guide in pump suction piping, and a combination check-balance-shut-off valve assembly in pump discharge piping, installed in accordance with manufacturer's instructions. Remove suction guide start-up strainer screens after piping flushing and cleaning is complete. Combination check-balance-shut-off valve assemblies are to be 150 mm (6") away from pump discharge for discharge piping to 150 mm (6") dia., and 300 mm (12") away from pump discharge for discharge pipe larger than 150 mm (6") dia.
- 11.2.6. For pumps equipped with seal flush line filters, the Contractor shall replace flush line filter cartridge when pipe flushing, and cleaning is complete.
- 11.2.7. The Contractor shall supply variable frequency drives (VFD) for pumps as scheduled. Hand VFD's to electrical trade at site for installation as part of the electrical work.
- 11.2.8. The Contractor shall install horizontal inline pumps in place in vertical piping approximately 1.2 m (4') above floor in accordance with pump manufacturer's instructions.
- 11.2.9. If circulating pumps are used for piping flushing and cleaning, and pump seal flush line filters are not installed, the Contractor shall replace pump mechanical seals when flushing and cleaning is complete.
- 11.2.10. Refer to Section 20 05 10 for equipment/system manufacturer certification requirements.
- 11.2.11. Refer to Section 20 05 10 for equipment/system start-up requirements.

11.3. FLUSHING AND CLEANING PIPING

- 11.3.1. The Contractor shall flush and clean new piping in accordance with requirements specified in Section entitled HVAC Water Treatment.

11.4. TESTING, ADJUSTING AND BALANCING

- 11.4.1. When work is complete and equipment is operating as intended, the Contractor shall test, adjust and balance water flows in accordance with requirements specified in Section 20 05 50 -Testing, Adjusting, and Balancing.

END OF SECTION