

1 GENERAL

1.01 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings where required.
 - .2 Indicate on drawings:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
 - .3 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
 - .6 Showing sleeves through walls and slabs including penetrations through fire rated partitions.
 - .7 Operations and maintenance manuals will not constitute acceptable shop drawings.
 - .8 Shop drawings shall be reviewed beforehand by the contractor to ensure envelopes account for actual site conditions.
 - .4 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.02 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.
 - .1 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
All manuals shall be machine readable PDF format.
 - .2 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .3 Maintenance data to include:

- .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
- .2 Data to include schedules of tasks, frequency, tools required and task time.
- .4 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Approvals:
 - .1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .6 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .7 Site records:
 - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .8 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for review and make corrections as directed.
 - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
 - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .9 Submit copies of as-built drawings for inclusion in final TAB report.

1.03 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Furnish spare parts as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One glass for each gauge glass.

- .3 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .4 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.05 COORDINATION

- .1 Cooperate and coordinate with other trades and verify order of installation of overlapping or interconnecting services or equipment before starting Work
- .2 Coordinate installation of the Work with manufacturer's recommended installation details and procedures, supplemented by requirements of Contract Documents; provide adequate access space for maintenance and service of equipment and systems.
- .3 Not Used.
- .4 Not Used.
- .5 Install material and equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space; remove and replace improperly installed equipment as determined by Departmental Representative.
- .6 Refer to electrical, mechanical and architectural drawings when setting out work and coordinate with other applicable components of the Work when setting out locations for ductwork, equipment, and piping so that conflicts are avoided and symmetrical even spacing is maintained.
- .7 Provide coordination drawings showing the work involved in areas of potential conflict or congestion at no additional cost to the Contract.
- .8 Coordinate dimensional details with applicable architectural drawings.
- .9 Not used.

- .10 Coordinate requirements of, and connect to, equipment specified in other Sections, and to equipment supplied and installed by Department Representative; uncrate equipment, assemble, move in place, and install complete, start-up and test.

2 PRODUCTS

2.01 NOT USED

- .1 Not used.

3 EXECUTION

3.01 EXAMINATION

- .1 Not Used.

3.02 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 23 - Interior Painting
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.03 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.04 FIELD QUALITY CONTROL

- .1 Not used.

3.05 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to all systems
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative may record these demonstrations on video tape for future reference.

3.06 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00- Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal

3.07 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers International (ASME)
 - .1 ANSI/ASME B16.15-13, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-13, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-11, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .5 ASME B16.26-13, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .6 ASME B31.9-14, Building Services Piping.
 - .7 ASME B36.19M-04, Stainless Steel Pipe.
- .2 ASTM International
 - .1 ASTM A 182/A 182M-16, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - .2 ASTM A 269-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .4 ASTM A 312/A 312M-16, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - .5 ASTM A 351/A 351M-16, Castings, Austenitic, for Pressure Containing Parts.
 - .6 ASTM A 403/A 403M-16, Wrought Austenitic Stainless Steel Piping Fittings.
 - .7 ASTM A 536-84(2014), Standard Specification for Ductile Iron Castings.
 - .8 ASTM B 32-08(2014), Standard Specification for Solder Metal.
 - .9 ASTM B 42-15a, Seamless Copper Tube, Standard Sizes.
 - .10 ASTM B 88M-14, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American National Standards Institute/American Water Works Association (ANSI) / (AWWA)
 - .1 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - .2 ANSI/AWWA C151/A21.51-09, Ductile Iron Pipe, Centrifugally Cast, for Water.
- .4 CSA Group
 - .1 CSA B137.5-13, Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
 - .2 CSA B242-05, Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S101-07, Fire Endurance Tests of Buildings Construction and Materials.
 - .2 CAN/ULC S102.2-10, Method of Test for Surface Burning

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- Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
- .3 CAN/ULC S115-11, Standard Method of Fire Tests of Firestop.
 - .6 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
 - .7 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .8 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-02a, Butterfly Valves.
 - .2 MSS-SP-70-06, Grey Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-05, Grey Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.
 - .9 National Research Council (NRC)
 - .1 National Plumbing Code of Canada (NPC) 2015.
 - .10 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992, c. 34 (TDGA).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.03 DELIVERY, STORAGE AND HANDLING

- .1 Store and manage materials in accordance with Section 01 61 00.
- .2 Packaging Waste Management: remove for reuse in accordance with Section 01 74 19 - Waste Management and Disposal.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, Regional and Municipal regulations.
- .5 Not Used.

1.04 RELATED REQUIREMENTS

- .1 Not Used.

2 PRODUCTS

All piping, fittings, valves, etc. shall be certified in accordance with NSF/ANSI 61 Annex G or NSF 372 to not have a weighted average of greater than 0.25 percent lead.

This section is applicable to all water piping serving fixtures within the laboratory, including piping labelled as "Laboratory" water instead of "Domestic".

2.01 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground:
 - .1 Copper tube, hard drawn, type L to ASTM B 88M.

2.02 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI/ASME B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 NPS 2 and larger:
 - .1 ANSI/ASME B16.18 or ANSI/ASME B16.22 roll grooved to CSA B242.
- .6 NPS 1 ½ and smaller:
 - .1 Wrought copper to ANSI/ASME B16.22, cast copper to ANSI/ASME B16.18; with 301 stainless steel internal components and EPDM seals. Suitable for operating pressure to 1380 kPa.

2.03 JOINTS

- .1 Flanged Joints: Rubber gaskets, latex-free 1.6 mm thick: to AWWA C111.
- .2 Flanged Joints: Bolts, nuts, hex head and washers: to ASTM A 307, heavy series.
- .3 Solder: 95/5 tin copper alloy
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting, complete with thermoplastic liner.

2.04 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.

- .2 NPS 2 and under, threaded:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.03 - Valves - Cast Steel.

2.05 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Lockshield handle as indicated.
- .2 NPS 2 and under, threaded:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Lockshield handles: as indicated.

2.06 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2 1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, renewable seat, bronze disc, bolted cap specified Section 23 05 23.03 - Valves - Cast Steel: Gate, Globe, Check.

2.07 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, full port. as specified Section 23 05 23.01 - Valves - Bronze.

- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, chrome plated brass ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.

2.08 BUTTERFLY VALVES

- .1 NPS 2-1/2 and over, lug:
- .1 To MSS-SP-67, Class 200.
- .2 Cast iron body, ductile iron chrome plated disc, stainless steel stem, EPT liner.
- .3 Lever operated, NPS8 and over, gear operated.

3 EXECUTION

3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.02 INSTALLATION

- .1 Install in accordance with NPC and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 15 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI and Standards Council of Canada (SCC) standards.
- .4 Install CWS piping below and away from HWS and HWC and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Valves
 - .1 Isolate equipment, fixtures and branches with gate, butterfly, or ball valves.
 - .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.03 PRESSURE TESTS

- .1 Not Used.
- .2 Pressure test piping before insulation is applied. Cut-out and replace leaking soldered or brazed fittings and retest.
- .3 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.

3.04 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 hours. Let stand for 24 hours, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean copper to Federal and provincial potable water guidelines. Let system flush for additional 2 hours, then draw off another sample for testing.

3.05 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.06 DISINFECTION

- .1 Flush out, disinfect and rinse system to requirements of authority having jurisdiction and approval of Departmental Representative
- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative approval.

3.07 START-UP

- .1 Timing: start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring HWS storage tank up to design temperature slowly.
 - .4 Monitor piping HWS and HWC piping systems for freedom of movement, pipe expansion as designed.
 - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.08 PERFORMANCE VERIFICATION

- .1 Scheduling:
 - .1 Verify system performance after pressure and leakage tests and disinfection are completed, and Certificate of Completion has been issued by authority having jurisdiction.
- .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design objectives.

- .2 TAB in accordance with Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .3 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
- .4 Sterilize HWS and HWC systems for Legionella control.
- .5 Verify performance of temperature controls.
- .6 Verify compliance with safety and health requirements.
- .7 Check for proper operation of water hammer arrestors. Run one outlet for 10 seconds, then shut of water immediately. If water hammer occurs, replace water hammer arrestor or re-charge air chambers. Repeat for outlets and flush valves.
- .8 Confirm water quality consistent with supply standards, and ensure no residuals remain as result of flushing or cleaning.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Section 22 05 00, 23 05 15, 23 05 29.

1.02 REFERENCE STANDARDS

- .1 ASTM International Inc.
 - .1 ASTM D 2235-04, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D 2564-12, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Series B1800-18, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 National Research Council Canada (NRC)
 - .1 National Plumbing Code of Canada 2015 (NPC).
- .6 Ontario Building Code (2015)
- .7 South Coast Air Quality Management District (SCAQMD), California State
 - .1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 29.06 - Health and Safety Requirements

1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: in accordance with Section 01 74 19 - Waste Management and Disposal.

2 PRODUCTS

2.01 PIPING

- .1 Waste and Vent Pipe from Connection to Plumbing Fixture (Including P-Trap) to Sanitary or Vent Riser Connection:
 - .1 Pipe: Flame-retardant Polypropylene, schedule 40, acid waste piping with no-hub/plain ends in accordance with ASTM D4101 and dimensional tolerances of ASTM F1412. Piping shall be factory grooved.
 - .2 Fittings: Flame-retardant Polypropylene, schedule 40, acid waste piping with no-hub/plain ends in accordance ASTM D4101. Fitting layouts will conform to ASTM D3311, and ASTM F1412.
 - .3 Joints: No-Hub/Plain mechanical joints method in accordance with ASTM F1412, with an outer band of 300 series stainless steel, 5/16" bolts, nuts, and washers plated to meet 100 hour salt spray test per ASTM B117.
 - .4 Joints to Dissimilar Materials: Flanged.
 - .5 P-Trap: Schedule 40 Polypropylene in accordance with ASTM D4101
 - .6 Serviceable Items: All piping and fittings shall be by same manufacture.

2.02 CLEANOUTS

- .1 Materials similar to piping provided.

2.03 ISOLATION VALVES

- .1 Zone Isolation Valves: Ball valve, fully ported, polypropylene with ANSI 150# flange connections, PTFE seals and packing, and padlocking lever.

3 EXECUTION

3.01 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling,

storage and installation instructions, and datasheets.

3.02 INSTALLATION

.1 Execution

1. Pipe to be installed per manufacturer's recommendations for threaded fittings
2. Pipe shall be supplied in 3050mm lengths.
3. Install piping neat and orderly; accomplish changes of direction using proper pipe fittings. Connect to sinks, cup sinks, floor drains, and other devices as shown on drawings.
4. Support all waste and vent piping to manufacturer's recommendations, applicable codes, and design details.
5. Pitch vent piping to waste line.
6. Install horizontal waste piping above ground with a minimum pitch 1:50. Make changes in direction of flow by use of drainage pattern fittings.
7. Set floor drains level and at low points. Floors shall slope toward drain. Drains installed without proper slope shall not be acceptable and shall be repaired to the Departmental Representative satisfaction at the contractor's cost.
8. Install cleanouts as required. Locate cleanout access cover so that snake of 30.5 m. can be properly used.
9. Provide caps and plugs on open pipe ends during construction phase to prevent construction debris from entering pipe.
10. Provide necessary transition fitting and couplings required when changing from one piping material to dissimilar material.

.2 Install in accordance with National Plumbing Code, Ontario Building Code 2015 and local authority having jurisdiction.

3.03 TESTING

1. Testing of all waste and vent piping must conform to the requirements of the Canadian Plumbing Code, latest edition.
2. Hydrostatically test both waste and vent piping applying a water column of at least 3m. Maintain hydrostatic pressure for 2 hrs without leakage.
3. Replace or repair piping system until satisfactory test is obtained. No piping shall be concealed until satisfactorily tested.
4. Provide documentation of successful, no leakage, hydrostatic testing of all drain piping to the Departmental Representative. Results of testing must be approved by the Departmental Representative prior to burying or enclosing the waste and vent piping
- .5 Hydraulically test to verify grades and freedom from obstructions.

3.04 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
Not Used
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.05 CLEANING

- .1 Clean in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal

END OF SECTION

1 GENERAL

1.01 REFERENCE STANDARDS

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code Section VIII Pressure Vessels.
 - .1 BPVC-VIII B - 2010, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 1.
 - .2 BPVC-VIII-2 B - 2010, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 2 - Alternative Rules.
 - .3 BPVC-VIII-3 B - 2010, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 3 - Alternative Rules High Press Vessels.
 - .2 ASME B16.5-2017, Pipe Flanges and Flanged Fittings.
 - .3 ASME B16.11-2016, Forged Fittings, Socket-Welding and Threaded.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A 181/A 181M-14, Standard Specification for Carbon Steel Forgings for General Purpose Piping.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B51-14, Boiler, Pressure Vessel, and Pressure Piping Code.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.02 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.
 - .2 Not used.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout including layout, dimensions and extent of piping system.
 - .1 Vertical and horizontal piping locations and elevations and connections details.
 - .2 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .4 Instructions: submit manufacturer's installation instructions.
 - .5 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in Section

01 78 00 - Closeout Submittals

- .4 Contractor to apply for and cover cost of TSSA Registration and Inspection

1.03 RELATED REQUIREMENTS

- .1 Not used.

2 PRODUCTS

2.01 PIPING/TUBING

- .1 Type 'L' copper to ASTM B819;
 - .1 Factory cleaned and marked with classification symbols,
 - .2 Shipped sealed with plastic end caps, and
 - .3 Hard drawn.
- .2 Fittings:
 - .1 Wrought copper suitable for silver soldering
- .3 Jointing Materials
 - .1 Silver brazing alloy AWS Classification BCUP-5.

2.02 BALL VALVES

- .1 Shut-off valves for compressed air up to NPS 2:
 - .1 Forged brass, bolted pattern, ball type with 200 mm type "K" copper extensions,
 - .2 Quarter turn from open to closed,
 - .3 Stainless steel, brass or chrome plated bronze ball, with teflon seat and viton seals,
 - .4 Blow-out resistant stem with viton seal, and
 - .5 Gauge port.
 - .6 Pressure rating of 4137 kPa ,2.03
 - .7 Factory assembled, cleaned for oxygen service with extension ends sealed with plastic caps and shipped in sealed plastic bag.

3 EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling,

storage and installation instructions, and datasheet.

3.02 COMPRESSED AIR PIPING CONNECTIONS AND INSTALLATION

- .1 Install flexible connection.
- .2 Install shut-off valves at outlets, major branch lines and in locations as indicated.
- .3 Install quick-coupler chucks and pressure gauges on drop pipes.
- .4 Install unions to permit removal or replacement of equipment.
- .5 Install tees in lieu of elbows at changes in direction of piping. Install plug in open ends of tees.
- .6 Grade piping at 1% slope minimum.
- .7 Install compressed air trap and pressure equalizing pipe at moisture collecting points. Drain pipe to nearest floor drain.
- .8 Make branch connections from top of main.
- .9 Install compressed air trap at bottom of risers and at low points in mains, piped to nearest drain. Distance between drain points to be 30 m maximum.
- .10 Provide drain from refrigerated air dryer.
- .11 Weld steel piping in accordance with Section 23 05 17 - Pipe Welding and;
 - .1 To ASME code and requirements of authority having jurisdiction.
 - .2 Weld concealed and inaccessible piping regardless of size.

3.03 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Testing: pressure test for 4 hours minimum, to 1100 kPa, with outlets closed and with compressor isolated from system. Pressure drop not to exceed 10 kPa.

3.04 CLEANING

- .1 Cleaning: blow out piping to clean interior thoroughly of oil and foreign matter.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1 General

1.1 SCOPE

1.1.1 This Section specifies pipe, fittings, and methods for all pure water system piping.

1.2 SHOP DRAWINGS AND PRODUCT DATA

1.2.1 Submit shop drawings for;

1.2.1.1 Pipe distribution.

1.2.2 Submit manufacturers product sheets with performance and installation data for;

1.2.2.1 Pipe & fittings,

1.2.2.2 Joints,

1.2.2.3 Fusion weld methods and equipment.

1.3 APPLICABLE CODES AND STANDARDS

1.3.1 ASTM D3222, Standard Specification for Unmodified

2 Products

2.1 PURE WATER PIPING

2.1.1 Application: high purity water systems as shown in the contract documents. Confirm existing piping system matches as specified here, and advise if different than shown.

2.1.2 Piping

2.1.2.1 Material: virgin, unpigmented PVDF (polyvinylidene fluoride) resin to ASTM D3222.

2.1.2.2 Dimensions: Schedule 80, iron pipe dimensions, minimum 3000mm lengths

2.1.2.3 Working pressure:

2.1.2.3.1 1500 kPa @ 23°C

2.1.2.3.2 410 kPa @ 120°C.

2.1.2.4 Pipe to be supplied clean and capped.

2.1.3 Fittings

2.1.3.1 Material: virgin, unpigmented PVDF (polyvinylidene fluoride) resin to ASTM D3222. Suitable for infrared butt welding.

2.1.3.2 Dimensions: minimum wall thickness to Schedule 80 iron pipe dimensions.

2.1.3.3 Injection molded.

2.1.3.4 Fittings to be supplied clean and individually bagged.

2.1.4 Valves

2.1.4.1 Material: virgin, unpigmented PVDF (polyvinylidene fluoride) resin to ASTM D3222, fully compatible with piping system. Pressure tested to 1030 kPa. Suitable for infrared butt welding or mechanical joint.

2.1.4.2 Working pressure: 1000 kPa @ 23°C

2.1.4.3 Diaphragm valves: EPDM diaphragm with BCF tail pieces

2.1.4.4 Ball valves: double block type with O-ring, PTFE seats, and union connections with BCF tail pieces

2.1.4.5 Ball check valves: single union design.

2.1.4.6 Union connection joints

2.1.4.7 Each valve to be supplied clean and individually bagged.

2.1.5 Pipe Supports

2.1.5.1 U.V. stabilized polypropylene pipe bracket,

2.1.5.2 Allows free axial movement of pipe.

3 Execution

3.1 INSTALLATION

3.1.1 Install in accordance with manufacturer's instructions and contract documents.

3.1.2 Provide pipe hangers of type and spacing as recommended by pipe manufacturer, and as shown.

3.1.3 Connections to equipment shall be via mechanical connection to facilitate maintenance. Should there be options base on equipment connections, flanged connection will be chosen.

3.1.4 Install level and with adequate access to allow for servicing, at minimum to manufacturer's directions or as required to properly service and maintain the equipment.

3.1.5 Cut pipe ends clean and prepare for welding. Clean pipe ends of dirt inside and outside of pipe before threading, grooving or welding.

3.1.6 Cap ends during construction to prevent entry of foreign matter.

3.1.7 Fusion weld piping in accordance with manufacturer's directions, using proprietary fusion tool specific to the product. Welds shall be crevice free. Installer to have experience with product on other jobs and have received training from factory-authorized representatives in the use of the tool and installation of product.

3.1.8 Pressure Test:

3.1.8.1 Leak test water system after field assembly with initial pneumatic pressure test at 350 kPa and repair leaks. Conduct a hydraulic pressure test at 150% of design pressure for 10 minutes, then reduce to design pressure and hold for 24 hours.

- 3.1.8.2 Obtain TSSA inspection report for piping system components that are registered as pressure piping.
- 3.1.8.3 Conduct pressure test with water of same quality as piping system design water product.

3.1.9 Final Flush:

- 3.1.9.1 Provide a final flush and filling of water system.
- 3.1.9.2 Fill piping with design water quality water and circulate for four hours. Where faucets or other points-of-use fittings are installed, flush water through each fixture at the end of the flush period.
- 3.1.9.3 Periodically take water samples and test for pH and conductivity, until product water quality in piping is equal to pure water generation equipment product water.

- 3.1.10 Provide testing and commissioning services and documentation for the pure water distribution system

END OF SECTION