

PWGSC
DARTMOUTH, NOVA SCOTIA

BIO WATER UPGRADES

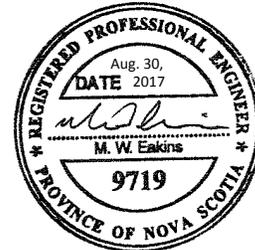
ISSUED FOR ADDENDUM NO. 2



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PART 1 - GENERAL

1.1 GENERAL

- .1 This section covers items common to all sections of Divisions 22 and 23.

1.2 SCOPE OF WORK

- .1 The work of this section includes all labour, materials, and equipment necessary for the installation complete of the mechanical systems shown on the drawings and described in these specifications.
- .2 It is the requirement of this work to provide all systems complete, functioning in intended system operation, notwithstanding that every item necessarily required may not be specifically mentioned.

1.3 EQUIPMENT LIST

- .1 Complete list of equipment and materials to be used on this project and forming part of tender documents including manufacturer's name, model number and details of materials, and submit for approval.
- .2 Submit for approval within 7 days after award of contract.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit shop drawings to be approved by Departmental Representative.
 - .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. eg. access door swing spaces.
 - .4 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.
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.5 Certification of compliance to applicable codes.

.5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use Mechanical Contractors Association of Canada (MCAC) "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

.6 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

.2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.

.3 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.

.4 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.

.5 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.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.

.2 Make changes as required and re-submit as directed by Departmental Representative.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Contractor shall obtain 1 set of reproducible mechanical drawings. Provide sets of white 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 weekly 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.

.9 As-built drawings:

.1 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).

.2 Submit to Departmental Representative for approval and make corrections as directed.

.3 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

1.6 EQUIPMENT INSTALLATION

- .1 In accordance with Manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

1.7 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.
 - .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.
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1.8 TRIAL USAGE

- .1 Departmental Representative may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.9 PROTECTION OF OPENINGS

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

1.10 ELECTRICAL

- .1 Division 22 and 23 as applicable is responsible for all wiring required for controls systems, including obtaining 120 V sources from the electrical system.

1.11 PREPARATION FOR FIRESTOPPING

- .1 Provide Firestopping and Smoke Seals.
- .2 Contractor to identify all locations where mechanical penetrations are required through fire rated separations including type and sizing.

1.12 EXISTING CONDITIONS

- .1 Connect into existing systems at times coordinated with Owner.
- .2 Request written approval 10 days minimum, prior to commencement of work.
- .3 Be responsible for damage to existing plant by this work.
- .4 Ensure daily clean-up of existing areas.

1.13 TESTS

- .1 Give 48 h written notice of date for all tests.
 - .2 Insulate or conceal work only after testing and approval by Departmental Representative.
 - .3 Conduct tests in presence of Departmental Representative.
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- .4 Bear costs including retesting and making good.
- .5 Equipment: test as specified in relevant sections.
- .6 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.14 ACCESS DOORS

- .1 Supply access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 x 600 mm for body entry and 300 x 300 mm for hand entry unless otherwise noted. Doors to open 180, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as high humidity areas, use stainless steel with brushed satin or polished finish as directed by Departmental Representative.
 - .2 Remaining areas: use prime coated steel.
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
 - .3 Installation is specified in applicable sections.
- .5 Acceptable material: Buensod, LeHage, Zurn.

1.15 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
 - .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
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1.16 DEMONSTRATION, OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Where specified elsewhere in Divisions 22 and 23, Manufacturers to provide demonstrations and instructions.
- .2 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.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections. Provide minimum 8 hour instruction.
- .5 When deemed necessary, Departmental Representative will record these demonstrations on video tape for future reference.

1.17 INTERPRETATION OF PLANS AND SPECIFICATIONS

- .1 These specifications are to be considered as an integral part of the plans which accompany them and neither the plans nor the specifications shall be used alone. Any item which is omitted in one but which is reasonably implied in the other shall be considered properly and sufficiently specified and must, therefore, be provided by this Contractor.
 - .2 Misinterpretation of the plans or specifications shall not relieve this Contractor of responsibility; final interpretation of details and clauses remains with the Departmental Representative.
 - .3 Where uncertainty exists in the passing of pipes and location of equipment, the General Contractor and or project manager shall be consulted before work is started. Where such materials and equipment have been installed so as to cause interference with the inside treatment of the building, they shall be removed and relocated without additional cost to the Owner.
 - .4 The plans do not necessarily show all valves, access panels, connections, balancing fittings, bases, isolators, flexible connections, drains, etc., and this Contractor shall not avail himself of these obvious omissions, but shall install the work complete in essential details so that it will function properly, can be easily balanced and so that repairs and removal of equipment can easily be made.
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- .5 Building dimensions shall not be scaled from the Mechanical plans but shall be obtained from on-site dimensions of the building. Any discrepancy between the drawings and the building shall be questioned before proceeding with any installation.

1.18 CO-OPERATION OF CONTRACTORS

- .1 This Contractor shall become familiar with the work of other Contractors and in laying out and installing the work shall co-operate with the other Contractors, so as to facilitate the progress of the work as a whole and avoid interference or delays. Where interference exists, this Contractor shall notify the General Contractor and/or project manager and the Departmental Representative before installing the work. Any changes in the work or alterations of the Mechanical Contractor's schedule of procedure required for such co-operation will not be considered as a claim for extra compensation.
- .2 It is required that all trades co-operate closely so as to install all systems in their allotted locations as indicated on the drawings, or coordination on site.

1.19 ERRORS AND OMISSIONS

- .1 The drawings are not intended to show every item of accessory equipment, but the Contractor shall tender on and install all essential details to provide for efficiency of operation and ease of maintenance.
- .2 Should this Contractor discover errors or discrepancies in the plans or specification, he shall refer the matter to the Departmental Representative for change or clarification and shall not proceed with that portion of the work until advised by the Departmental Representative to do so.

1.20 TESTING, ADJUSTING AND BALANCING (TAB)

- .1 This Contractor shall provide labour and materials to verify calibration of all flow sensing devices. Provide support during commissioning and verification.
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PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that condition of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PAINTING REPAIRS AND RESTORATION

- .1 Prime and touch up marred finished paintwork to match original.
- .2 Restore to new condition, finishes which have been damaged.

3.3 SYSTEM CLEANING

- .1 Clean interior and exterior of all systems including strainers.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
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.3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.5 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 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.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - 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 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

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

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for copper domestic water service used in the following:
 - .1 Copper incoming domestic water service, up to NPS 4.
 - .2 Hard drawn copper domestic hot and cold water services inside building.
 - .3 Soft copper tubing inside building.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .3 Section 01 35 29.06 - Health and Safety Requirements.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 22 05 01 - Common Work Results for Mechanical.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15-2013, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
 - .3 ANSI/ASME B16.22-2013, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - .4 ANSI/ASME B16.24-2016, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 88M-16, Standard Specification for Seamless Copper Water Tube (Metric).
 - .3 ASTM F 492-95, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.
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- .3 American Water Works Association (AWWA).
 - .1 ANSI/AWWA C111/A21.11-17, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-05(R2016), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-2017, Butterfly Valves.
 - .2 MSS-SP-70-2006, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS SP-71-2011, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction.
 - .1 NRCC 38728, National Plumbing Code of Canada (NPC) - 1995.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for following: valves.
- .3 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
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1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M-16.
 - .2 Buried, crawl space, or embedded: copper tube, soft annealed, type K: to ASTM B 88M-16, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24-2016.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15-2013.
- .3 Cast copper, solder type: to ANSI/ASME B16.18-2012).
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22-2013.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to ANSI/AWWA C111/A21.11-17.
 - .2 Bolts, nuts, hex head and washers: to ASTM A 307-14e1, heavy series.
 - .3 Solder: 95/5 tin copper alloy.
 - .4 Teflon tape: for threaded joints.
 - .5 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492-95, complete with thermoplastic liner.
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2.4 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18-2012, Class 150.
 - .2 Bronze body, stainless steel 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.

2.5 HANGERS AND SUPPORTS

- .1 Hangers and supports to be in accordance with the National Plumbing Code of Canada 2015.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with National Plumbing code, Provincial Plumbing Code, and local authority having jurisdiction.
 - .2 Assemble piping using fittings manufactured to ANSI standards.
 - .3 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.
 - .4 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
 - .5 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.
 - .2 Bend tubing without crimping or constricting. Minimize use of fittings.
 - .6 Hangers and supports to be in accordance with the National Plumbing Code of Canada 2015.
-

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using circuit balancing valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of Section 22 05 01 - Common Work Results for Mechanical.
- .2 Test pressure: greater of 1.5 times maximum system operating pressure or 860 kPa.
- .3 Pressure test report to be submitted to Departmental Representative and Commissioning Agent prior to installation of pipe insulation.

3.4 FLUSHING AND CLEANING

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

3.5 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.

3.6 DISINFECTION

- .1 Flush out, and rinse system to approval of Departmental Representative.
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- .2 Upon completion, provide laboratory test reports on water quality for Departmental Representative's approval.
- .3 Disinfection: liquid chlorine to ANSI/AWWA 13 303, Under take disinfection in accordance with ANSI/AWWA C651.

3.7 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 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.

3.8 PERFORMANCE VERIFICATION

- .1 Timing:
 - .1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.
 - .2 Procedures:
 - .1 Verify that flow rate and pressure meet Design Criteria.
 - .2 Adjust pressure regulating valves while withdrawal is maximum and inlet pressure is minimum.
 - .3 Sterilize HWS and HWC systems for Legionella control.
 - .4 Verify performance of temperature controls.
 - .5 Verify compliance with safety and health requirements.
 - .6 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.
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.7 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

.1 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and vent piping.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B32-08(2014), Specification for Solder Metal.
 - .2 ASTM B306-13, Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C564-14, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-12(R2016), Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125-01, Plumbing Fittings.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground Type DWV to: ASTM B 306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: tin-lead, 50:50, type 50A.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above Ground sanitary to: CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets.
 - .2 Stainless steel clamps.
 - .2 Hub and spigot.
 - .1 Caulking lead: to CSA B67.
 - .2 Cold caulking compounds.

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PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code Provincial Plumbing Code and local authority having jurisdiction.
- .2 Pipe materials to be in accordance with the Canadian Plumbing Code.

3.2 TESTING

- .1 Pressure test buried systems before backfilling shall consist in applying a water column of at least 3m to all joints. According to NPC 2010.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 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 that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Ensure that fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section includes:
 - .1 The installation of drainage waste and venting piping - plastic.
- .2 Related Sections:
 - .1 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
 - .2 Section 01 35 29.06 - Health and Safety Requirements.

1.2 REFERENCES

- .1 American Society for Testing and Materials Internations, (ASTM).
 - .1 ASTM D 2235-04, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D 2564-04(2009)e1, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-Series B1800-06, Plastic Nonpressure Pipe Compendium.
 - .2 CSA/CSA B1800-06, PVC Drain, Waste and Vent Pipe and Pipe Fittings.
 - .3 CSA-B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- .1 For buried and above ground DWV piping to:
 - .1 CSA/CSA B1800-02.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D 2564-04(2009)e1.
 - .2 Solvent weld for ABS: to ASTM D 2235-04.
-

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with National Plumbing Code Provincial Plumbing Code and local authority.

3.2 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.3 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 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .4 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Management and Disposal.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A126-04(2014), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B62-17, Specification for Composition Bronze or Ounce Metal Castings.
- .2 American Water Works Association (AWWA)
 - .1 ANSI/AWWA C700-15, Cold Water Meters-Displacement Type, Bronze Main Case.
 - .2 ANSI/AWWA C701-15, Cold Water Meters-Turbine Type for Customer Service.
 - .3 ANSI/AWWA C702-15, Cold Water Meters-Compound Type.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B64-Series-01(R2007), Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08(R2013), Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
 - .3 CAN/CSA-B356-10(R2015), Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .4 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-96, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
 - .2 PDI-WH201-92, Water Hammer Arresters Standard.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 For product data, indicate dimensions, construction details and materials for items specified herein.
-

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- .2 Data to include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

PART 2 - PRODUCTS

2.1 BACK FLOW PREVENTER

- .1 Preventers: to CSA B64-Series, reduced pressure principle type, consisting of two spring-loaded check valves, two ball valves for shutoff, intermediate pressure differential relief valve, and test cocks.
- .2 Maximum working temperature and pressure: 1034 kPa at 43°C.

2.2 PRESSURE REGULATORS

- .1 Capacity: as indicated.
- .2 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62-09.
- .3 Semi-steel spring chambers with bronze trim.

2.3 HOSE BIBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.

2.4 WATER METERS

- .1 Displacement type to ANSI/AWWA C700 for potable water service. NSF/ANSI 372 certified and NSF/ANSI 61 compliant.
 - .2 Capacity: NPS 1.
 - .3 Accessories:
 - .1 Direct reading on meter complete with cover.
-

.2 Remote reading system compatible for integration into BIO's existing monitoring system to approval of Departmental Representative.

- .4 Acceptable Material: Neptune T-10 water meter or approved alternative.

2.5 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.

2.6 PRESSURE GAUGE

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel or phosphor bronze bourdon tube having 0.5% accuracy full scale.
- .2 Suitable for use with potable/domestic water.
- .3 Complete with bronze stop cock.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheet.

3.2 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.3 BACKFLOW PREVENTORS

- .1 Install in accordance with CSA B64-Series, where indicated and elsewhere as required by code.
-

- .2 Pipe relief part discharge as indicated with appropriate air gap fitting.

3.4 STRAINERS

- .1 Install with sufficient room to remove basket.

3.5 WATER METERS

- .1 Prior to installation verify water meter's remote reading system is compatible with BIO's existing monitoring system by getting written approval from Departmental Representative.
- .2 Install water meters as indicated, and in accordance with manufacturer's recommendations.

3.6 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of all risers, at low points to drain systems, and as indicated.

3.7 PRESSURE GAUGE

- .1 Install as indicated. provide test port.

3.8 START-UP

- .1 Timing: Start-up only 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.

3.9 TESTING AND ADJUSTING

- .1 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
 - .2 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.
-

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.3 Training:

.1 Demonstrate full compliance with Design Criteria.

PART 1 - GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2010, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 125-96(2013)e1, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307-14, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-15, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
- .6 Underwriter's Laboratories of Canada (ULC)

1.2 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP 58 or ASME B31.1.
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.
-

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 36 29.06 - Health and Safety Requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP 58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated or have method to isolate copper from steel.
 - .2 Upper attachment structural: suspension from lower flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: malleable iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 13 mm FM approved.
 - .3 Upper attachment structural: suspension from upper flange of I-Beam:
 - .1 Cold piping NPS 2 maximum: ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, ULC listed and approved to MSS SP 69.
 - .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed and approved to MSS SP 69.
 - .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies.
 - .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.
 - .3 Do not use 22 mm or 28 mm rod.
-

- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black, with formed portion plastic coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: black, carbon steel to MSS SP 58, type 42, UL listed, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.

2.5 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.6 OTHER PIPING AND EQUIPMENT SUPPORTS

- .1 Fabricate other piping and equipment supports from structural grade steel.
- .2 Submit structural calculations with shop drawings.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .3 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete insets, one at each corner.
- .4 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code or authority having jurisdiction.
 - .2 Gas and fuel oil piping: up to NPS 1/2: every 1.8 m.
 - .3 Copper piping: up to NPS 1/2: every 1.5 m.
 - .4 Within 300 mm of each elbow.
-

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hangers and support so that rod hangers is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 Site Test: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.

- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Thermal insulation for piping and piping accessories in commercial type applications.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
 - .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C 335-10, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .2 ASTM C 411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .3 ASTM C 449/C449M-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C 547-07e1, Mineal Fiber Pipe Insulation.
 - .5 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
 - .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
 - .4 Canada Environmental Protection Act (CEPA), 1999, C. 33.
 - .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
 - .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-03, Surface Burning Characteristics of Building Materials and Assemblies.
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- .2 CAN/ULC-S701-01, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .3 CAN/ULC-S702-1997, Thermal Insulation, Mineral Fibre, for Buildings
- .4 CAN/ULC-S702.2-03, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CPF: Code Piping Finish.

1.4 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 in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Instructions: submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Installer: specialist in performing work of this Section, and qualified to standards member of TIAC.
 - .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.
-

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.
 - .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

PART 2 - PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
 - .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
 - .3 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
 - .4 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation with vapour retarder jacket.
 - .2 Jacket to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor to CAN/ULC-S702 ASTM C547.
 - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.
-

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, plain reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Minimum service temperatures: -20 degrees C.
 - .3 Maximum service temperature: 65 degrees C.
 - .4 Moisture vapour transmission: 0.02 perm.
 - .5 Thickness: 0.5 mm.
 - .6 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
-

- .2 Tacks.
- .3 Pressure sensitive vinyl tape of matching colour.
- .7 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.

.2 Canvas:

- .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: compatible with insulation.

.3 Aluminum:

- .1 To ASTM B 209.
- .2 Thickness: 0.50 mm sheet.
- .3 Finish: stucco
- .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
- .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
- .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5mm thick at 300 mm spacing.

2.9 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Same insulation thickness as adjoining piping systems.
- .2 PVC or high temperature fabric jacket.
- .3 Designed to permit periodic removal and re-installation without requiring repair to adjacent insulated surfaces.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
 - .2 Surfaces clean, dry, free from foreign material.
-

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
 - .2 TIAC Code: A-3.
 - .1 Securements: SS wire bands Tape at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
 - .3 TIAC Code: A-6.
 - .1 Insulation securements: as recommended by manufacturer.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
-

Applic ation	Temp degrees C	TIAC code	Pipe sizes (NPS) and insulation thickness (mm)				
			to 1	1 1/4 to 2	2 1/2 to 4	5 to 6	8 & over
Domestic Cold Water - interior	A-3	Run out 38	38	38	38	38	38
Domestic Cold Water - exterior (and crawl space where applicable)	A-6	50	50	50	50	50	50

.4 Finishes:

- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: PVC jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors and crawl space where applicable: water-proof aluminum jacket.
- .6 Finish attachments: SS screws bands, at 150 mm on centre. Seals: wing closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 - GENERAL

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit complete heat tracing system calculation provided by the equipment manufacturer. Calculation to be provided for each heat tracing circuit and to include as minimum:
 - .1 Heat loss and cable rating/type.
 - .2 Circuit loading and breaker sizing.
 - .3 Bill of materials.

1.2 OPERATION AND MAINTENANCE MANUAL

- .1 Provide heat tracing system operation and maintenance data for incorporation into manual.
- .2 Include:
 - .1 Instructions for complete heat tracing system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.3 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.4 TRAINING

- .1 Provide on-site lectures and demonstration by heat tracing equipment manufacturer to train operational personnel in use and maintenance of heat tracing system.
 - .2 Provide minimum of two (2) hours of training. The time schedule of the training sessions to be coordinated with Departmental Representative.
-

PART 2 - PRODUCTS

2.1 PIPE TRACING HEATING CABLES

- .1 Self-regulating heating cable, nickel-plated copper bus wires embedded in a self-regulating polymeric core, polyolefin primary and overall jackets, tinned copper ground braid (12AWG equivalent size). Heating capacity: as indicated on drawings and verified by the heat tracing equipment manufacturer. For use on metallic and non-metallic piping with 208V power supply.
- .2 Cable to vary its power (heat) output all along its length relative to the temperature of the pipe surface, designed to be crossed over itself without overheating, cut to length in the field.
- .3 Cable accessories used to attach heating cable onto pipes and connection components used to terminate heating cable, including power connectors, splices, tees, and end connectors shall be approved for the application and for the use with the particular type of heating cable. Enclosure rating CSA Type 4X.
- .4 Fiberglass tape for fastening heating cable to metallic and non-metallic pipes. Aluminum tape, lengthwise over the cable for non-metallic pipes as a heat-transfer aid. Cable ties where the pipe surface prevents proper tape adhesion.
- .5 Heat tracing components from one manufacturer throughout project.

2.2 CONTROLS

- .1 Microprocessor based temperature control and monitoring unit. Unit to individually monitor and control heat tracing circuit integral with:
 - .1 LED's to indicate power-on, present status, and alarm status.
 - .2 Input: Three 3-wire RTD's for each heat tracing circuit.
 - .3 Output: 30A, 208V solid-state Contractor.
 - .4 Alarm and control relays rated 1A minimum at 208V for remote alarm and annunciation.
 - .5 Base program and parameters on Non-volatile memory.
 - .6 Alarms:
 - .1 High temperature.
 - .2 Low temperature.
 - .3 Ground leakage current.
 - .4 Sensors fault.
 - .7 Operating temperature: -40°C to 40°C.
-

- .8 Temperature control range: -40 C to 40 C, adjustable in 1 degree increments.
 - .9 Relative humidity: 0% to 90%.
 - .10 Enclosure: lockable, NEMA type 4.
 - .11 Communication: the controller shall be provided with a communication interface compatible with BACnet IP or BACnet MSTP and capable of relaying all signals and alarms herein specified.
 - .12 Ground fault monitoring.
- .2 Resistance temperature detector (RTD): platinum, insulated and shielded, 3-wire 100 ohms at 0 C with 1800mm lead wire and connection box CSA type 4X. Sensor accuracy +/- 0.5 C. Lead wire compensation.
 - .3 RTD extension cable: One Triad (3 conductor #18 AWG tinned copper insulated, twisted, shielded, c/w tinned copper drain wire, PVC jacket) and in accordance with manufacturer recommendation, Belden 8770 or approved equal.
 - .4 Terminal end seal kits: certified for installation in damp conditions to CAN/CSA-C22.2 No. 130 and consisting of:
 - .1 Self-regulating:
 - .1 Two heat-shrinkable tubes.
 - .5 Power connection kits: connect to pipe and to CAN/CSA-C22.2 No. 130 as indicated.
 - .1 Self regulating:
 - .1 Base.
 - .2 Top.
 - .3 Sealing gasket.
 - .4 Terminal block.
 - .5 Locknuts.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install heating cables in accordance with manufacturer's instructions. Distribute and fasten cable evenly on pipe using pipe strap or tape at maximum spacing 305 mm. Bond shield to ground. Coordinate cable installation with insulation application. Loop additional cable at fittings, valves, and flanges.
- .2 In addition to cable fastening tape, use aluminum tape for non-metallic pipes as a heat transfer aid. Tape lengthwise over the heating cable.

- .3 Use cable ties where the pipe surface prevents proper tape adhesion.
- .4 Install heat tracing system components and required mounting accessories.
- .5 Install RTD's and associated connection boxes. Bond shield of lead and extension wires to ground as per manufacturer recommendation.
- .6 Program temperature control and monitoring unit. Engage heat tracing equipment manufacturer for programming the unit as specified.
- .7 Install power and control wiring and make connections.
- .8 When the insulation and weatherproofing are complete, attach heat tracing caution labels on the outside of the insulation so they are visible. Place labels at alternate sides about every 3 meters.
- .9 Provide equipment and conduit/cable identification in accordance with Section 26 05 00 - Common Work Results For Electrical.
- .10 Provide identification nameplates on each heat tracing component's box. Nameplate: lamicooid 3mm thick, red face and white core, size 7, indicate component designation, heat tracing or RTD circuit number, and system voltage.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Use 500 V megger to test cables for continuity and insulation value and record readings before, during and after installation.
 - .3 Where resistance of 10 megohms or less is measured, stop wok and advise Departmental Representative.
 - .4 Arrange and pay for field testing of ground fault equipment protection for new or affected by this work circuits by heat tracing equipment manufacturer before commissioning service. Demonstrate simulated ground fault tests.
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- .5 Arrange and pay for field testing of operation and commissioning service of heat tracing system by heat tracing equipment manufacturer.
- .6 Submit report of tests to Departmental Representative and certificate that system as installed meets criteria specified.