

PART 1 - GENERAL

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| <u>1.1 WORK INCLUDED</u> | .1 | This section specifies requirements for constructing water mains and services. Work includes supply, installation and testing of pipe, fittings and service connections, and disinfection. |
| | .2 | Supply and installation of pipe heat tracing system including heating cable, controller and all necessary accessories. |
| <u>1.2 RELATED SECTIONS</u> | .1 | Section 03 30 00 - Concrete |
| | .2 | Section 05 50 00 - Metal Fabrications |
| <u>1.3 REFERENCE STANDARDS</u> | .1 | ANSI/ASME B16.1-2010, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800. |
| | .2 | ANSI/AWWA C104/A21.4-2013, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water. |
| | .3 | ANSI/AWWA C105/A21.5-2010, Polyethylene Encasement for Ductile-Iron Pipe Systems. |
| | .4 | ANSI/AWWA C110/A21.10-2012, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., (75mm Through 1200mm) for Water and Other Liquids. |
| | .5 | ANSI/AWWA C111/A21.10-2012, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings. |
| | .6 | ANSI/AWWA C151/A21.51-2009, Ductile-Iron Pipe, Centrifugally Cast, for Water. |
| | .7 | ANSI/AWWA C153/A21.53-2011, Ductile-Iron Compact Fittings, 3 in. Through 24 in. (76mm Through 610mm) and 54 in. Through 64 in. (1400mm Through 1600mm) for Water Service. |
| | .8 | ANSI/AWWA C301-2014, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type, for Water and Other Liquids. |
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- .9 ANSI/AWWA C302-2011, Reinforced Concrete Pressure Pipe, Non-cylinder Type.
 - .10 ANSI/AWWA C303-2008, Reinforced Concrete Pressure Pipe, Steel Cylinder Type.
 - .11 ANSI/AWWA C502-2014, Dry-Barrel Fire Hydrants.
 - .12 ANSI/AWWA C504-2010, Rubber-Seated Butterfly Valves.
 - .13 ANSI/AWWA C515-2009, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.
 - .14 ANSI/AWWA C600-2010, Installation of Ductile Water Mains and Their Appurtenances.
 - .15 ANSI/AWWA C606-2011, Grooved and Shouldered Joints.
 - .16 ANSI/AWWA C651-2014, Disinfecting Water Mains.
 - .17 ANSI/AWWA C800-2012, Underground Service Line Valves and Fittings.
 - .18 ANSI/AWWA C900-2007, Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. (100mm) Through 12 in. (300mm), for Water Distribution.
 - .19 ANSI/AWWA C901-08, Polyethylene (PE) Pressure Pipe and Tubing, ½ in. (13mm) Through 3 in. (76mm), for Water Service.
 - .20 ANSI/AWWA C905-2010, Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 in. Through 36 in. (350mm Through 900mm) for Water Transmission.
 - .21 ANSI/AWWA C906-07 Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100mm) Through 63 in. (1,600mm), for Water Distribution and Transmission.
 - .22 ANSI/NSF 61-2013, Drinking Water System Components - Health Effects.
 - .23 ASME B18.2.1-2012, Square, Hex, Heavy Hex and
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Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head and Lag Screws.

- .24 ASTM A183-2014, Carbon Steel Track Bolts and Nuts.
- .25 ASTM A276-2013A, Stainless and Heat-Resisting Steel Bars and Shapes.
- .26 ASTM B62-2009, Composition Bronze or Ounce Metal Castings.
- .27 ASTM B88-2014, Seamless Copper Water Tube.
- .28 ASTM B418-2012, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
- .29 AWWA B300-2011, Hypochlorites.
- .30 AWWA B301-2010, Liquid Chlorine.
- .31 AWWA C904-2006, Cross-linked Polyethylene (PEX) Pressure Pipe, ½" (12mm) Through 3" (76mm) for Water Service.
- .32 AWWA C909-2009, Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe 4" (100mm) Through 18" (450mm) for Water Distribution.
- .33 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Board and Pipe Coverings.
- .34 CAN/CSA B137 Series-2013, Thermoplastic Pressure Piping Compendium.
- .35 CAN/CSA-C22.2 NO. 130-03 (R2013) - Requirements for Electrical Resistance Heating Cables and Heating Device Sets.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 10 00 for items listed in Supplementary Specifications.
 - .2 Submit data sheets for all heat tracing materials and components. Include heat tracing system
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calculations as follows: heat loss, cable type and rating, circuit loading and bill of materials.

1.5 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 10 00 for items listed in Supplementary Specifications.
- .2 Submit certificate signed by manufacturer representative that materials and installation comply with specified performance characteristics and physical properties.

1.6 HANDLING AND STORAGE

- .1 Handle and store pipe, valves and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.
- .3 Store hydrants and valves to prevent retention of water and damage by freezing.

1.7 SCHEDULING OF WORK

- .1 Coordinate and organize work to minimize interruptions to existing services.
- .2 Notify Departmental Representative and building occupants a minimum of 24 hours in advance of planned interruptions in service.
- .3 Do not interrupt water service except between 10:00 a.m. and 4:00 p.m. local time, unless otherwise authorized.
- .4 Notify Fire Department of any planned or accidental interruption to water service.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Diameter, material and strength class of pipe and fittings: as indicated.

- .2 Any material that comes in contact with drinking water must comply with NSF 61.
- 2.2 DUCTILE IRON PIPE AND FITTINGS
- .1 Pipe: Special Class 52, to ANSI/AWWA C151/A21.51 latest revision.
- .2 Fittings: to ANSI/AWWA C100/A.21.10 or ANSI/AWWA C153/A21.53, cement mortar lined, minimum pressure rating 1035 kPa for cast-iron, 1720 kPa for ductile-iron.
- .3 Pipe Coatings:
- .1 Interior: cement mortar lining with asphaltic seal coat to ANSI/AWWA C104/A21.4.
- .2 Exterior: asphaltic seal coat to ANSI/AWWA C151/A21.51 latest revision.
- .4 Joints: mechanical or push-on to ANSI/AWWA C111/A21.10; flanged where indicated, to ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53 with Class 125 flanged ends to ANSI/ASME B16.1 (grooved type coupling joint with malleable iron couplings and gaskets).
- 2.3 POLYVINYL CHLORIDE PIPE AND FITTINGS
- .1 Pipe and Joints: to CAN/CSA B137.3, AWWA C900 Class 305 duct-iron outside diameter, gasketed bell-end joint, with integral joint resistant system.
- .2 Fittings:
- .1 PVC: to CAN/CSA B137.
- .2 Gray or ductile-iron: to AWWA C110 and C153 cement mortar lined to AWWA C104, minimum pressure rating 1035 kPa for cast, 1720 kPa for ductile iron.
- 2.4 POLYETHYLENE PIPE AND FITTINGS
- .1 Pipe:
- .1 13 to 76mm diameter: to AWWA C901.
- .2 100mm diameter and larger: to AWWA C906.
- .2 Joints:
- .1 Thermal Butt Fusion.
- .2 Electro-fusion coupling.
- .3 Mechanical Connections: polyethylene flange end with metal back-up ring.
- .3 Fittings:
- .1 Polyethylene: to AWWA C901 and AWWA C906.
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.2 Flanged cast-iron: to AWWA C110.

2.5 GATE VALVES

- .1 Buried: to AWWA C515 up to 300mm, minimum working pressure rating 1380 kPa and as follows:
 - .1 Body: cast-iron with mechanical joint ends.
 - .2 Mechanism (AWWA C515): wedge disc with resilient rubber seat ring and machined seating surface, non-rising spindle, and O-ring seals.
 - .3 Direction of opening: counter-clockwise.
 - .4 Operating nut: 50mm square.
 - .5 Provide centering disc.
- .2 Chamber: to AWWA C515 up to 300mm, minimum working pressure rating 1380 kPa and as follows:
 - .1 Body: cast-iron with Class 125 flanged ends to ANSI/ASME B16.1.
 - .2 Mechanism (AWWA C515): wedge disc with resilient rubber seat ring and machined seating surface, O.S.& Y., rising stem and handwheel.
 - .3 Direction of opening: counter-clockwise.
- .3 Epoxy coat all gate valves with minimum 150 micron coating.

2.6 VALVE BOXES

- .1 Valve Boxes:
 - .1 Cast-iron, slide type, adjustable for depth of pipe below finished grade or composite valve box.
 - .2 Covers marked "Water".
 - .3 Lugged to prevent turning and rolling of cover, and cover notched to suit.

2.7 GASKETS AND BOLTS
FOR FLANGES

- .1 Gaskets: unless otherwise specified, supply full face one piece red virgin rubber gaskets of 3mm thickness for all flange joints.
- .2 Bolts: unless otherwise specified, all steel bolts and nuts to be American Standard threads of the coarse thread series, conforming to ANSI B18.2.1. Bolts, heads and nuts to be hexagonal. Length of any bolt to be such that it will not project beyond nut more than 10mm or less than 5mm and no bolt to be less than diameter of the hole in which it fits by more than 3mm. Bolts to be utilized for all flanged joints unless otherwise indicated. Studs or stub bolts may be used for certain connections only when approved

by the Departmental Representative.

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| <u>2.8 THRUST RESTRAINT</u> | .1 | Thrust blocks and anchors: 20 MPa concrete and 15 M, Grade 400 reinforcing steel where indicated. |
| | .2 | Mechanical joint restraint device: Integral joint restraint system, minimum pressure working rating 2410 kPa and minimum safety factor of 2:1. |
| <u>2.9 DISINFECTANT</u> | .1 | Sodium hypochlorite or calcium hypochlorite: to AWWA B300. |
| | .2 | Liquid Chlorine: to AWWA B301. |
| <u>2.10 REDUCING AGENT</u> | .1 | Hydrogen Peroxide, 35% by mass commercial grade. |
| <u>2.11 TRENCH INSULATION</u> | .1 | Insulation: to ULC S701, Type 4, extruded polystyrene. |
| <u>2.12 MARKER STAKE</u> | .1 | Timber, 40mm x 90mm. |
| <u>2.13 GEOSYNTHETIC</u> | .1 | Synthetic fibre, rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents. Non-woven construction, with minimum thickness of 2mm and minimum density of 200 g/m ² . |
| <u>2.14 ANODE PACKS</u> | .1 | Zinc anodes, to ASTM B418 as directed. |
| <u>2.15 PROTECTIVE COATING</u> | .1 | Anti-corrosion petrolatum paste, tape and mastic. |
| <u>2.16 HEAT TRACING CONDUIT(S)</u> | .1 | Heat tracing conduits shall consist of an extruded molding and shall be applied to the pipe prior to application of the insulation. The conduit will be securely fastened to the pipe to prevent the ingress of foam therein during the insulation process. Each conduit shall be checked after insulating to insure they are not plugged. The ends shall be sealed prior to shipping to prevent any foreign material from entering the conduit while in transit or during installation. |
| <u>2.17 PRE-INSULATED PIPE INSULATION</u> | .1 | Material: rigid polyurethane foam, factory applied. |
| | .2 | Thickness: 50 mm (2 in.) or as required. |

- .3 Density: (ASTM D 1622) 35 to 46 kg/m3 (2.2 to 3.0 lbs/ft3).
- .4 Closed cell content: (ASTM D 6226) 90%, minimum.
- .5 Water absorption: (ASTM C272) 4.0% by volume.
- .6 Thermal conductivity: (ASTM C518) 0,020 to 0,026 W/m °C (0.14 to 0.17 Btu • in/ft2 • hr • °F).

2.18 SYSTEMS PROPERTIES

- .1 System compressive strength: (modified ASTM D 1621) approximately 1379 kPa (200 lbs/in2), varies with gauge and type of jacket material and pipe diameter.
- .2 Core pipe service temperature range: from cryogenic to 930C (200oF); the overall factory insulated system limitations are dependent on core pipe type and application.

2.19 OUTER JACKET

- .1 Aluminum:
 - .1 Jacket OD >300mm (12") @ 18 ga

2.20 INSULATED PIPE JOINTS

- .1 Insulated pipe joints shall be completed using prefabricated polyisocyanurate or urethane foam half shells and metal consistent with that on the factory insulated pipe. All metal overlaps at the joints and fittings shall be 50 mm (2 in) minimum and shall be field positioned in such a way as to shed water.

2.21 INSULATION KITS FOR FITTINGS

- .1 Insulation kits for fittings shall consist of rigid polyisocyanurate or urethane foam insulation complete with a thin elastomeric coating on the outside surfaces for strength during transit and installation, and fabricated aluminum outer protective jacket consistent with that on the factory insulated pipe. All kits to be supplied complete with stainless steel bands, band-it clips, and screws to suit. Rigid Polyisocyanurate or Urethane Foam Insulation
 - .1 Density (ASTM D1622) 27 to 32 kg/m3 (1.7 to 2.0 lbs/ft3).
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- .2 Compressive strength (ASTM D1621) 131 to 158 kPa (19 to 23 lbs/in2).
- .3 Closed cell content 90%, minimum.
- .4 Water absorption: (ASTM D2842) 4.0% by volume.
- .5 K factor: (ASTM C 518) 0,027 W/m °C, (0.19 Btu • in/ft2 • hr • °F).
- .6 Thickness, to match pipe insulation thickness.

2.22 ELECTRIC
TRACING SYSTEM

- .1 The electric heat tracing system and associated controls shall be as per the manufacturer's recommendations with particular attention being paid to the watt densities applied through conduits on ductile iron pipes to prevent pipe damage. All tracing cables and related accessories to be CSA approved and comply with CSA heat tracing standard C22.2 No 130. All heat tracing components from one manufacturer.
 - .1 Heating cable shall be designed specifically for the freeze protection of the pre-insulated pipe. They shall be intended for field pulling into trace conduits which are attached to the carrier pipe, beneath the factor applied polyurethane insulation. Suitable for high density polyethylene (HDPE) pre-insulated pipe systems. Cable features:
 - .1 Parallel resistance type heating strip with a thermally stable nichrome heating wire.
 - .2 Constant watt cable with heating zones to produce constant and predictable watts per meter heat output.
 - .3 Fluoropolymer jacket, rugged, water resistant, easy to pull into trace conduits. CSA certified for wet locations. Tinned copper grounding braid.
 - .4 Suitable for cutting to length in the field.
 - .5 Heating capacity as indicated on drawing.
 - .6 Cable accessories including above insulation type power connection kit, adhesive lined heat shrinkable end termination kit, fastening tape suitable for pipe and any other accessories as required to provide complete system. Enclosure minimum CSA Type 4.
 - .2 Heat tracing controller: state-of-the-art

electronic thermostat to control one heating cable operating at 240 Vac having a total current draw that does not exceed 30 A. Non-volatile memory retains all programmed parameters in the event of a power outage.

- .1 Input voltage range: 240 Vac, 60 Hz.
- .2 Power output: 2-pole relay output rated 30 A, 240 Vac.
- .3 Enclosure: CSA Type 4. Operating ambient: -40 to +40°C (-40 to +104°F).
- .4 Alarm output: 1 A max, 240 Vac max., 60 Hz, SPDT (form C) relay output configured for "fail-safe" operation.
- .5 Monitoring and alarming: The electronics monitor low temperature, ground fault current, open / shorted temperature sensor(s) and high cable temperature.
- .6 Programmable features:
 - .1 Auto-cycle: When the temperature controller is energised the controller performs an auto-cycle test in intervals to measure the ground fault leakage current. If the measured ground fault current is above the set level, the ground fault current alarm is activated.
 - .2 Ground fault detection: Factory adjustable to trip and alarm or alarm only. Setting @ 30 or 100 ma.
 - .3 Temperature control : 3-wire 100 W @ 0°C Platinum RTD ($\alpha=0,00385 \text{ W/W/}^\circ\text{C}$), lead compensated to 20 W per lead.
 - .4 Deadband : 1 to 5°C (1.8 to 9°F).
 - .5 Control temperature setpoint range : -5 to 75°C (23 to 167°F)
 - .6 Low temperature setpoint range : -10 to 75°C (14 to 167°F).
 - .7 High cable temperature : the high limit feature will override demand for heat and shut off the load when a high cable temperature condition is reached. High temperature setpoint range : 25 to +100°C (77 to +212°F).

PART 3 - EXECUTION

- 3.1 SEQUENCE OF WORK .1 Submit temporary service plan and methodology to

Departmental Representative for approval, 10 days prior to shutoff.

- .2 Shut off water supply at water valves as indicated on drawings.
- .3 Install one (1) new isolation water valve at the East connection point.
- .4 Install temporary Water Service pipe as indicated on drawings.
- .5 Temporary Water Service pipe shall be suspended along the existing bridge and will extend the entire length of the bridge as indicated on drawings.
- .6 Connect pipe to existing water main as indicated.
- .7 Test and disinfect temporary Water Service pipe.
- .8 Remove and abandon existing Water Service pipe as required, and as directed by Departmental Representative.
- .9 Complete all work(s) associated with bridge construction.
- .10 Construct new Water Service pipe alignment along newly constructed bridge.
- .11 Test and disinfect new Water Service pipe.
- .12 On completion and verification of performance of installation, remove temporary Water Service pipe as instructed by Departmental Representative.
- .13 Contractor to notify Departmental Representative prior to activating water flow for new Water Service pipe.

3.2 PREPARATION

- .1 Inspect products for defects and remove defective products from site.
- .2 Confirm pipe, fittings, valves and hydrants are clean before installation.
- .3 Pipe and the spiral metal jacket shall be cleaned

of surface dust or dirt, if necessary, to insure adhesion of the foam to the pipe and inner jacket surface. The pipe and/or jacket may be treated by sand blasting, application of a chemical foam-bonding compound, or by steam cleaning to enhance adhesion.

3.3 TRENCHING, BEDDING
AND BACKFILLING

- .1 Do excavating, trenching and backfilling to Section 31 23 33.01.

3.4 PIPE
INSTALLATION

- .1 Lay and join pipe, fittings, and valves as specified herein and according to manufacturer's published instructions.
- .2 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
Horizontal Alignment: 150mm
Vertical Alignment: 75mm
- .3 Face bell ends in direction of laying. On grades of 5% or greater lay pipe up grade.
- .4 Do not exceed maximum joint deflection recommended by manufacturer.
- .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipelaying is not in progress.
- .6 Install gaskets in accordance with manufacturers published instructions. Use only lubricant supplied by manufacturer. During cold weather store gaskets in heated area to promote flexibility.
- .7 Align pipes before joining.
- .8 Support pipes as required to promote concentricity until joint is properly completed.
- .9 Keep pipe joints free from mud, soil, gravel or other foreign materials.
- .10 Avoid displacing gasket or contaminating with soil, petroleum products or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.

- .11 Complete each joint before laying next length of pipe.
- .12 Where deflection at joints is permitted, deflect only after spigot is fully inserted in bell.
- .13 For concrete pressure pipe, install diaphragms and pour cement mortar into joint recess. Fill inside joint recess with stiff cement grout for pipe 600mm and larger.
- .14 At structures provide flexible joint not more than 1 m from outside face of structure. Support pipe between structure wall and first joint with 20 MPa concrete.
- .15 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating and leave smooth beveled edge.
- .16 Provide concrete thrust blocks to undisturbed ground on all tees, bends, plugs and caps or as indicated on Project Documents. Construct as indicated and keep joints and couplings free of concrete.
- .17 Install mechanical joint restraint to AWWA C111 and tighten lug nuts until all wedges are in firm contact with pipe surface. Continue to tighten alternating between bolts until lug nuts twist off.

3.5 UNDERCROSSING

- .1 Provide shop drawings showing proposed method of installation for pipe in undercrossing.
- .2 Excavate working pit according to reviewed shop drawings.
- .3 Dewater area of excavation and undercrossing.
- .4 Place jacking, boring or tunneling equipment in working pit to approved line and grade of the proposed pipe.
- .5 Install encasing pipe to proposed line and

grade as indicated.

- .6 Use mechanical or welded type joints for encasing pipe.
- .7 After encasing pipe has been installed, check line and grade for approval.
- .8 Remove any soil that remains in the casing pipe.
- .9 Insert pipe into encasement pipe, starting from the working pit.
- .10 Place pipe one (1) length at time outside encasement pipe. Maneuver pipe into position.

3.6 VALVES AND VALVE BOXES

- .11 Use approved blocking method to guide pipe in true alignment.
- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
- .2 On direct buried valves, install valve boxes centered over operating nut, using centering disc, and true to line and grade.
- .3 Use thrust anchors for valves greater than 150mm on PVC and polyethylene pipe.

3.7 CONNECTIONS TO EXISTING MAIN

- .1 Connect new mains to existing mains as indicated.
- .2 Prior to cutting into existing main, verify outside diameter and type of pipe. Do not cut main unless all items required to complete connection are on hand.
- .3 Valves on existing system will be operated only by the water utility.
- .4 After bacteriological tests pass, place water main in service, as directed.

3.8 HYDROSTATIC AND LEAKAGE TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
- .3 Test after services and hydrants are installed.

- .4 Backfill prior to testing.
- .5 Notify Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of Departmental Representative.
- .6 Open all valves in test section.
- .7 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air vacuum release valves are installed. After testing, remove corporation stops and install plugs.
- .8 Fill concrete pipe 24 hours before testing to allow for absorption.
- .9 Apply test pressure of 1035 kPa or pressure equal to 1.5 times working pressure, whichever is greater, measured at lowest point in test section. Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted by the test process.
- .10 Locate and repair defects if test fails. Retest.
- .11 Repair visible leaks regardless of test results.

3.9 FLUSHING AND
DISINFECTION

- .1 Flush and disinfect water mains to AWWA C651 and as herein specified. Notify Departmental Representative 24 hours in advance of flushing and disinfection.
- .2 Flush water mains with potable water through available outlets with sufficient flow to produce minimum velocity in water main of 1.5 m/s, for 10 minutes. Flush until foreign materials have been removed and water is clear.
- .3 Slowly open and close valves and hydrants to ensure thorough flushing.
- .4 If satisfactory results cannot be achieved by flushing, swab pipes by approved methods and reflush.

- .5 Disinfect water main upon completion of flushing using chlorine solution distributed throughout entire system.

- .6 Inject 1% chlorine solution through a corporation cock in the top of newly laid pipe, at point close to where main is being filled and at rate proportional to filling rate. Prepare stock chlorine with concentration of 1% free chlorine by volume as follows:

<u>Product</u>	<u>Amount of Compound</u>	<u>Quantity of Water</u>
High test calcium hypochlorite (67-70% Cl)	1.0 kg	60 litres
Chlorinated lime (32-35% Cl)	1.0 kg	30 litres
Liquid bleach (5.25% Cl)	1.0 litre	3.5 litres
(10.5% Cl)	1.0 litre	7.0 litres

- .7 Calcium hypochlorite and chlorinated lime are not to be used when water temperature is less than 5°C.
- .8 The following table indicates the quantity of 1% chlorine stock solution required per 100 metre length of pipe.

<u>Pipe Diameter (mm)</u>	<u>1% Chlorine Stock Solution (litres)</u>
100	5
150	11
200	19
250	30
300	43
350	58
400	76
450	97
500	119
600	172
750	268

- .9 Operate valves, hydrants and appurtenances while main contains chlorine solution.

- .10 Take water samples at all hydrants and termination points, in suitable sequence, to test chlorine residual.
- .11 When tests indicate minimum chlorine residual of 50 mg/L, leave system charged with disinfectant solution for 24 hours and ensure minimum chlorine residual of 25 mg/L throughout system.
- .12 Flush disinfectant solution from line after 24 hours. Add 1.0% Hydrogen Peroxide reducing agent to the disinfectant solution at point of discharge or within a retention facility such that the solution is disposed to the environment with a total chlorine residual no greater than 0.0 mg/L in accordance with the requirements of Nova Scotia Environment. Check chlorine residual before disposal and at regular intervals during disposal to ensure compliance. This dechlorination requirement can only be excluded with the written consent of Nova Scotia Environment.
- .13 Dispose of dechlorinated disinfectant solution. Where disposing to the environment, disposal of the dechlorinated solution must be at least 100 m from the nearest watercourse.
- .14 Where disinfectant solution is dechlorinated at point of discharge, inject stock reducing agent at a rate proportional to discharge rate. Injection and discharge rates must be monitored continuously to ensure proper proportioning.
- .15 Prepare stock reducing agent by volume with concentration of 1% Hydrogen Peroxide (H_2O_2) by mass, as follows:
- | <u>Liquid Reducing Agent</u> | <u>Amount of Agent (litres)</u> | <u>Quantity of Water (litres)</u> |
|--|---------------------------------|-----------------------------------|
| Hydrogen Peroxide (35% H_2O_2 by mass) | 1.0 | 34 |
- .16 The following table indicates quantity of 1% Hydrogen Peroxide required to reduce total chlorine residual of disinfectant solution

contained per 100 metre length of pipe, from 50 mg/L to 0.0 mg/L.

Pipe Diameter 1% (mm)	Hydrogen Peroxide Stock Solution (litres)
100	5
150	10
200	18
250	28
300	41
350	55
400	72
450	91
500	113
600	163
750	254

- .17 Where total chlorine residual of disinfectant solution exceeds 50 mg/L, quantity of stock reducing agent for dechlorination can be increased in direct proportion to the quantity indicated in the above table.
- .18 After the disinfection solution has been flushed from the new water main, assist Departmental Representative in obtaining water samples to confirm adequate disinfection has taken place. The required procedure is:
- .1 After disinfection and flushing is complete, take chlorine residuals throughout the portion of the system being tested. Do not collect bacteriological samples until such time as total chlorine residual is less than 0.5 mg/l unless the water used for flushing is from the distribution system in which case, do not collect the samples until such time as the total chlorine residual is equal or less than a value equal to the total chlorine residual in the water used for flushing plus 0.5 mg/l.
 - .2 After chlorine residuals have been reduced to the levels outlined in step 1, collect a minimum of two (2) samples for bacteriological analysis from representative points throughout the portion of the system being tested. Collect at least one (1) sample every 366 m of new water main, plus one (1)

from the end and at least one(1) from each branch. The sample points do not include hydrants.

- .3 At least 24 hours after collection of the first two samples, collect two additional samples for bacteriological analysis from representative points throughout the portion of the system being tested.
- .4 Have the samples collected in steps 2 and 3 analyzed for total coliform bacteria. The sample bottles will contain a chlorine neutralizing agent. Sampling collection and preservation shall follow the procedure contained in Appendix A of the Nova Scotia Environment Guidelines for Monitoring Public Drinking Water Supplies. Sample analysis will be conducted by an independent laboratory acceptable to the Departmental Representative following procedures defined in the latest edition of "Standard Methods for the Examination of Water and Wastewater".
- .5 Should the analysis results of any of the samples collected in steps 2 or 3 show the presence of total coliform bacteria, the disinfection procedure and sampling program will be repeated.
- .6 Should any of the repeated samples outlined in step 5 show the presence of total coliform bacteria, an investigation to determine the cause of the contamination will be conducted and remediation steps taken to remove the source of contamination to the satisfaction of the Departmental Representative prior to re-disinfection and resampling.
- .7 The portion of the system being tested will be considered to have been adequately disinfected when the samples taken on two (2) consecutive days show the absence of total coliform.

3.10 ELECTRIC HEAT
TRACING INSTALLATION

- .1 Compliance: comply with manufacturer's written recommendations and specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.
- .2 Install heating cables in accordance with manufacturer's instructions. Loop additional cable at "heat sinks", e.g. fittings, hangers, supports and flanges.

- .3 Install tracing components and required mounting accessories.
- .4 Install temperature sensors. Bond shield of lead and extension wires to ground as per manufacturer recommendations.
- .5 Install heat tracing controller on the mounting structure. Program controller to achieve specified functionality.
- .6 Make power and control connections.

3.11 ELECTRIC HEAT TRACING; .1
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 50 megohms or less is measured, stop work and advise the Departmental Representative.
- .4 Arrange and pay for field testing of operational and commissioning service of complete heat tracing system by heat tracing equipment manufacturer's representative.
- .5 Submit report of conducted tests and certificate that system as installed meet specified criteria to the Departmental Representative.

PART 1 - GENERAL

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|--|----|---|
| <u>1.1 RELATED SECTIONS</u> | .1 | Section 01 33 00 - Submittal Procedures |
| | .2 | Section 01 74 21 - Construction/Demolition Waste Management and Disposal |
| | .3 | Section 31 05 16 - Aggregate Materials |
| | .4 | Section 31 23 33.01 - Excavating, Trenching and Backfilling |
| <u>1.2 REFERENCES</u> | .1 | Canadian General Standards Board (CGSB)
.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric. |
| | .2 | CSA International
.1 CSA A3000-08, Cementitious Materials Compendium (Consists of A5-98, A8- 98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).
.1 CAN/CSA-A5-98, Portland Cement.
.2 CSA A257 Series-14, Standards for Concrete Pipe and Manhole Sections.
.3 ASTM C14M-2015, Concrete Sewer, Storm Drain, and Culvert Pipe (Metric). |
| <u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u> | .1 | Submit in accordance with Section 01 33 00 - Submittal Procedures. |
| | .2 | Submit list of all pipe, indicating location, type, diameter, length and invert elevations for Departmental Representative review, at least 4 weeks prior to ordering of pipe. |
| | .3 | Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and backfill and include product characteristics, performance criteria, physical size, finish and limitations. |
| | .4 | Samples:
.1 Inform Departmental Representative at least 4 weeks before beginning Work, of proposed source of bedding materials and provide access for sampling. |
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- .5 Certification: to be marked on pipe.
- .6 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification at least 4 weeks prior to beginning Work.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance 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 in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 CONCRETE PIPE

- .1 Concrete: to CAN/CSA A257 Series-14.

2.2 GRANULAR BEDDING AND BACKFILLING

- .1 Granular bedding and backfill material to Section 32 11 23 - Aggregate Base Courses.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe culvert installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
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.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 PREPARATION

- .1 Inspect products for defects and remove defective products from site.
- .2 Confirm pipe is clean before installation.
- .3 Temporary Erosion and Sediment Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Obtain Departmental Representative's approval of trench line and depth prior to placing bedding material or pipe.

3.4 BEDDING

- .1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.
- .2 Place 200 mm minimum thickness of approved granular material on bottom of excavation and compact to 95% minimum of corrected maximum dry density.
- .3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and

to camber as indicated or as directed by
Departmental Representative, free from sags or
high points.

- .4 Place bedding in unfrozen condition.

3.5 PIPE INSTALLATION

- .1 Lay and join pipe as specified herein and according to manufacturer's published instructions.
- .2 Lay pipe on prepared bed, true to line and grade indicated, within following tolerances:
 - .1 Horizontal Alignment: 50 mm.
 - .2 Vertical Alignment: the lesser of 13 mm or one half the rise per pipe length.
- .3 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
- .4 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipelaying is not in progress.
- .5 Align pipe before joining.
- .6 Support pipes as required to assure concentricity until joint is properly completed.
- .7 Where a flexible joint is not integral to the structure, provide flexible joint not more than 1 metre from outside face of structure.

3.6 JOINTS: CONCRETE PIPE CULVERTS

- .1 Joints may be made with rubber gaskets, bituminous jointing compound or Portland cement mortar.
 - .1 Rubber gasket joints:
 - .1 Install in accordance with manufacturer's written recommendations.
 - .2 Ensure that tapered ends are fully entered into flanged ends.
 - .2 Bituminous filled joint:
 - .1 Make joint with excess of filler to form continuous bead around outside of pipe and finish smooth on inside.
 - .3 Mortar joints:
 - .1 Prepare mortar as specified herein.
 - .2 Clean pipe ends and wet with water
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- before joint is made.
- .3 Place mortar in lower half of flanged end of pipe section in place.
 - .4 Apply mortar to upper half of tapered end of pipe section being installed.
 - .5 Join pipe ends and force joint up tight, taking care to ensure inner surfaces of abutting pipe sections are flush and even.
 - .6 Clean inside of pipe and annular space between ends of pipes after each joint is made.
 - .7 Fill joint with mortar and finish smooth and even.
 - .8 For pipes 800 mm or less diameter, fill joints before mortar in joints has set.
 - .9 For pipes over 800 mm diameter, postpone filling joint until backfilling has been completed. Re-clean joints before applying mortar.

- 3.7 BACKFILLING .1 Place and compact granular material for bedding and backfilling in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.

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PART 1 - GENERAL

<u>1.1 RELATED REQUIREMENTS</u>	.1	Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
<u>1.2 REFERENCES</u>	.1	CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
<u>1.3 ACTION AND INFORMATIONAL SUBMITTALS</u>	.1	Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
	.2	Product Data:
	.1	Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
<u>1.4 QUALITY ASSURANCE</u>	.1	Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
	.1	Certificates: signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
	.2	Manufacturer's Instructions: for installation and special handling criteria, installation sequence and cleaning procedures.
<u>1.5 DELIVERY, STORAGE AND HANDLING</u>	.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:
	.1	Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
	.3	Packaging Waste Management: remove for reuse and return packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

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|------------------------------------|----|--|
| <u>2.1 RIGID PVC CONDUITS</u> | .1 | Rigid PVC conduits to CSA C22.2 No. 211.2. |
| | .2 | Rigid PVC couplings, reducers, plugs, caps, adaptors, and supports to make a complete installation. |
| | .3 | Expansion joints as recommended by manufacturer and as required. |
| <u>2.2 CABLE PULLING EQUIPMENT</u> | .1 | 6 mm stranded nylon pull rope tensile strength 5 kN. |
| <u>2.3 MARKERS</u> | .1 | Concrete type cable markers: as indicated, with words: "Cable", "Joint" or "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs. |
| <u>2.4 WARNING TAPE</u> | .1 | Standard 4-mil polyethylene 76 mm wide tape, yellow with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW". |

PART 3 - EXECUTION

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| <u>3.1 MANUFACTURER'S INSTRUCTIONS</u> | .1 | Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets. |
| <u>3.2 INSTALLATION</u> | .1 | Install duct pipe in accordance with manufacturer's instructions and at elevations as indicated. |
| | .2 | Clean inside of ducts before laying. |
| | .3 | Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length. |
| | .4 | Slope ducts with 1 to 400 minimum slope. |
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- .5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
- .6 Pull through each duct steel wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material.
 - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Place continuous strip of warning tape 1/2 way between installation and grade level before backfilling trenches.
- .9 Install markers as required.
- .10 Notify the Departmental Representative for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION