
1.0 GENERAL

This Section provides guidance on the provision and installation for water supply and sewer entrance.

1.1 Measurement procedures

- .1 These works are paid in lump sum of global works. The price includes watermain for water supply and fire protection and sewer entrance pipe including supply of equipment and materials, trenching, backfilling, connexions, service connexions, valves, insulation, manhole, fire hydrant, valve, heating cables and electronic control box, leak testing, thrust blocks and all others required accessories.

1.3 References

- .1 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C117-04, Standard Test Method for Material Finer than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-05, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM C518-04, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - .4 ASTM D638-03, Standard Test Method for Tensile Properties of Plastics
 - .5 ASTM D698-00a1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN- m/m³)).
 - .6 ASTM D1505-03, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - .7 ASTM D1621-04a, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - .8 ASTM D1622-03, Standard Test Method for Apparent Density of Rigid Cellular Plastics.
 - .9 ASTM D2657-03, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .10 ASTM D2842-01, Standard Test Method for Water Absorption of Rigid Cellular Plastics.
 - .11 ASTM D2856-94-1998, Standard Test Method for Open Cell Content of Rigid Cellular Plastics by the Air Pycnometer.
 - .12 ASTM D3574-05, Standard Method of Testing Flexible Cellular Materials – Slab, Bonded and Molded Urethane Foams.
 - .13 ASTM E96/E96M-05, Standard Test Methods for Water Vapour Transmission of Materials.
 - .14 ASTM F714-05, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - .15 ASTM G14-04, Standard Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test).
 - .16 AWWA C906-07 Polyethylene (PE) Pressure Pipe and Fittings 4 in. through 63 in. for Water Distribution and Transmission.
- .2 Canadian General Standards Board
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-88, Sieves, Testing, Woven Wire, Metric.

- .3 Canadian Standards Association (CSA International)
 - .1 CSA-B137 Series-05, Thermoplastic Pressure Piping Compendium.
 - .1 CSA B137.1-05, Polyethylene (PE) Pipe, Tubing and Fittings for Cold-Water Pressure Services.
 - .2 CSA-C22.2 No. 130-03, Requirements for Electrical Resistance Heating Cables and Heating Device Sets (A National Standard of Canada (2004)).
 - .3 CAN/CSA-C22.2 No. 130.2-93 – October 2000, Heat Cable Systems for Use in Other than Industrial Establishments.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 Action and Informational Submittals

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product data:
 - .1 Manufacturer's printed product literature, specifications and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality Assurance submittals:
 - .1 Manufacturer's instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.
 - .1 Departmental Representatives will make available copy of systems supplier's installation instructions.
- .4 Closeout submittals:
 - .1 Provide operation and maintenance data for piping systems for incorporation into manual specified in Section 01 78 00.
 - .2 Record drawings: provide record drawings upon project completion and as per following requirements:
 - .1 Give details of pipe material, location of fittings, maintenance and operating instructions.

1.4 Quality Assurance

- .1 Pre-installation meetings: convene pre-installation meeting one (1) week prior to beginning on-site installation, with Contractor's representative and Departmental Representative.
 - .1 Verify project requirements
 - .2 Review installation and substrate conditions.
 - .3 Coordination with other building subtrades.
 - .4 Review manufacturer's installation instruction and warranty requirements.

1.5 Delivery, Storage and Handling

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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- .2 Storage and protection:
 - .1 Unload from trucks or containers by hand or by lifting apparatus with fabric slings. Do not use cables or chains.
 - .2 Once removed, store on smooth surface.
 - .1 Lay pipes flat.
 - .2 Several lengths of wide planks to provide broad bearing surface.
 - .3 Lift-do-not-drag-insulated pipes from storage area to job site.
 - .3 Waste management and disposal:
 - .1 Dispose waste materials in accordance with Section 01 74 21.

1.6 Scheduling

- .1 Schedule work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval by Departmental Representative and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative minimum of 24 hours in advance of interruption in service.

2.0 PRODUCTS

2.1 Sustainable requirements

- .1 Not used.

2.2 Carrier core pipe

- .1 Series 160, Polyethylene pressure pipes to CSA B137.1 and ASTM F714:
 - .1 Type PE3406 for CSA B137.1, series 160.
 - .2 Type PE3408 for ASTM F714, DR 9.
 - .3 Pressure rating:
 - .1 Series 160 for CSA B137.1.
 - .2 DR 9 for ASTM F714.
- .2 Series 200, Polyethylene pressure pipes to CSA B137.1 and ASTM F714:
 - .1 Type PE3406 for CSA B137.1, series 200, AWWA C906.
 - .2 Type PE3408 for ASTM F714, DR 7.
 - .3 Pressure rating:
 - .1 Series 200 for CSA B137.1, 175 psi.
 - .2 DR 7 for ASTM F714.
- .3 Polyethylene to polyethylene joints: thermal butt fusion joined to ASTM D2657 and flanged with steel and backing flanges at building entrance.
- .4 Polyethylene fittings: to CSA B137.1 for pipe sizes NPS 4 and under.
 - .1 AWWA C906, 175 psi.
- .5 Copper pipe:
 - .1 Type K – Underground certified.
 - .1 Pressure rating: 160 psi.

2.3 Factory applied insulation

- .1 Clean pipes of surface dust or dirt and treat to assure positive bond of foam to entire pipe surface.
- .2 Material: rigid polyurethane foam factory applied.
- .3 Insulation thickness: 75 mm.
- .4 Density: to ASTM D1622, 0.032 to 0.048 gm/cm³.
- .5 Closed cell content: to ASTM D2856, 90% minimum.
- .6 Water absorption: to ASTM D2842, 4.0 gm/1000 cm³, maximum 4.25% by volume.
- .7 Compressive strength: to ASTM D1621, up to 200 kPa.
- .8 Thermal conductivity: to ASTM C518, 0.0022 to:
 - .1 4W/m, degrees C.

- .9 Service temperature: minus 45°C to plus 120°C.
- .10 Centering of pipe within insulation: no more than plus or minus 6 mm off centre.
- .11 Protect insulation on both ends of pipe from moisture and sunlight by 3 mm thick continuous concentration of black mastic compound.
- .12 Insulation must completely fill space between pipe and conduit.

2.4 Outer jacket for buried applications

- .1 Material: factory applied high density polyethylene jacket, black in colour (UV inhibited).
- .2 Density of HDPE jacket: to ASTM D1505, 0.940 gm/cm³ minimum.
- .3 Sealant: synthetic polymers or modified rubber mastic.
- .4 Jacket thickness: 1.14 mm minimum.
- .5 Elongation: to ASTM D638, 400% maximum 6-month test.
- .6 Service temperature: minus 45°C to plus 120°C maximum.
- .7 Water vapour transmission rate: 3 gm/m²/24 hours average.
- .8 Tensile strength: 25 kg/cm width minimum.
- .9 Impact strength: to ASTM G14, 7.79 N/m at minus 40°C minimum.

2.5 Outer jacket for above ground applications

- .1 Material: factory applied galvanized lock seam, spiral steel outer jacket.
- .2 Spirally applied from continuous steel strip using lock seam.
- .3 Jacket thickness: 0.889 mm minimum.
- .4 Protective metal jacket for fittings: as indicated.

2.6 Insulated pipe joints for buried applications

- .1 Material: rigid polyurethane half shells with heat shrink sleeves and mastic sealant to provide moisture-proof seal.
- .2 Pre-formed rigid polyurethane halves, as indicated, with properties as described in this section.

- .3 Heat shrink sleeves: adhesive coated cross-linked polyethylene sleeve.
- .4 Sleeves: to cover entire exposed joint length plus overlap of about 75 mm of pipe coating on either side.
- .5 Waterproofing mastic sealant for coating exposed ends of insulation after field cutting or trimming has been carried out: as described in this section.

2.7 Insulated pipe joints for aboveground applications

- .1 Material: rigid polyurethane half shells with heat shrink sleeves to provide strong, moisture-proof seal as described in this section.
- .2 Silicone caulking: circumferentially beaded around outer jacket of pipe 50 mm from pipe end as specified.
- .3 Rolled steel sheet: 0.889 mm thick, wrapped around and strapped into place to complete joint.
- .4 Pre-formed rigid polyurethane halves: as indicated, with properties specified.
- .5 Heat shrink sleeves: adhesive coated cross-linked polyethylene sleeve.
- .6 Sleeves: to cover entire exposed joint length plus overlap of about 76 mm of pipe coating on either side.
- .7 Waterproof mastic sealant for coating exposed ends of insulation after field cutting or trimming: as specified.

2.8 Insulation kits for fittings

- .1 Material: rigid polyisocyanurate foam with fully bonded FRP glass reinforced polyester or polymer protective coating on exterior surfaces including ends.
 - .1 Supply kits complete with silicone caulking for seams, stainless steel attachment straps and clips, and heat shrink sleeves to seal between pipe and insulation cover.
- .2 Rigid polyisocyanurate foam insulation
 - .1 Density: to ASTM D1622, 0.03 gm/cm³ minimum.
 - .2 Compressive strength: to ASTM D1621, 137 kPa minimum.
 - .3 Closed cell content: 92% minimum.
 - .4 Water absorption: to ASTM D2842, 0.02 g/m².
 - .5 K Factor: to ASTM C518, 0.02 W/m. degrees C maximum.
 - .6 Thickness: 75 mm.

- .3 FRP coating
 - .1 Glass reinforced polyester fully bonded to insulation.
 - .2 Laminating resin black in colour, UV inhibited.
 - .3 Thickness: 2.54 mm minimum.
 - .4 Exterior surface: resin-rich hot coat of 0.25 mm minimum thickness.
- .4 Polymer coating: to ASTM D3574
 - .1 Two-component high density polyurethane coating, black in colour.
 - .2 Density: 1170 kg/m².
 - .3 Abrasion: durometer D scale: 60.
 - .4 Tensile strength: 11 000 kPa minimum.
 - .5 Tear strength: 26.5 N/mm minimum.

2.9 Insulation foamed in place

- .1 Material: two-component polyurethane Class I foam, supplied in portable, disposable, pressurized container.
- .2 Density: to ASTM D1622, 0.035 to 0.039 gm/cm³.
- .3 Closed cell content: to ASTM D2856, 90% minimum.
- .4 Thermal conductivity: to ASTM C518, 0.022 to 0.024 W/m. degrees C.
- .5 Compressive strength: to ASTM D1621, 103 to 172 kPa at 10% deflection minimum.
- .6 Water absorption: to ASTM D2842, 4.25% maximum by volume.

2.10 Insulation accessories

- .1 Heat shrink tape for sealing insulation half shells against moisture adaptable to flexible installations.
 - .1 Cross-linked polyolefin backing with a hot melt adhesive coating.
 - .2 Backing thickness: 0.35 mm minimum.
 - .3 Adhesive thickness: 0.51 mm.
 - .4 Service temperature: minus 18°C to plus 20°C maximum.
 - .5 Tensile strength: 16 N/mm.
- .2 High density polyethylene tape for minor repair of the outer jacket or completion of straight insulation joints in field where irregular surfaces are not involved.
 - .1 Adhesive backed tape: heated to approximately 50°C prior to installation.
 - .2 Backing thickness: 0.50 mm average.
 - .3 Adhesive thickness: 0.127 mm average.
 - .4 Service temperature: minus 34°C to plus 82°C.
 - .5 Tensile strength: 10 N/mm.
 - .6 Colour: black.

- .3 Asphalt mastic vapour barrier coating to waterproof exterior surface of half shells or sprayed-in-place foam.
 - .1 Colour: black.
 - .2 Solid by volume: 62%.
 - .3 Coverage: 14 L at 9.0 m².
 - .4 Drying time to touch: 4 hours maximum.
 - .5 Drying time firm: 48 hours maximum.
 - .6 Service temperature: minus 29°C plus 93°C.
 - .7 Application temperature: 4.4°C minimum.
 - .8 Moisture permeability: 3.2 mm wet film at 37.3°C.
 - .9 90% relative humidity: to ASTM E96, 02 perms.
 - .10 Shelf life: 12 months.
- .4 Silicone caulking for joining faces of rigid urethane insulation.
 - .1 Colour: black.
 - .2 Specific gravity: 1.07.
 - .3 Tensile strength: 25 kg/cm².
 - .4 Tear strength: 8 kg/cm².
 - .5 Service temperature: 205°C maximum.

2.11 Electric heat tracing

- .1 Heat tracing conduits:
 - .1 Consisting of copper pipe, 19 mm inside diameter and applied to pipe prior to application of insulation.
 - .2 Fasten securely to pipe and seal to prevent ingress of foam during insulation.
 - .3 Check conduit after insulating to ensure they are not plugged.
 - .4 Seal ends prior to shipping to prevent foreign material from entering conduit while in transit or during installation.
- .2 See Electrical Engineering Section 26 60 00.

2.12 Warning tape

- .1 Polyethylene tape: 150 mm wide by 0.15 mm thick as approved by Departmental Representative.
- .2 Tape for water mains: blue in colour with factory applied markings at one metre intervals, i.e. "Caution Buried Water Line".
- .3 Tape for sanitary sewers: green in colour with factory applied markings at one metre intervals, i.e. "Caution Buried Sewer Line".

2.13 Buried warning and identification tape

- .1 Provide detectable aluminium foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping
- .2 Tape: detectable by electronic detection instrument.

- .3 Provide tape in rolls, 75 mm minimum width, colour coded for utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length.
- .4 Warning and identification: reading CAUTION BURIED PREINSULATED PIPING BELOW or similar wording.
- .5 Use permanent code and letter colouring unaffected by moisture and other substances contained in trench backfill material.

2.14 Pipe bedding and surround materials

- .1 Granular material to following requirements:
 - .1 Crushed or screened stone or sand consisting of hard, durable particles free from clay lumps, cementation, organic material and other deleterious materials.
 - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	% Passing
200 mm	-
75 mm	-
50 mm	-
38.1 mm	-
25 mm	-
19 mm	-
12.5 mm	-
9.5 mm	-
4.75 mm	100
2.00 mm	50–90
0.425 mm	10–50
0.180 mm	-
0.075 mm	0–10

- .2 Concrete for cradles, encasement, supports, thrust blocks: in accordance with Section 03 30 00.

2.15 Escutcheon plates

- .1 Provide split hinge type metal plates for piping entering walls and floors in exposed spaces.
- .2 Provide polished stainless steel plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.16 Pipe sleeves

- .1 Provide Link-Seal type sleeves where piping passes entirely through concrete walls and floors.
- .2 Ensure sleeves are of sufficient length to pass through entire thickness of walls and floors.
- .3 Provide 25 mm minimum clearance between exterior of piping or pipe insulation, and interior of sleeve or core-drilled hole.

- .4 Firmly pack space with mineral wool insulation.
- .5 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass and provide mechanically adjustable segmented elastomeric seal.
- .6 In fire walls and fire floors, seal both ends of sleeves or core-drilled holes with UL-listed fill, void, or cavity material.
 - .1 For sleeves in masonry and concrete walls and floors provide hot-dip galvanized steel sleeves.
 - .2 Provide core drilling of masonry and concrete in lieu of sleeves when cavities in core-drilled hole are grouted smooth.
 - .3 In other than masonry and concrete walls and floors provide sleeves made from 0.5 mm thick galvanized steel sheet.

2.17 Backfill materials

- .1 Granular material:
 - .1 Crushed, pit run or screened stone, gravel or sand consisting of hard, durable particles free from clay lumps, cementation, organic material and other deleterious materials.
 - .2 Gradations: within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.2 Table:

Sieve Designation	% Passing
Type 1 Fill	
200 mm	-
75 mm	100
50 mm	-
37.5 mm	-
25 mm	-
19 mm	-
12.5 mm	-
9.5mm	-
4.75 mm	25–85
2.00 mm	-
0.425 mm	5–30
0.180 mm	-
0.075 mm	0–10

3.0 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 sheets

3.2 Repairing damaged pre-insulated pipe

- .1 Repair damage to outer jacket by applying heat shrink sleeve as reviewed by Departmental Representative or cover using heated HDPE UV resistant adhesive backed tape

3.3 Trenching

- .1 Do trenching work in accordance with Section 31 23 33.01.
- .2 Trench depth to provide cover over pipe as indicated.
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material or pipe.

3.4 Granular bedding and surround

- .1 Place bedding and surround material in unfrozen condition.
- .2 Place materials in uniform layers not exceeding 150 mm compacted thickness up to 300 mm above top of pipe.
 - .1 Compact each layer before placing succeeding layer.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.
- .4 Shape transverse depressions in bedding as required to make joints.
- .5 Compact each layer full width of bed at least 95 % maximum density to ASTM D698.
- .6 Fill authorized excavation or unauthorized over excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.5 Pipe installation

- .1 On dry ground, assemble shipping lengths of pipe to suitable installation lengths by heat butt-fusion.
- .2 Provide trained personnel and jointing machine approved by pipe manufacturer for butt-fusion jointing of polyethylene pipe.
 - .1 Obtain services of trained technician from pipe manufacturer to certify and train Contractor's personnel on jointing procedures and inspect jointing machine.

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- .2 Obtain letter from manufacturer certifying that Contractor's representative who will perform jointing is/are qualified and that jointing equipment has been inspected and is suitable for pipe supplied.
 - .3 Follow manufacturer's instructions in butt-fusion of joints.
 - .4 Join pipes at flanged ends in accordance with manufacturer's recommendations.
 - .5 Recheck pipe joints assembled above ground after placing in trench to ensure no movement of joints has taken place.
 - .6 Complete installation of rigid polyurethane halves on joints after laying pipe in trench and after successful pressure testing of pipe.
 - .1 Trim half shells to required length with handsaw to provide tight-fit in insulation gap between ends of factory insulation.
 - .2 Do not allow seam to exceed 3 mm in width at joint.
 - .1 Match outer surface of shell with outer surface of installation on pie within tolerance of plus or minus 6 mm.
 - .2 Shave off any sharp edges with rasp.
 - .3 Hold half shells in place with masking tape while installing heat shrink sleeve.
 - .7 Install heat shrink sleeves using large broad flame propane torch to produce 600 mm flame.
 - .1 Peel back release liner 12 cm from end, centre sleeve over joint and press firmly down.
 - .1 Wrap sleeve around pipe, removing release liner as it is wrapped.
 - .2 If corner on under lap is not precut, then cut-off about 25 mm from each corner.
 - .2 Before completing overlap wrapping, warm under lap area approximately 12 cm until adhesive starts to appear at edge. Smooth out wrinkles with gloved hand.
 - .3 Remove remaining release liner and complete wrapping.
 - .4 Remove release paper from closure seal, prewarm adhesive slightly, centre seal over overlap and press down until well bonded. Heat closure seal, and press down with gloved hand to remove bubbles and wrinkles.
 - .5 Shrink sleeve around joint with torch: start at centre of sleeve.
 - .1 Keep torch moving using broad circumferential strokes to avoid burning.
 - .2 Continue shrinking sleeve toward one end until about 50 mm is left.
 - .3 Then aim torch inward centre and shrink edges.
 - .4 Repeat this operation on other end of sleeve.
 - .5 Finish off by applying long horizontal strokes of torch all around sleeve.
 - .6 Pay special attention to sleeve overlap area, ensuring no void remains along under lap edge.
 - .1 Use roller or gloved hand to firmly and thoroughly press down along under lap edge.
 - .2 Start in centre and work outwards.
 - .7 Joint and sleeve cool for at least 30 minutes before lowering pipe into trench.
 - .8 Lay pipes on prepared bed, true to line and grade as indicated.
 - .1 No deviations without written approval of Departmental Representative.
 - .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .3 Take out and replace defective pipe.
 - .4 Correct pipe which is not in true alignment or grade, or pipe which shows undue settlement after installation.

- .5 Change method or equipment for setting alignment or grade, if requested by Departmental Representative.
- .9 Do not lay pipe on frozen bedding.
- .10 Do not let rocks or other foreign material, which might damage insulation jacket, fall on pipe.
- .11 Keep jointing materials and installed pipe free of dirt and other foreign materials.
 - .1 Install removable watertight bulkhead at open end of pipe to prevent entry of foreign materials.

3.6 Insulation of fittings

- .1 Cut pipes as required to accommodate fittings and fitting insulation kits without damaging pipe insulation or its jacket.
 - .1 Leave smooth end at right angles to pipe axis.
- .2 Cracks larger than 6.4 mm to be filled with insulation foamed-in-place in following manner:
 - .1 Use strip of thin galvanized sheet metal wide enough to overlap both insulation kit and pipe by at least 8 cm and long enough to wrap around pipe leaving 2.5 cm opening on top.
 - .2 Hold metal in place with two tension metal or nylon straps, one at either end.
 - .3 Spray foam through opening on top into cavity.
 - .4 Spray until cavity is almost half-filled on both sides of pipe.
 - .1 Foam will rise to complete filling.
 - .5 Allow to cure for 10 to 15 min.
 - .6 Trim top and apply waterproof sealant asphalt mastic, HDPE tape or heat shrink tape.

3.7 Electric tracing

- .1 Seal heat trace channel at fittings and flanged joints, with silicone caulking.
- .2 Cable conduit: in lengths as indicated.
 - .1 Splicing of heat-trace cable is not allowed unless approved by Departmental Representative.
- .3 Install tracer cable conduit prior to installation of half shell joints, terminal seal kits, and power connector kits, thermostatic controllers, in accordance with system supplier's instructions and as indicated in Section 26 60 00.

3.8 Thrust blocs

- .1 Do concrete work in accordance with Section 03 30 30.
- .2 Place concrete thrust blocks between bends, tees and fittings and undisturbed ground as indicated.
- .3 Keep pipe couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.

3.9 Pipe backfilling

- .1 Do backfilling work in accordance with Section **31 23 33.01**.
- .2 Lay continuous runs of warning tape on top of surround material 300 mm directly above water and sewer mains.
- .3 Surround and cover pipes between joints when pipe laying is complete and inspected by Departmental Representative.
- .4 Protect pipe from freezing if temperatures lower than minus 5°C.
- .5 Surround and cover joints and fittings with surround material placed and compacted as specified when testing results are accepted by Departmental Representative.
- .6 Place backfill material above pipe surround, in uniform layers not exceeding 150 mm compacted thickness.
- .7 Mechanically compact each layer to at least 95% maximum density to ASTM D698.

3.10 Field quality control

- .1 Site tests and inspections:
 - .1 Test water mains for leakage in accordance with Part 4 of the present section.
 - .2 Flush and disinfect water mains in accordance with Part 4 of the present section.
 - .3 After completion of repair work, redo exfiltration tests and pig test.
 - .4 Test electric heat tracing – See Electrical Engineering Section **26 60 00**.
 - .5 Protect piping from freezing if testing at temperatures lower than minus 5°C.
 - .1 Proceed in accordance with Section **01 74 11**.
 - .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

4.0 LEAK TEST AND DINISFECTION**4.1 Preparatory work**

- .1 Produce a plan showing the pipes, accessories and connections; indicate the points of intervention on the network for cleaning, rinsing, disinfecting and sampling.
- .2 Provide 24 hours' notice to the Departmental Representative before starting work.
- .3 In the presence of the Departmental Representative, proceed with cleaning by mechanical means, or by hydraulic flushing; a minimum speed of 1 m/s is required during a period of 30 minutes.
- .4 All parts of piping in contact with drinking water must be cleaned and disinfected with a solution of chlorine to 5% (50 g/l or 50 000 ppm) of a known brand bleach. Minimum contact time is 60 minutes.

4.2 Leak test - Watermain

- .1 Ensure that all the air has been evacuated, if required: install purges if there is place.
- .2 Apply a hydrostatic pressure of 850 kPa.
- .3 A period of stabilization is required.
- .4 Maintain 850 kPa pressure constant for 60 consecutive minutes for test.
- .5 Measure, during this 60-minute period, the amount of water needed to maintain the test pressure using a graduated cylinder.
- .6 The quantity of water to be added must be lower for each section at the trials than the values in the following table.

Pipe nominal diameter (mm)	Leak permissive per 100 linear metres							
	50 [2]	100 [4]	150 [6]	200 [8]	250 [10]	300 [12]	350 [14]	400 [16]
Quantity of water (l/h)	0.21	0.42	0.63	0.83	1.04	1.25	1.46	1.67

- .7 Detect and correct leaks above the maximum values. The Contactor corrects leaks at his expense. Corrections must be accepted in writing by the Departmental Representative.
- .8 All visible leaks must be corrected.

4.3 Disinfection

- .1 Rinse: Perform a thorough rinsing of the network by maintaining a minimum pressure of 275 kPa.
- .2 Fill: Fill the pipes with a chlorine solution with a concentration of at least 50 mg/l free chlorine. Open all taps for a few minutes.

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- .3 Chlorination:
 - .1 Check that the concentration of chlorine in the pipes and accessories is minimum 25 g/l free chlorine.
 - .2 Once this value has been reached, begin the 24-hour chlorination period.
 - .3 If the temperature of the water is less than 5°C, the chlorination period is 48 hours.
 - .4 At the end of chlorination, the concentration of free chlorine must have a minimum value of 10 ml/l of free chlorine.
 - .5 Repeat chlorination if the minimum is not reached.
 - .4 Final rinse:
 - .1 Carry out the final rinse once disinfection has been approved by the Departmental Representative.
 - .2 Flush the pipes until the chlorine concentration is less than 1 mg/l.
 - .3 Take a sample of water for 150 m hose.
 - .4 Wait 24 hours with water in the stagnant state.
 - .5 Take a second sample for 150 m of pipe.
 - .6 Analysis of samples by an accredited laboratory.
 - .7 Resume disinfection if the tests do not conform.

4.4 Leak test – Sewermain

- .1 Ensure that all the air has been evacuated, if required, install purges if there is place.
- .2 Apply a hydrostatic pressure or air test 30 kPa.
- .3 A period of stabilization is required.
- .4 Maintain 30 kPa pressure constant for 20 consecutive minutes for the test.
- .5 Leak permissive per 100 meter linear metre is 0,15 L/h for hydrostatic pressure or 2 kPa for air test.
- .6 Detect and correct leak above this maximum value. All correction leaks is the contractor's responsibility.

End of Section