

PART 1 GENERAL

1.1 MEASUREMENT PROCEDURES

- .1 Measure supply and installation of sewage force main including excavating and backfilling, granular bedding and surround, surface restoration and filter fabric in lineal metres including all incidentals of each type and size of pipe installed. Measurement will be along slope length of actual length of pipe in place, through valves and fittings, after work has been completed.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C906-07 Polyethylene (PE) Pressure Pipe and Fittings, 4 In. (100 mm) Through 63 In. (1,600 mm), for Water Distribution and Transmission
 - .2 AWWA C207, Joint Pipes Using Thermal Butt Fusion
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D 3350 Polyethylene Plastics Pipe and Fittings Materials
 - .2 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM C117-04, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m³).
 - .5 ASTM F714-01, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .3 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.
 - .3 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B137 Series-02, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CSA B182.6-02, Profile Polyethylene Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .2 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .5 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)
- .6 Department of Justice Canada (Jus)

- .1 Canadian Environmental Protection Act, 1999 (CEPA)

1.3 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide Departmental Representative at least 4 weeks prior to beginning Work, with proposed source of bedding materials and provide access for sampling.
- .3 Submit complete shop drawings and construction schedule, including methods of installation.
- .4 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work in accordance with Section 01 33 00 - Submittal Procedures.
- .5 Certification to be marked on pipe.
- .6 Contractor will make available 1 copy of manufacturer's installation instructions.
- .7 Provide As-built drawings on project completion. Give directions and list equipment required for opening and closing of valves, details of pipe materials, location of cleanouts, locations of vacuum and air release valves, maintenance and operating instructions.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions in accordance with Section 01 78 00 - Closeout Submittals.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Collect and separate for disposal packaging material for recycling in accordance with Waste Management Plan.
- .3 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

1.7 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.

- .2 Submit schedule of expected interruptions and adhere to schedule approved by Departmental Representative.
- .3 Notify Departmental Representative a minimum of 96 h in advance of interruption in service.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Polyethylene (PE) pressure pipes: to CSA-B137.1, CGSB 41-GP-25M:
 - .1 NPS 1/2 to NPS 6: to CSA B137.1 type PE 3406, series 160 ASTM F714, type PE 3408, series DR 11.
 - .2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE 1404, series 250.
 - .3 Polyethylene to polyethylene joints: to be thermal butt fusion joined, to ASTM D2657 or flanged with steel aluminum ductile iron backing flanges.
 - .4 Cast iron fittings with flanged ends: to ANSI/AWWA C110/A21.10 for pipe size above NPS 4, Cement mortar lined to ANSI/AWWA C104/A21.4.
 - .5 Polyethylene fittings: to CSA B137.1, for pipe sizes NPS 4 and less.
 - .6 Size as indicated on drawings.
- .2 Fittings:
 - .1 To be flanged to AWWA C207.
 - .2 Fittings shall match pipe supplied and shall be supplied by the manufacturer of the pipe or by suppliers approved by the manufacturer.
 - .3 All fittings to be compatible in materials and dimensions with the pipe.

2.2 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Crushed or screened stone or gravel consisting of hard, durable particles.
 - .2 Gradations within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
- .2 Table

Sieve Designation	% Passing by Mass	
	Stone/Gravel	Gravel/Sand
200 mm	-	-
75 mm	-	-
50 mm	-	-
38.1 mm	-	-
25 mm	100	-
19 mm	-	-
12.5 mm	65-90	100
9.5 mm	-	-
4.75 mm	35-55	80-100
2.00 mm	-	50- 90
0.425 mm	10-25	10- 50

Sieve Designation	% Passing by Mass	
	Stone/Gravel	Gravel/Sand
0.180 mm	-	-
0.075 mm	0- 8	0- 10

- .1 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks and plugs: to Section 03 30 00 - Cast-in-Place Concrete.

2.3 BACKFILL MATERIAL

- .1 Type 3, in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

2.4 TRACER WIRE

- .1 Tracer wire to be electric #14 AWG Solid SBC (1/64") polyethylene insulated wire or metal tape detectable to 3m bury, c/w direct bury wire nuts and lugs.
- .2 Blue tri-view plastic markers w/Test Screws
- .3 4 foot U-channel posts
- .4 Installation
 - .1 Install the wire in a continuous flow and placed on top of the force main.
 - .2 Tape the wire down every 1.5 metres to keep it in position.
 - .3 Bring the wires up to the surface at the fibre optic vault locations or at blue plastic marker locations.
 - .4 Tracer wire shall be brought to surface once every 300 metres at a minimum.
 - .5 If the wire coating is damaged, cover it with electrical tape.
- .5 Joining Ends of Trace Wire
 - .1 Connections into existing tracer wire, connections between one spool of tracer wire to another, and other similar connections shall be made using a direct bury wire nut.
 - .2 When connecting tracer wire ends together, strip 5/8" of insulation from the end of each wire.
 - .3 Insert the two ends firmly into the direct bury wire nut.
 - .4 Twist the wire nut clockwise while pushing the wires firmly into the nut.
 - .5 Do not over torque.
- .6 Joining Trace Wire - Branch to Main
 - .1 Connections of trace wire at tees, crosses, and at locations where the trace wire will be brought to the surface shall be conducted using a direct bury lug.
- .7 Tracer Wire in Blue Plastic Pipe Line Marker
 - .1 To bring a tracer wire to a blue plastic marker, bury a four-foot u-channel but only to a depth of two feet underground. The top two feet are to be above ground.
 - .2 Lead the wire up through marker before running it over the post.
 - .3 Put the marker six inches underground and attach the tracer wire to the brass connecting screws.

- .4 Use a permanent marker to label the screws.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Pipes and fittings to be clean and dry. Carefully inspect materials before installing. Remove any defective materials from site.
- .2 Prior to installation, obtain Departmental Representative's approval of pipes and fittings.

3.2 TRENCHING AND BACKFILLING

- .1 Do trenching Work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth require approval of the Departmental Representative prior to placing bedding material and pipe.
- .4 Do not backfill trenches until pipe grade and alignment have been checked and accepted and test results are within limits specified.

3.3 CONCRETE PLUGS

- .1 Do concrete work for drainage plugs in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Place concrete to details as indicated or directed by the Departmental Representative.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Do not backfill over concrete within 24 hours after placing.

3.4 GRANULAR BEDDING

- .1 Place selected bedding materials to details indicated on the contract drawings or as directed. Do not place material in frozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33 - Excavating Trenching and Backfilling with compacted bedding material.
- .4 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.

- .5 Shape transverse depressions as required to suit joints.
- .6 Compact each layer full width of bed to at least 98% corrected maximum dry density.

3.5 INSTALLATION

- .1 Polyethylene (PE) pressure pipes:
 - .1 Install polyethylene pipe in strict conformance with manufacturer's recommendation for the specific pipe being installed.
 - .2 Just prior to placement in the trench, check the pipe to ensure the surface is free of debris, stones, nails, loose concrete or other material that may ultimately damage the pipe. Any gouges or cuts that are deeper than 10% of the wall thickness shall result in rejection of that section of pipe. Other defects such as kinking and ovality shall not be cause for rejection provided the sections involved are satisfactorily repaired and meet limits outlined by the pipe manufacturer.
 - .3 Any spillage of petroleum products on any polyethylene pipe material shall result in rejection of that section.
 - .4 Stainless steel bolts for fittings, to the class shown on the drawings shall be used in conjunction with insulating bolt sleeves and washers to install all fittings.
 - .5 The pipe shall be lifted and placed into the trench, not rolled.
 - .6 Make all allowances for expansion and contraction of pipe due to temperature changes, especially when tying into rigid structures and existing lines.
 - .7 Backfilling shall follow a minimum of 20 m behind the point where the pipe passes over the top of the trench. Backfilling equipment shall maintain a minimum of 1 m vertical separation above the pipe.

3.6 TRACER WIRE

- .1 Install tracer wire along the entire length of all plastic pipe installations.

3.7 THRUST BLOCKS

- .1 Restrain bends, tees and fittings by concrete thrust blocks as required.
- .2 Keep pipe couplings free of concrete.
- .3 Bearing area of thrust blocks to be as indicated.

3.8 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated. Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers simultaneously on each side of pipe not exceeding 150 mm compacted thickness as indicated.

- .4 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.
- .5 Compact each layer from mid height of pipe to underside of backfill to at least 95% corrected maximum dry density.

3.9 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Compact backfill to at least 98 % S.P.D.D.
- .4 Place unshrinkable fill in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

3.10 UNDERCROSSING

- .1 Excavate working pit to minimum of 0.5 m below lowest invert of encasing pipe.
- .2 Dewater excavation.
- .3 Dewater area of undercrossing.
- .4 Install heavy timber or steel frame backstop.
- .5 Provide shop drawings showing proposed method of installation for sewage force main in undercrossing.

3.11 TESTING SERVICES AND REPORTS

- .1 The following shall be the minimum acceptable standard for Testing Services and Reports.
 - .1 Tests are taken within 24 hours of the backfill being placed in the trench or cut. Reports indicate date when the backfill was placed and testing completed.
 - .2 Soil density and moisture content tests are taken on each 150mm of trench depth for a maximum of 75 meters of trench length.
 - .3 Tests shall be so distributed that they are representative of the entire area of the backfill operations.
- .2 Trenches shall be tested from pipe zone to finished sub-grade.
- .3 Such tests are taken adjacent to all manholes and valves from pipe zone to finished sub-grade.

3.12 TESTING OF PE FORCEMAIN

- .1 Pressure Test
 - .1 Apply hydrostatic pressure of 1650 kPa.

- .2 Test completed mains after services are installed and after all backfill is complete. Pipe shall be properly anchored for testing purposes from lift station to blow off chamber.
 - .3 Test in sections on lengths as recommended by manufacturer or as directed by the Departmental Representative.
 - .4 Fill the system with water and expel air at valves. Install temporary taps wherever necessary to expel air and plug after completion.
 - .5 Apply test pressure by means of a test pump with a measurable volume container acceptable to the Consultant, supplied by the Contractor.
 - .6 Repair all leaks and replace any defective pipes.
- .2 The test procedure consists of two steps: Initial Expansion Phase and the Test Period.
- .1 Initial Expansion Phase: Duration = 3 hours. The test pressure shall not exceed 1650 kPa. In order to accommodate the initial expansion of the pipe under test, sufficient make-up water is added to the system at hourly intervals, returning the piping system to the test pressure. This repressurization is repeated 3 times after the original pressurization of the pipe.
 - .2 Test Period: Duration = 2 hours. After completion of the initial expansion phase the actual test period will begin. The test pressure shall be returned to 1650 kPa and held for 2 hours. After this test period, a measured amount of make-up water should be added to return the piping system to the test pressure. The amount of make-up water should not exceed the amount shown in the following table.

High Density Polyethylene Pipe

Allowance for Expansion Under Test Pressure

1650 kPa @ 23°C

Nominal Pipe Size (mm)	Allowance for Expansion (litres per 30 metres of pipe)		
	One Hour Test	Two Hour Test	Three Hour Test
75	0.38	0.57	0.95
100	0.49	0.95	1.51
150	1.14	2.27	3.41
200	1.89	3.79	5.68
250	2.65	4.92	7.95
300	4.16	8.71	12.87
350	5.30	10.22	15.90
400	6.43	12.49	18.93
450	8.33	16.28	24.61
500	10.22	20.82	30.28
550	13.25	26.50	39.75
600	17.03	33.69	50.35
900	34.07	68.14	102.21

- .3 The above table is based upon an ambient air, water and pipe temperature of 23°C. When testing the pipe at temperatures below 23°C, the amount of make-up water shown in the above table should be multiplied by the factor listed below.

Ambient Air Temperature

Correction Factor

23°C	1.00
20°C	0.75
15°C	0.55
10°C	0.42
5°C	0.30
0°C	0.22
-5°C	0.15
-10°C	0.10

- .4 Under no circumstances should the total time under test pressure exceed 8 hours. If the test is not completed due to leakage, equipment failure or any other reason within this time period, the test section should be permitted to “relax” for an additional 8 hour period prior to starting the next testing sequence.

3.13 SURFACE RESTORATION

- .1 After installing and backfilling over sanitary force mains, restore surface to original condition as directed by the Departmental Representative, incidental to unit price.

END OF SECTION