

PART 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C111/A21.11-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C14M-99, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .2 ASTM C117-95, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM C136-01, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D698-00a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft³ (600 kN-m/m³)).
 - .5 ASTM D3034-00, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .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.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
- .5 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA)
- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

1.2 DEFINITIONS

- .1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Submit complete shop drawings and construction schedule, including methods of installation.
- .3 Inform the Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .4 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.
- .5 Ensure certification is marked on pipe.
- .6 Submit manufacturers information data sheets and instructions in accordance with Section 01 33 00 - Submittal Procedures.

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 for approval and adhere to approved schedule.
- .3 Notify the Departmental Representative 96 hours minimum in advance of any interruption in service.

1.8 MEASUREMENT PROCEDURES

- .1 Measure supply and installation of sanitary mains 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.

PART 2 PRODUCTS

2.1 PIPE, JOINTS AND FITTINGS

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2.
 - .1 Standard Dimensional Ratio (SDR):35.
 - .2 Separate gasket and integral bell system.
 - .3 Nominal lengths: 6 m.
 - .4 Size: as indicated on drawings.

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 to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.

- .2 Table

Sieve Designation	% Passing	
	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
0.180 mm	-	-
0.075 mm	0- 8	0- 10

- .3 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 FLOW MEASURING SYSTEM - MANHOLE G5

- .1 Flow Module:
 - .1 Portable, permanent-site Area Velocity Module type flow meter
 - .2 Ultrasonic Doppler Technology to measure mean velocity
 - .3 Materials: High-impact polystyrene, stainless steel
 - .4 Enclosure: NEMA 4X, 6P (IP68)
 - .5 Serial Communication Speed: 38,400 bps
 - .6 Temperature Range: -40° to 60°C operating and storage
 - .7 Built-in Flow Rate Conversions:
 - .1 Level-to-Area Conversions
 - .2 Level-to-Flow Conversions
 - .8 Data Storage:
 - .1 Non-volatile flash; retains stored data during program updates.
 - .2 Capacity 395,000 bytes (up to 79,000 readings, equal to over 270 days of level and velocity readings at 15-minute intervals, plus total flow and input voltage readings at 24-hour intervals)
- .2 Area Velocity Sensor
 - .1 Materials: Sensor - Epoxy, chlorinated polyvinyl chloride (CPVC), stainless steel
 - .2 Cable - Polyvinyl chloride (PVC), chlorinated polyvinyl chloride (CPVC)
 - .3 Operating Temperature: 30° to 60° C
 - .4 Level Measurement: Submerged pressure transducer mounted in the flow stream
 - .5 Transducer Type - Differential linear integrated circuit pressure transducer
 - .6 Range (standard): 0.010 to 3.05 m
 - .7 Maximum Allowable Level: 10.5 m
 - .8 Accuracy: ± 0.003 m from 0.01 to 3.05 m
 - .9 Long-Term Stability: ± 0.007 m/yr
 - .10 Compensated Range: 0° to 50°C
 - .11 Velocity Measurement:
 - .12 Method - Doppler ultrasonic, frequency 500 kHz
 - .1 Typical Minimum Depth: 25 mm
 - .2 Range: -1.5 to +6.1 m/s
 - .3 Accuracy (in water with uniform velocity profile):
 - .4 Speed of sound: 4850 ft/s, for indicated velocity range
 - .5 ± 0.03 m/s from -1.5 to +1.5 m/s,
 - .6 $\pm 2\%$ of reading from 1.5 to 6.1 m/s

PART 3 EXECUTION

3.1 PREPARATION

- .1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of the Departmental Representative.
 - .2 Remove defective materials from site as directed by the Departmental Representative.

3.2 TRENCHING

- .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 If required, 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 Lay and join pipes in accordance with manufacturer's recommendations and to approval of the Departmental Representative
- .2 Handle pipe using methods approved by the Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by the Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes as directed by the Departmental Representative to prevent creep during down time.

- .11 Plug lifting holes with pre-fabricated plugs approved by the Departmental Representative set in shrinkage compensating grout.
- .12 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .13 Make watertight connections to manholes and storage tanks.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .14 Use prefabricated saddles or field connections approved by Engineer Consultant, for connecting pipes to existing sewer pipes.
 - .1 Joints to be structurally sound and watertight.

3.6 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after the 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.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 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 95 % corrected maximum dry density.

3.8 TESTING

- .3 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 or as directed by the Departmental Representative.
 - .3 Tests shall be so distributed that they are representative of the entire area of the backfill operations.
 - .4 Trenches shall be tested from pipe zone to finished sub-grade.
 - .5 Such tests are taken adjacent to all manholes and valves from pipe zone to finished sub-grade.

3.9 FIELD TESTING GRAVITY MAINS

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by the Departmental Representative draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test to ASTM C828.
- .6 Do infiltration and exfiltration testing as specified herein and as directed by the Departmental Representative.
 - .1 Perform tests in presence of the Departmental Representative.
 - .2 Notify the Departmental Representative 96 hours in advance of proposed tests.
- .7 Carry out tests on each section of sewer between successive manholes including service connections.
- .8 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .9 Exfiltration test:
 - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .2 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1m above static ground water level, whichever is greater.
 - .3 Duration of exfiltration test: 2 hours.
 - .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- .10 Infiltration test:

- .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750mm or more above top of pipe measured at highest point in line to be used.
- .2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
- .3 Install watertight plug at upstream end of pipeline test section.
- .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
- .5 Prevent damage to pipe and bedding material due to flotation and erosion.
- .6 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .11 Leakage: not to exceed following limits in litres per hour per mm of diameter per 100m of sewer including service connections:
 - .1 Exfiltration, based on 600 mm head: 0.175 L.
 - .2 Infiltration: 0.150 L.
- .12 Repair and retest sewer line as required, until test results are within limits specified.
- .13 Repair visible leaks regardless of test results.
- .14 Television and photographic inspections:
 - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
 - .2 Provide means of access to permit the Departmental Representative to do inspections.

3.10 SURFACE RESTORATION

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

END OF SECTION