

1. General

1.1 Section Includes

- 1.1.1 This Section specifies the requirements for the supply and installation of materials for gravity sanitary sewer.

1.2 Related Sections

- 1.2.1 Section 01 33 00 - Submittal Procedures.
- 1.2.2 Section 01 78 00 – Closeout Submittals.
- 1.2.3 Section 31 23 33 - Excavating, Trenching and Backfilling.
- 1.2.4 Section 31 05 16 - Aggregate Materials.
- 1.2.5 Section 03 30 00 - Cast-in-Place Concrete.

1.3 References

- 1.3.1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- American Society for Testing and Materials International, (ASTM).
 - ASTM C117-95, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
 - ASTM C136-01, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - ASTM D698-00a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft³ (600 kN-m/m³).
 - ASTM D2680-01, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly Vinyl Chloride (PVC) Composite Sewer Piping.
 - ASTM D3350-02, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- 1.3.2 Canadian General Standards Board (CGSB).
- CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- 1.3.3 Canadian Standards Association (CSA International).
- 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).

- CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
- CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
- CSA B182.6-02, Profile Polyethylene Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
- CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.4 Definitions

- 1.4.1 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.

1.5 Submittals

- 1.5.1 Submit shop drawings and samples in accordance with Section 01 33 00 - Submittal Procedures.
- 1.5.2 Inform Departmental Representative prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- 1.5.3 Submit manufacturer's test data and certification at least two (2) weeks prior to beginning Work.
- 1.5.4 Certification to be marked on pipe.
- 1.5.5 Submit manufacturer's information data sheets and instructions in accordance with Section 01 33 00 - Submittal Procedures.

1.6 Delivery, Storage and Handling

- 1.6.1 Deliver, store and handle materials in accordance with manufacturer's recommendations.

1.7 Waste Management and Disposal

- 1.7.1 Separate waste materials for re-use.
- 1.7.2 Place materials defined as hazardous or toxic in designated containers.

1.8 As-Built Drawings

- 1.8.1 Provide all data necessary to produce As-built Drawings, including, but not limited to, details of pipe material, invert elevations at connections, location of tees, bends, clean-outs, saddles, laterals and end caps.

2. Products

2.1 Plastic Pipe

- 2.1.1 Smooth wall polyvinyl pipe and fittings to ASTM D3034 – 80 and ASTM F679.
- 2.1.2 Plastic pipe and fittings: to CAN/CSA B182.1 – M92 for 100/125/150 mm sizes. CAN/CSA B182.2 – M90 for 200 mm to 675 mm sizes.
- 2.1.3 Standard Dimensional Ratio (SDR): 35 for Mains and 28 for service pipe, unless otherwise indicated on the contract drawings, with locked-in gasket and integral bell system.
- 2.1.4 Nominal lengths: 4 and 6 m.
- 2.1.5 Profile wall polyvinyl chloride pipe with locked-in gasket and integral bell system.
- 2.1.6 Pipe and fittings to be certified to CAN/CSA B182.4 – M92 and ASTM F794.
- 2.1.7 Pipe stiffness to be 320 kPa for sanitary sewer mains; this pipe not to be used for diameters less than 300 mm.

2.2 Pipe Bedding Material

- 2.2.1 Granular pipe bedding shall be Type 2.
- 2.2.2 Granular bedding in accordance with Section 31 23 33 – Excavating, Trenching and Backfilling.
 - Crushed or screened stone, gravel or sand.
 - Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.
- 2.2.3 Concrete mixes and materials for bedding, cradles, encasement, and supports: In accordance with Section 03 30 00 - Cast-in-Place Concrete.

2.3 Backfill Material

- 2.3.1 Backfill material to Section 31 23 33 – Excavating, Trenching and Backfilling.

3. Execution

3.1 Preparation

- 3.1.1 Clean pipes and fittings of debris and water before installation. Inspect materials for defects before installing. Remove defective materials from the site.

3.2 Trenching and Backfilling

- 3.2.1 Do trenching and backfill work in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- 3.2.2 Trench line and depth as well as condition of trench bottom require approval from Departmental Representative prior to placing bedding material and pipe.
- 3.2.3 Do not backfill trenches until pipe grade and alignment have been checked and accepted and infiltration and ex-filtration test results are within the limits specified. If the pipe is backfilled for any reason prior to testing, accept responsibility to meet the tests or to re-excavate and repair the pipe and pay all costs.

3.3 Granular Bedding

- 3.3.1 Place granular bedding materials in accordance with details specified or as directed by Departmental Representative.
- 3.3.2 Place bedding in unfrozen condition.
- 3.3.3 Place granular bedding in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- 3.3.4 Shape bed true to grade and provide continuous, uniform bearing surface for barrel of pipe. Do not use blocks when bedding pipe.
- Shape transverse depressions as required to bell if bell and spigot pipe is used.
 - Compact full width of bed to at least 95% of corrected maximum dry density. ASTM D698 – 78 Method D.
 - Fill excavation below bottom of manholes or structures with specified bedding material or common backfill as directed by the Departmental Representative.

3.4 Installation

- 3.4.1 Lay and join pipes in accordance with manufacturer's recommendations.
- 3.4.2 Handle pipe with approved equipment. Do not use chains or cables passed through the pipe bore so that weight of pipe bears upon pipe ends.
- 3.4.3 Use laser-type instrument to control line and grade for installation of sewers unless otherwise approved by the Departmental Representative.
- 3.4.4 Lay pipes on a prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points. Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- 3.4.5 Commence placing pipe at the outlet and proceed in upstream direction with bell ends of pipe facing upgrade.

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- 3.4.6 Check alignment as each portion of pipe is laid by utilizing the laser instrument and target. If in the opinion of the Departmental Representative, the necessary tolerance is not being adhered to the Contractor shall, at his own cost, remove and reinstall the pipe to the required line and grade.
- 3.4.7 Do not allow water to flow through the pipe during construction, except as may be permitted by the Departmental Representative.
- 3.4.8 Whenever work is suspended, install a removable watertight bulkhead at the open end of the last pipe installed to prevent the entry of foreign materials.
- 3.4.9 Position and join pipes by approved methods. Do not use excavating equipment to force the pipe sections together.
- 3.4.10 Install PVC pipe and fittings in accordance with CSA B182.11 – 1967.
- Pipe Joining:
 - ♦ Install gaskets as recommended by manufacturer, if required.
 - ♦ Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - ♦ Align pipes carefully before joining.
 - ♦ Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - ♦ Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted. Use only manufacturer's recommended lubricant.
 - ♦ Complete each joint before laying next length of pipe.
 - ♦ Minimize joint deflection after joint has been made to avoid joint damage.
 - ♦ Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
 - ♦ At rigid structures, install pipe joints not more than 600 mm from the side of the structure.
- 3.4.11 Block pipes as directed when any stoppage of work occurs to prevent creep during down time.
- 3.4.12 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes as directed by the Departmental Representative. Backfill as required or as directed by the Departmental Representative.
- 3.4.13 Cut pipes as required for special inserts, fittings or closure pieces in a neat manner, as recommended by the pipe manufacturer, without damaging the pipe or its coating and to leave a smooth end at right angles to the axis of the pipe.

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- 3.4.14 Make watertight connections to manholes or other structures. Provide details of proposed method of installing pipe stubs in structure walls to ensure a watertight joint. Any grout used shall be non-shrink type.
- 3.4.15 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint of saddle to pipe shall be structurally sound and watertight.
- 3.4.16 Leave joints and fitting exposed for ex-filtration testing. Provide protection when required. If it is necessary to backfill sections of the sewer pipe prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipes, fittings or joints that may be necessary.
- 3.4.17 When infiltration and ex-filtration test results are acceptable to the Departmental Representative, backfill the remainder of the trench in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- 3.4.18 Hand place granular material in uniform layers not exceeding 150 mm thick to minimum of 300 mm over top of the pipe. Dumping of material directly on top of the pipe is not permitted.
- 3.4.19 Place layers uniformly and simultaneously on each side of the pipe to prevent lateral displacement of the pipe.
- 3.4.20 Compact each layer to at least 95% maximum density ASTM D698 – 78, Method D.
- 3.5 Service Connections**
- 3.5.1 Install pipe to CSA B182.11 – 1967 and manufacturer's standard instructions and specifications.
- 3.5.2 Service connections to main sewer shall be approved tees, including bends. "Insert a Tee" system, or approved equal, may be used. Do not break-in and mortar patch type joints.
- 3.5.3 Service connections for type PSM Poly (PVC) pipe to be certified to CAN/CSA B – 182.1 – M92, B – 182.2 – M90 and B 182.4 – M92, depending on wall type and diameter.
- 3.5.4 Service connection pipe shall not extend into interior of main sewer.
- 3.5.5 Make up required horizontal and vertical bends from 45 degree bends or less, separated by a straight section of pipe with a minimum length of four pipe diameter. Use long radius bends where applicable. 100 mm long radius bends shall have a minimum radius of curvature of 600 mm. 150 mm long radius bends shall have a minimum radius of curvature of 900 mm.
- 3.5.6 Plug service laterals with watertight caps or plugs as approved.

3.5.7 Place location marker at ends of plugged or capped unconnected sanitary sewer lines. Each marker shall consist of a 38 x 89 mm stake extending from the pipe end at pipe level to 0.6 m above the grade. Paint the exposed portion of the stake red with designation SAN SWR LINE.

3.5.8 Install service connections before carrying out infiltration and ex-filtration tests.

3.6 Pipe Surround

3.6.1 Do not start backfill operations until pipe installation has been inspected and approved by Departmental Representative.

3.6.2 Place backfill material in unfrozen condition.

3.6.3 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

3.6.4 Compact backfill to at least 95 % corrected maximum dry density to ASTM D698.

3.7 Field Testing

3.7.1 Repair or replace pipe, pipe joint or bedding found defective.

3.7.2 TV inspection shall be completed for each section of sanitary sewers main line.

3.7.3 Prior to TV inspection remove foreign material from sewers and related appurtenances by flushing with water.

3.7.4 Perform infiltration or ex-filtration testing as soon as is practicable after jointing and bedding are complete, and service connections have been installed.

3.7.5 Do infiltration and ex-filtration testing as directed. Perform tests in the presence of the Departmental Representative. Notify the Departmental Representative 24 hours in advance of the proposed tests.

3.7.6 Carry out tests on each section of sewer between successive manholes including service connections.

3.7.7 Install watertight bulkheads in suitable manner to isolate the test section from the rest of the pipeline.

3.7.8 Ex-filtration Test:

- Ex-filtration tests are required on sanitary sewer only.
- Fill test section with water in such a manner as to allow displacement of air in the line.
- Immediately prior to test period add water to pipeline until there is a minimum head of one metre over the interior crown of pipe measured at the highest point of

the test section or water in manhole is 1500 mm above static ground water level, whichever is greater.

- Duration of the ex-filtration test shall be one hour.
- Water loss at the end of the test period shall not exceed the maximum allowable ex-filtration over any section of pipe between manholes.

3.7.9 Infiltration Test:

- Infiltration tests are required on sanitary sewer only.
- Conduct infiltration test in addition to ex-filtration test.
- Install a watertight plug at the upstream end of the pipeline test section.
- Discontinue the trench dewatering operations throughout the test section for at least three (3) days before test measurements are to commence.
- Prevent damage to pipe in bedding material due to flotation and erosion.
- Place a 90 degree V-notch weir, or other measuring device approved by the Departmental Representative in invert of sewer at each manhole.
- Measure the rate of flow over a minimum of 1 hour, with recorded flows for each five (5) minute interval.

3.7.10 Infiltration/ex-filtration shall not exceed 4.63 litres per millimetre of internal pipe diameter per kilometre per 24 hours which are the following limits in litres per hour per 100 m of pipe, including service connections.

Internal Pipe Diameter (mm)	Maximum Amount (l/hr)
100	1.93
150	2.89
200	3.86
250	4.83
300	5.79
350	6.75
400	7.72

3.7.11 Repair and retest sewer line as required, until test results are within the limits specified at no additional cost to the Contract.

3.7.12 Repair visible leaks regardless of test results.

3.7.13 Carry out any retesting of sewer sections which have previously passed ex-filtration and/or infiltration tests, as directed by the Departmental Representative. If any sewer

section passes this initial retest, additional payment will be made for retest of that section. If any sewer section does not pass this initial retest, repair and retest such sewer as required until test results are again within the specified limits, at no additional cost to the Contract.

3.7.14 Deflection Test for PVC Pipe:

- Carry out deflection test on all sections of the sewer. The maximum allowable deflection under fully backfilled and compacted trench conditions shall not exceed 5% before 30 days and 7.5% after 30 days.
- Locations with excessive deflection shall be repaired and/or the pipe replaced at the Contractor's expense. The equipment used for the deflection test shall be that as recommended by the manufacturer, and may include an Electronic Deflection Meter or a rigid "Go – No – Go" Device. For the purpose of deflection measurement, the base inside diameters and the deflection mandrel dimensions are provided in the following table. To ensure accurate testing the lines shall be thoroughly cleaned.

Table for Base Inside Diameters and Deflection Mandrel Dimensions

PVC SDR – 35 (ASTM D3034)

Nominal Size	Base Inside Diameter	5% Deflection Mandrel	7.5% Deflection Mandrel
150 mm	146.25 mm	138.9 mm	135.5 mm
200 mm	194.69 mm	185.0 mm	180.0 mm
250 mm	242.90 mm	230.8 mm	224.6 mm
300 mm	288.57 mm	274.0 mm	266.9 mm
375 mm	353.01 mm	335.4 mm	326.6 mm

- For nominal sewer sizes not shown in the above table the Mandrel dimensions shall be calculated as follows:
- $\text{Mandrel O.D.} = \{(100 - Y) (\text{Base I.D.})\} / 100$
- Where Y = Deflection Limit in %

4. Measurement and Basis for Payment

4.1 Measurement for Payment

- 4.1.1 Trenching and backfilling will be measured as per Standard Specification 31 23 33 – Excavating, Trenching and Backfilling, Measurement for Payment.
- 4.1.2 Sanitary Sewer will be measured in meters of each size of pipe and depth class supplied and installed through fittings after the work has been completed. Measurement will be horizontally in meters over the center line of the pipe where the

grade of the pipe is less than 10% and in meters along the slope length of the pipe when the grade of the pipe is 10% or greater.

4.1.3 For service connections, measurement will be made horizontally, where the grade of the pipe is less than 10% and in meters along the slope length of the pipe when the grade of the pipe is 10% or greater, from the center line of the main sewer to a point vertically above the end of the service connections of each size and class of pipe supplied and installed. The length of long radius bends will not be included as service pipe.

4.1.4 Tees, end caps, plugs and other fittings will be considered incidental to the installation of pipe and included in the measurement for pipe.

4.1.5 Granular bedding material will be measured in cubic meters as per Standard Specification 31 23 33 – Excavating, Trenching and Backfilling, Measurement for Payment. No deduction for pipe volume up to and including nominal diameter of 300 mm will be made. Calculation of pipe volume deduction will be made based on the nominal diameter for pipes in excess of 300 mm nominal diameter.

4.1.6 Locating and connecting to existing sewer stubs will be considered incidental to the installation of pipe and included in the measurement for pipe.

4.2 Basis for Payment

4.2.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

4.2.2 Payment shall be made to the maximum of 90% of the value of sewers, fittings and appurtenances until the system, or sections of the system if payment approved by the Departmental Representative, has passed all tests. The 10% retained shall be called the sewer testing allowance.