



**CONSTRUCTION SPECIFICATION FOR
PIPE SEWER INSTALLATION IN OPEN CUT**

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This specification covers the requirements for the installation and inspection of storm and sanitary pipe sewers, laterals, service connections, and concrete appurtenances in open cut.

410.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 408	Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers
OPSS 411	The Cleaning and Flushing of Culverts, Pipe Sewers, Catchbasins, Maintenance Holes, Ditch Inlets, and Oil-Grit Separators
OPSS 421	Pipe Culvert Installation in Open Cut
OPSS 490	Site Preparation for Pipelines, Utilities, and Associated Structures
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities

OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 510	Removal
OPSS 517	Dewatering
OPSS 902	Excavating and Backfilling - Structures
OPSS 904	Concrete Structures

Ontario Provincial Standard Specifications, Material

OPSS 1205	Clay Seal
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1840	Non-Pressure Polyethylene Plastic Pipe Products
OPSS 1841	Non-Pressure Polyvinyl Chloride Pipe Products
OPSS 1843	Non-Pressure Polypropylene (PP) Plastic Pipe Products
OPSS 1860	Geotextiles

Ontario Ministry of Transportation Publications

Gravity Pipe Design Guidelines

CSA Standards

B1800:21 Thermoplastic Nonpressure Piping Compendium

410.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Aluminum Alloy means as defined in OPSS 421.

Backfilling means as defined in OPSS 421.

Concrete Appurtenances means as defined in OPSS 421.

Drainage Structure means as defined in OPSS 407.

Elastomeric Gasket means a gasket that is made from a silicone elastomer based material.

Flexible Pipe means as defined in OPSS 421.

Gravity Pipe Installation means as defined in OPSS 421.

Inspection Assessment means as defined in OPSS 421.

Pipe Run means a section of a pipe sewer between two drainage structures or between a drainage structure and an outlet.

Pipe Sewer means an installation designed for the conveyance of sanitary sewage or storm water using preformed or precast pipe sections, circular or non-circular in cross-section, laid end to end using suitable jointing material and connected by maintenance holes for sanitary pipe sewers and by maintenance holes, catch basins, ditch inlets, or concrete appurtenances for storm pipe sewers.

Pipe Type means a pipe's inner wall design, which can be smooth or corrugated.

Polypropylene Plastic means a material made with virgin polymers in which propylene is essentially the sole monomer.

Post Installation Inspection means quantifying the final installed condition of gravity pipe installations using accepted surveillance and measuring methods.

Service Connection means the pipe used to convey sanitary sewage or storm water from the property line to the main sanitary or storm pipe sewer respectively.

Test Segment means as defined in OPSS 421.

410.05 MATERIALS

410.05.01 Clay Seal

Clay seal material shall be according to OPSS 1205.

410.05.02 Concrete

Concrete for concrete appurtenances shall be according to OPSS 1350 with a nominal minimum 28-Day compressive strength of 30 MPa.

410.05.03 Geotextile

Geotextile shall be according to OPSS 1860.

410.05.04 Elastomeric Seal

Elastomeric seal (gaskets) for pipe joints shall be according to ASTM F477.

410.05.05 Mortar

Mortar for joints shall be according to OPSS 904.

410.05.06 Pipe Materials

410.05.06.01 General

Pipe sewer size, type, and class shall be consistent throughout a pipe run and as specified in the Contract Documents.

Fittings shall be suitable for and compatible with the pipe type and class for which they will be used.

410.05.06.02 Aluminum Alloy Pipe Products

Aluminum alloy pipe products shall be according to OPSS 421.

410.05.06.03 Concrete Pipe

Concrete pipes shall be according to OPSS 421.

410.05.06.04 Corrugated Steel Pipe Products

Corrugated steel pipe products shall be according to OPSS 421.

410.05.06.05 Polyethylene Pipe Products

Polyethylene pipe products shall be according to OPSS 1840.

410.05.06.06 Polypropylene Plastic Pipe Products

Polypropylene plastic pipe products shall be according to OPSS 1843.

410.05.06.07 Polyvinyl Chloride Pipe Products

Polyvinyl chloride pipe products shall be according to OPSS 1841.

Polyvinyl chloride service connection pipe shall be according to CSA B1800 and shall have bell and spigot joints with elastomeric gaskets.

410.05.07 Steel Reinforcement

Steel reinforcement shall be of the size and grade specified in the Contract Documents and shall be according to OPSS 1440.

410.07 CONSTRUCTION

410.07.01 Site Preparation

Site preparation shall be according to OPSS 490.

410.07.02 Removals

Removals shall be according to OPSS 510.

410.07.03 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

410.07.04 Protection Against Floatation

Damage to the pipeline due to floatation shall be prevented during construction and until completion of the work.

410.07.05 Cold Weather Work

All work shall be protected from freezing. Pipes and bedding material shall not be placed on frozen ground.

410.07.06 Transporting, Unloading, Storing, and Handling Pipe

The transporting, unloading, storing, and handling of pipe, shall be according to the manufacturer's recommendations.

All pipes, fittings, and gaskets that are unsound or damaged shall be rejected.

410.07.07 Excavation

Excavation for the placement of pipe sewers shall be according to OPSS 401.

410.07.08 Support Systems

Support systems shall be according to OPSS 404.

410.07.09 Dewatering

Dewatering shall be according to OPSS 517.

410.07.10 Protection Systems

The construction of all protection systems shall be according to OPSS 421.

410.07.11 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

410.07.12 Pipe Installation

410.07.12.01 General

If a universal dimple coupler or any other coupler does not follow the contour of the flexible pipe sections to be joined, polyethylene gaskets shall then be installed at all joints when such couplers are used. Polyethylene gaskets shall be installed symmetrically about the pipe joint, between the coupler and the pipe, and shall be of sufficient length to equal the circumference of the pipe plus a minimum overlap of 300 mm.

The pipe shall be laid within the alignment and grade tolerances specified in the Contract Documents. When bell and spigot pipe is laid, the bell end of the pipe shall be laid upgrade.

The pipe shall be kept clean and dry as work progresses. The trench shall be kept dry. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

The pipe shall not be laid until the preceding pipe joint has been completed and the pipe is carefully embedded and secured in place.

When installing gaskets, all pipe ends shall be thoroughly cleaned. For gaskets requiring field lubrication, a lubricant recommended by the pipe manufacturer shall be used.

When gaskets have been affixed, the pipe shall be handled in a way so that the gasket is not damaged, displaced, or contaminated with foreign matter. Any gasket displaced or contaminated shall be removed, cleaned, and lubricated, if required, and reinstalled before closure of the joint is attempted. When specified in the Contract Documents, nitrile gaskets shall be used.

The pipe shall be properly positioned by means of an appropriate mechanism. Sufficient pressure shall be applied in making the joint to ensure that the joint is in position. Sufficient restraint shall be applied to the line to ensure that joints are held in this position.

Once the pipe has been jointed, a test shall be made with a feeler gauge at intervals around the joint to ensure that the gasket has not been displaced from the spigot groove. If the gasket is found out of position, the joint shall be opened and the gasket placed in its proper position. If necessary, a new gasket shall be installed.

410.07.12.02 Circular Concrete Pipe

All circular concrete pipe joints shall have elastomeric gaskets.

410.07.12.03 Non-Circular Concrete Pipe

Elliptical concrete pipes and joints shall be used for storm pipe sewers only.

All non-circular concrete pipe joints shall be according to the procedures recommended by the manufacturer.

410.07.12.04 Corrugated Steel Pipe Products

Corrugated steel pipe products shall be used for storm pipe sewers only.

Helical corrugated steel pipe without rerolled ends shall be installed so that the helix angle is constant for the total length of the installation. Each pipe section shall be installed next to the previous section so that the lockseam forms a continuous helix. For rerolled ends, the correct fit of the coupling system does not depend on the location of the helical lockseam and corrugation.

Corrugated steel pipe sections shall be joined by means of steel couplers. The couplers shall be installed to lap approximately equal portions of the pipes being connected so that the corrugations or projections of the coupler properly engage the pipe corrugations. As the coupler is being tightened, it shall be tapped with a mallet to take up the slack.

When joint seals are specified in the Contract Documents, they shall be installed immediately prior to the installation of steel couplers.

410.07.12.05 Polyethylene Pipe

Polyethylene pipes shall be installed according to OPSS 421.

410.07.12.06 Polyvinyl Chloride Pipe

Polyvinyl chloride pipe shall be according to OPSS 421.

410.07.12.07 Polypropylene Pipe

Polypropylene pipe shall be according to OPSS 421.

410.07.12.08 Corrugated Aluminum Alloy Structural Plate Pipe

Corrugated aluminum alloy structural plate pipe shall be according to OPSS 421.

410.07.13 Service Connections

Service connections to the main pipe sewer shall be made using factory made tees or wyes, strap-on-saddles, or mortar-on saddles. Factory made tees or wyes shall be used for all service connections when the diameter of the main pipe sewer is:

- a) less than 450 mm; or
- b) less than twice the diameter of the service connection.

Strap-on-saddles shall be installed before laying the pipe.

Holes in the main pipe sewer shall be cut to the minimum diameter required to accept the service connection saddle. If mortar-on saddles are used, the inside of the pipe shall be mortared at the connection.

Service connections shall be plugged at the property line with watertight caps or plugs.

When existing service connections shall be connected to new pipe sewers or service connections, jointing methods according to gravity pipe design guidelines shall be used.

410.07.14 Marking and Recording Service Connections

A painted temporary location marker consisting of a 50 x 75 mm stake or two short sections of lumber connected by a piece of heavy gauge wire shall be placed at the end of the plugged or capped service connection. The marker shall be placed from 300 mm below the finished grade to a point 300 mm above the plugged end of the service pipe.

A painted surface stake, 50 x 75 x 450 mm long, shall be placed after trench restoration.

Service connections shall not be backfilled until they have been inspected and measurements of location have been taken by the Contract Administrator.

410.07.15 Breaking into Maintenance Holes, Catch Basins, Ditch Inlets, Culverts, and Sewers

Breaking into maintenance holes, catch basins, ditch inlets, culverts and sewers shall be according to OPSS 408.

410.07.16 Field Testing

410.07.16.01 General

Field tests shall be conducted when specified in the Contract Documents and applied to sanitary and storm pipe sewers. All tests shall be carried out in the presence of and accepted by the Contract Administrator.

When specified in the Contract Documents, leakage tests shall be carried out on completed pipe sewers 1,200 mm in diameter and smaller. There shall be no visible leakage for pipe sewers larger than 1,200 mm diameter.

Testing shall be carried out from maintenance hole to maintenance hole, including house service connections as work progresses.

The construction of new mainline pipe sewers shall not proceed when three previously placed sections of the pipe sewer have not been tested or have been tested and are unsatisfactory.

Leakage up to 25% in excess of the calculated limits shall be approved in any test section provided that the excess is offset by lower leakage measurements in adjacent sections so that the total leakage is within the allowable limits for the combined sections.

Pipe sewers shall be repaired and retested, as required, until the test results are within the limits specified in this specification. Visible leaks shall be repaired regardless of the test results.

No part of the work shall be accepted until the pipe sewers are satisfactorily tested following completion of installation of service connections and backfilling.

410.07.16.02 Prequalification Leakage Tests

Prequalification leakage tests shall be carried out as either infiltration or exfiltration tests, as required.

The test shall be performed on the first section of the pipe sewer of each size, not less than 100 m in length, installed by each crew in order to prequalify the crew and the material. Tests may be carried out prior to service connections being installed in the section being tested.

When tests are unsatisfactory, the test section shall be repaired and retested until satisfactory results are obtained.

410.07.16.03 Infiltration Test

Dewatering operations shall be discontinued at least 3 Days prior to conducting the test and allow for the groundwater level to stabilize. Infiltration tests shall be conducted when the groundwater level at the time of testing is 600 mm or more above the crown of the pipe for the entire length of the test section. The test section is typically between adjacent maintenance holes.

A watertight bulkhead shall be constructed at the upstream end of the test section. All service laterals, stubs, and fittings shall be plugged or capped to prevent water entering at these locations. A V-notch weir or other suitable measuring device shall be installed at the downstream end of the test section. Infiltrating water shall be allowed to build up behind the weir until the flow through the V-notch has stabilized. The rate of flow shall then be measured. The rate of flow shall not exceed the maximum allowable infiltration calculated for the test section. The allowable infiltration shall be calculated by the following:

$$\text{Allowable Infiltration} = \frac{0.075 \text{ L/mm diameter}}{100 \text{ m of pipe/hour}}$$

410.07.16.04 Exfiltration Test

410.07.16.04.01 General

Exfiltration tests shall be conducted when the groundwater level is lower than 600 mm above the crown of the pipe or the highest point of the highest service connection included in the test section.

The test section is typically between adjacent maintenance holes. The test section of the pipe sewer shall be isolated by temporarily plugging the downstream end and all incoming pipes of the upstream maintenance hole. All service laterals, stubs, and fittings are plugged or capped to prevent water entering at these locations.

410.07.16.04.02 Testing with Water

The test section shall be slowly filled with water ensuring that all air is removed from the line. A period of 24 hours for absorption or expansion shall be allowed prior to starting the test, except if exfiltration requirements are met by a test carried out during the absorption period.

Water shall be added to the pipeline prior to testing until there is a head in the upstream maintenance hole of 600 mm minimum over the crown of the pipe or at least 600 mm above the existing groundwater level, whichever is greater. The maximum limit of the net internal head on the line is 8 m. In calculating the net internal head, allowance for groundwater head, if any, shall be made.

The distance from the maintenance hole frame to the surface of the water shall be measured. After allowing the water to stand for one hour, the distance from the frame to the surface of the water shall again be measured. The leakage shall be calculated using volumes.

The leakage at the end of the test period shall not exceed the maximum allowable calculated for the test section. The allowable leakage shall be calculated by the following:

$$\text{Allowable Infiltration} = \frac{0.075 \text{ L/mm diameter}}{100 \text{ m of pipe/hour}}$$

An allowance of 3.0 litres per hour per metre of head above the invert for each maintenance hole included in the test section shall be made.

Maintenance holes shall be tested separately, if the test section fails.

410.07.16.04.03 Low Pressure Air Testing

The Contract Administrator may allow or require testing by use of air when water is not readily available or the differential head in the test section is greater than 8 m or freezing temperatures exist.

Air control equipment that includes a shut off valve, safety valve, pressure regulating valve, pressure reduction valve and monitoring pressure gauge with pressure range from 0 to 35 kPa with minimum divisions of 0.5 kPa and accuracy of approximately 0.25 kPa shall be provided.

Tests shall be conducted between two consecutive maintenance holes. The test section shall be plugged at each end. One plug shall be equipped with an air inlet connection to fill the pipe sewer system with air. The test section shall be filled slowly until a constant pressure of 24 kPa is maintained. If the groundwater is above the pipe sewer being tested, the air pressure shall be increased by 3.0 kPa for each 300 mm that the groundwater level is above the invert of the pipe.

The air pressure shall be stabilized for 5 minutes and then regulated to maintain it to 20.5 kPa plus the allowance for groundwater, if any. After the stabilization period, the time taken for a pressure loss of 3.5 kPa shall be recorded.

The time taken for a pressure drop of 3.5 kPa shall not be less than the times shown in Table 1.

If the length of the test section is greater than the length for minimum time, the new testing time shall be a product of the length of test section multiplied by the time shown in Table 1 for the appropriate size pipe.

If the results of an air test are marginal, the Contract Administrator may require the section to be retested using water.

410.07.17 Cleaning and Flushing of Pipe Sewers

At least 2 Business Days prior to the commencement of the post installation inspection, the pipe sewers shall be prepared for inspection by cleaning and flushing. The cleanout material from the cleaning and flushing operation shall be managed according to OPSS 411.

410.07.18 Clay Seals

Clay seals shall be placed according to OPSS 421.

410.07.19 Concrete Appurtenances

Concrete appurtenances shall be constructed according to OPSS 421.

410.07.20 Site Restoration

Site restoration shall be according to OPSS 492.

410.07.21 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

410.08 QUALITY ASSURANCE

410.08.01 Acceptance

Acceptance shall be according to this specification, including satisfactory completion of all replacement and remedial actions associated with identified deficiencies.

410.08.02 Post Installation Inspection

A post installation inspection shall be conducted by the Contractor when:

- a) Specified in the Contract Documents.
- b) A defective, damaged, or improperly installed pipe is encountered.
- c) At the request of the Contract Administrator.

When post installation inspection is conducted the following shall apply:

- a) The number of test segments per pipe sewer tender item shall account for a minimum of 25% of the total pipe sewer length in the work.
- b) On Contracts with less than four pipe runs, a minimum of one test segment shall be inspected.

410.09 MEASUREMENT FOR PAYMENT

410.09.01 Actual Measurement

410.09.01.01 Pipe Sewer

Measurement of pipe sewers shall be by length in metres along the horizontal centreline length of the pipe from the centre of one drainage structure to the centre of another drainage structure or outlet end of the pipe sewer. When the grade of the pipe sewer is 10% or greater, the above measurement shall then be of the slope length.

410.09.01.02 Service Connections

Measurement of the service connections shall be by length in metres along its horizontal centreline from the centreline of the main pipe sewer to the end of the service connection.

410.09.01.03 Concrete Appurtenances

Measurement for concrete appurtenances shall be by volume in cubic metres for the volume of concrete placed.

410.09.02 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

410.10 BASIS OF PAYMENT

**410.10.01 "size, type, class" Pipe Sewer - Item
Service Connections - Item
Concrete Appurtenances - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

410.10.02 Elevation Adjustment

Prior to the installation of a drainage structure, the Owner may, at its sole discretion, raise or lower the invert of a pipe sewer by 150 mm or less, at no additional cost. Bedding elevations shall be adjusted accordingly.

A change in invert elevation exceeding 150 mm shall be administered as a Change in the Work.

410.10.03 Clay Seal

Payment for clay seal shall be according to OPSS 902.

TABLE 1
Exfiltration Test - Low Pressure Air Testing

Nominal Pipe Size mm	Minimum Time min: sec	Length for Minimum Time m	Time For Longer Length sec
100	1:53	182	0.623
150	2:50	121	1.140
200	3:47	91	2.493
250	4:43	73	3.893
300	5:40	61	5.606
375	7:05	48	8.761
450	8:30	41	12.615
525	9:55	35	17.171
600	11:20	30	22.425
675	12:45	27	28.382
750	14:10	24	35.040
825	15:35	22	42.397
900	17:00	20	50.450