

**AMENDMENTS TO OPSS 412 (OCT 89) –  
CONSTRUCTION SPECIFICATION FOR SEWAGE FORCEMAIN  
CONSTRUCTION BY OPEN CUT METHOD**

**OPSS 412.05.08.01** is amended by replacing the sixth paragraph with the following:

Valves shall open in the clockwise direction.

CONSTRUCTION SPECIFICATION FOR SEWAGE FORCEMAIN CONSTRUCTION BY  
OPEN CUT METHOD

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**412.01 SCOPE**

This specification covers the requirements for constructing storm water and sanitary forcemains and associated appurtenances in open cut.

**412.02 REFERENCES**

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

**Ontario Provincial Standard Specifications, Construction:**

OPSS 503 Site Preparation for Pipelines  
OPSS 504 Preservation, Protection and Reconstruction of Existing Facilities  
OPSS 507 Site Restoration for Underground Utilities  
OPSS 514 Trenching, Backfilling and Compacting  
OPSS 517 Dewatering  
OPSS 538 Shoring and Bracing

**Ontario Provincial Standard Specifications, Material:**

OPSS 1004 Aggregates - Miscellaneous  
OPSS 1350 Concrete (Materials and Production)

**Canadian Standards Association Standards**

B137.3 - M1986 - Rigid Poly (Vinyl Chloride) (PVC) Pipe for Pressure Applications  
CAN/CSA-A5-M1988 - Portland Cements

**American Society for Testing and Materials Standards**

C296-83 - Asbestos-Cement Pressure Pipe  
C361M-87 - Reinforced Concrete Low-Head Pressure Pipe (Metric)  
D1869-78 - Rubber Rings for Asbestos-Cement (1983) Pipe  
D3035-88 - Polyethylene (PE) Plastic Pipe (SDR -PR) Based on Controlled Outside Diameter  
D3139-84 - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals  
D3350-84 - Polyethylene Plastics Pipe and Fittings Materials

**Canadian General Standards Board Standards**

41-GP-25M (October 1977) - Pipe, Polyethylene, for the Transport of Liquids

**American Water Works Association Standards**

C104/A21.4-85 - Cement-Mortar Lining for Ductile-Iron and Gray-Iron Pipe and Fittings for Water  
C110-82 - Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in., for Water and Other Liquids  
C111/A21.11-85 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings  
C151-81 - Ductile-Iron Pipe Centrifugally Cast in Metal or Sand Lined Molds for Water and Other Liquids  
C153-84 - Ductile-Iron Compact Fitting  
C200-80 - Steel Water Pipe 6 Inches and Larger  
C206-82 - Field Welding of Steel Water Pipe  
C208-83 - Dimensions for Fabricated Steel Water Pipe Fittings  
C301-84 - Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids  
C302-74 - Reinforced Concrete Pressure Pipe, Noncylinder Type, for Water and Other Liquids  
C400-80 - Asbestos-Cement Distribution Pipe, 4 in. Through 16 in. (100 mm Through 400 mm) NPS, for Water and Other Liquids  
C500-80 - Gate Valves, 3 Through 48 in NPS, for Water and Other Liquids  
C509-80 - Resilient-seated Gate Valves 3 through 12 NPS, for Water and Sewage Systems

**Ministry of Transportation Publication**

MTO Test Method LS 706

## **American National Standards Institute Standards**

B16.1-1975 - Valves with Flanged ends

### **412.03 DEFINITIONS**

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

**Appurtenances:** means structures, devices, and appliances, other than pipe and conduit, which are used in connection with a forcemain such as valves.

**Bedding:** means the material used to support the pipe.

**Cover Material:** means the material placed from the top of the bedding to a minimum distance of 300 mm above the outside top of the pipe.

**Fittings:** means connections, appliances, and adjuncts designed to be used in connection with pipes; examples are elbows, bends, plugs and caps.

**Forcemain:** means an installation designed for the conveyance of sanitary or storm sewage under pressure, using pre-formed or pre-cast pipe sections, circular in cross-section, laid end to end using suitable jointing materials.

**Maximum Dry Density:** means the definition as determined by the Ministry of Transportation Test Method LS 706.

**Selected Native Material:** means the material which was removed to form an excavation which is now accepted by the Engineer for return to the same excavation as backfill material.

**Spring Line:** means a line horizontally bisecting the pipe.

**Weakly Cemented Fill:** means any combination of granular material with low percentages of cement and/or other cementitious material such that the strength is in the order of 0.4 MPa at 28 days.

### **412.05 MATERIALS**

#### **412.05.01 General**

Pipe size and class shall conform to the requirements as specified in the contract. Pipe material shall be selected in accordance with the terms of the Contract.

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

#### **412.05.02 Asbestos Cement Pressure Pipe**

Asbestos cement pressure pipe shall conform to AWWA C 400.

Joints shall conform to ASTM C 296. Rubber gaskets shall conform to ASTM D 1869.

Fittings shall be gray or ductile iron conforming to AWWA C 110/A21.10 or Ductile Iron conforming to AWWA C153/A21.53.

#### **412.05.03 Concrete Pressure Pipe**

Prestressed concrete cylinder pipe including joints and fittings shall conform to AWWA C 301.

Non-cylinder pipe and joints shall conform to AWWA C 302 or ASTM C 361 M. Fittings shall conform to AWWA C 301 or C 302.

#### **412.05.04 Ductile Iron Pipe**

Ductile iron pipe shall conform to AWWA C151/ A21.51 and shall be cement lined. The cement lining shall conform to AWWA C 104/A21.4

Joints shall be push-on or mechanical and conform to AWWA C 111/A21.11.

Fittings shall be gray or ductile iron conforming to AWWA C 110/A21.10 or Ductile Iron conforming to AWWA C 153/A21.53.

#### **412.05.05 Polyethylene (PE) Pressure Pip**

Polyethylene (PE) pressure pipe shall conform to ASTM D 3035, ASTM D 3350, or CGSB 41-GP-25M. Joints shall be thermal butt fusion type. Fittings shall be gray or ductile iron and shall conform to AWWA C 110/A21.10 flanged.

#### **412.05.06 Polyvinyl Chloride (PVC) Pipe**

Polyvinyl chloride (PVC) pipe shall be supplied from a CSA certified plant and shall conform to CSA B 137.3-M.

Joints shall be bell and spigot with rubber rings conforming to ASTM D 3139.

Fittings shall be gray and ductile iron conforming to AWWA C 110/A21.10 or Ductile Iron conforming to AWWA C 153/A21.53.

#### **412.05.07 Steel Pipe**

Steel Pipe shall conform to AWWA C 200. Fittings shall conform to AWWA C 208.

#### **412.05.08 Gate Valves**

##### **412.05.08.01 General**

Valves shall conform to AWWA C 500 or AWWA C 509.

Valves shall be supplied with flanged ends conforming to ANSI B16.1, Class 125.

Valves for buried installation shall have mechanical or bell ends as required.

Valves shall be capable of a seat differential test pressure equal to the design pressure and to a hydrostatic shell test pressure at least 50% in excess of the design pressure.

Shaft spindles shall have O-rings of resilient materials.

Valves shall open in the direction specified in the contract.

Valves shall be made of the following:

- Cast iron for valves 100 mm in diameter or larger.
- Cast iron or bronze for valves less than 100 mm in diameter.

An adjustable disc stop shall be provided to the body, so that the disc cannot be wedged too tightly into the body upon closing. The disc stops shall be fitted in the shop.

The bottom of the gate shall not be above the seat rings when the gate is in the fully open position.

The gate shall bear on the guides for a length equal to at least 50% of the port diameter.

Guides for valves shall be designed to be set in a horizontal position to take the weight of the gate throughout its entire length of travel. Rollers shall not be used.

Thrust bearings shall be designed to safely develop full strength of the valve spindle. Bronze sleeve types shall not be used for thrust bearings. The housing for thrust bearings shall be machined and fully bronze lined.

Valve spindles shall be made of bronze or polished chrome-nickel iron machined all over to a smooth finish and threaded with ACME or square type thread.

Spindle nests shall be bronze Alloy A.

Two scour-holes shall be placed in the body of the valves, with the edges of the scour holes on both sides of body flush with the bottom of the guides for the wedge gate. The holes shall be drilled, tapped, and fitted with a 50 mm brass plug.

#### **412.05.08.02 Valves - 300 mm in Diameter and Smaller**

Valves shall be designed for a minimum cold water working pressure of 1035 kPa.

Valves shall be iron body, solid wedge or double-disc type, double-faced and seated that work equally well with full pressure on either side of the gate.

#### **412.05.08.03 Valves - 400 mm in Diameter and Larger**

Valves shall be provided with a by-pass, consisting of two flanged nozzles cast integrally with the valve body, flanged elbow and a flanged gate valve.

By-pass valves shall be iron body, with an inside screw non-rising stem, suitable for the same working and test pressures as the associated main valve.

#### **412.05.09 Knife Gate Valves**

Valves shall be made of cast 304 or 316 stainless steel.

Valves shall have full port area and wafer face to face. The valves shall have face to face welded parts including packing chest and packing stuffer and stem, complete with resilient seat.

#### **412.05.10 Valve Operators**

Valve operators shall be waterproof type suitable for continuous submergence duty. Operators shall be grease-packed, enclosed gear type. Work gear and input shaft shall be stainless steel.

Hand wheels shall be large enough to open and close valves under the specified design pressure with an input force of not greater than 355 N.

Tee wrenches shall be made of steel pipe and tubing furnished with sockets to suit the operating nut.

Geared operators shall consist of carburized, alloy steel spiral bevel gears with shafts operating in anti-friction bearings. Geared operators are to be self-contained units, permanently lubricated and totally enclosed in an impact resistant cast iron housing.

#### **412.05.11 Air and Vacuum Valves**

Air release valves shall be double acting type air and vacuum valves having cast iron bodies, bronze mechanisms, stainless steel seats, floats and lever pins.

Gate valves shall be provided with each air valve.

#### **412.05.12 Pipe Bedding Materials**

Granular materials greater than 25 mm in size shall not be used for pipe bedding.

Bedding material shall be as specified in the Contract.

Concrete for bedding shall conform to OPSS 1350 with a minimum 28 day compressive strength of 15 MPa.

#### **412.05.13 Cover Materials**

Cover materials greater than 25 mm in size shall not be used for cover.

Cover material shall be as specified in the Contract, and where Selected Native Material is specified it shall be free from frozen lumps, cinders, ashes, refuse, vegetable organic matter, rocks and boulders or other deleterious material.

#### **412.05.14 Concrete**

Concrete for thrust blocks shall conform to OPSS 1350 with a minimum 28 day compressive strength of 20 MPa.

### **412.07 CONSTRUCTION**

#### **412.07.01 Site Preparation**

Site preparation shall conform to OPSS 503.

#### **412.07.02 Preservation and Protection of Existing Facilities**

Existing facilities shall be preserved and protected to conform to OPSS 504.

#### **412.07.03 Protection Against Flotation**

Damage to the forcemain due to hydrostatic pressure shall be prevented during construction.

#### **412.07.04 Cold Weather Work**

All work shall be protected from freezing. Pipes and bedding materials shall not be laid on frozen ground.

#### **412.07.05 Transporting, Unloading and Storing Pipe**

Delivery and unloading of pipes and fittings shall cause the least possible delay to traffic.

All pipes, fittings and gaskets that are unsound or damaged shall be removed from the site and replaced.



Mechanical equipment shall be used to unload the pipe.

Materials shall be placed in safe storage.

Manufacturer's handling and storage recommendations shall be followed.

#### **412.07.06 Dewatering**

Dewatering shall conform to OPSS 517.

#### **412.07.07 Trenching, Backfilling and Compacting**

Trenching, backfilling and compacting shall conform to OPSS 514.

#### **412.07.08 Shoring and Bracing**

Shoring and bracing shall conform to OPSS 538.

#### **412.07.09 Pipe Bedding**

Bedding materials shall be placed as shown in the Contract. The bed shall be shaped true to line and grade, free from sags and high points. Bedding shall be shaped to a cylindrical surface with the radius conforming to the pipe in accordance with pipe manufacturer's recommendations. Bedding materials shall be placed simultaneously on each side to the spring line of the pipe.

Where concrete or weakly cemented fill bedding is specified, the pipe shall be supported on grade and aligned by solid concrete blocks having the same minimum compressive strength as the specified bedding, spaced so that no movement of the pipe occurs during placement of concrete or weakly cemented fill.

If necessary, concrete bedding may be placed in two pours. The level of the first pour shall not be higher than 75 mm below the bottom of the pipe. The first pour shall be cured a minimum of 24 hours before the second pour is started.

Granular bedding shall be uniformly compacted in layers not exceeding 150 mm in thickness to a minimum density of 95 percent of the maximum dry density.

At pipe joints, bedding materials shall be left clear of the joints to permit their completion as specified elsewhere. After the connection has been completed, approved bedding material shall be placed under the joint and thoroughly tamped to the compaction specified. Bedding material shall not be taken from completed portions of the trench for this purpose.

#### **412.07.10 Installation of Pipes**

Pipes shall be handled with special care during temperatures below freezing. Pipes shall not be exposed to localized high temperatures except as required for the jointing process.

Pipes shall be laid in a dry trench.

Pipes shall be lowered into the trench carefully.

Ends of pipe shall be kept clean.

Pipes shall be laid on the prepared bed, true to the line and grade as shown on the contract drawings. The barrel of each pipe shall be in contact with the shaped bed throughout its full length. The ends of the pipe shall abut against each other so that there is no unevenness along the inside.

Pipes shall be kept clean as work progresses. Water shall not be allowed to flow through the pipe during construction. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

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

#### **412.07.11 Jointing**

##### **412.07.11.01 General**

Joint surfaces shall be clean. Pipe ends shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing pipe shall be followed.

Pipes shall be aligned on centreline to previously laid pipe.

Pipe shall be pulled or pushed only by hand or power operated winch. A backhoe shall not be used for pushing pipe.

Joints shall be prevented from opening after the pipe has been laid.

##### **412.07.11.02 Jointing Asbestos Cement Pressure Pipe**

The rubber ring shall be inserted and properly seated in the coupling groove. The entire circumference of the pipe shall be lubricated back to the stop shoulder.

The coupling shall be installed on the forward end of the pipe to be laid.

The pipe ends shall be aligned and the pipe shall be inserted into the coupling of the pipe already in place. The pipe shall be pulled or pushed "home" by bar, block assembly, lever or friction type puller assembly.

The position of the rubber ring shall be checked by using an approved feeler gauge all around the pipe. If the ring has been displaced, the coupling shall be removed and the rubber ring shall be corrected. All damaged rubber rings shall be replaced.

##### **412.07.11.03 Jointing Ductile Iron Pipe**

Mechanical Joints:

The gland shall be positioned on the pipe with the lip extension toward the joint. The gasket shall be slipped on the pipe with the thick edge towards the gland.

The spigot end shall be pushed to its seat in the bell. The gasket shall be pressed to seat it evenly around the joint.

The gland shall be positioned for bolting and the bolts shall be inserted. All nuts shall be hand tightened.

The nuts shall be tightened half a turn at a time with a calibrated torque wrench. All nuts shall be tightened uniformly to the torque specified in AWWA C111/A21.11.

Bell and Spigot Joints:

The gasket shall be placed in the groove of the bell making certain it is properly seated.

The gasket shall be lubricated.

Pipes to be joined shall be aligned and the spigot shall be carefully entered into the bell until the spigot end just makes contact with the gasket.

The entry of the spigot into the bell shall be completed by hand or by the use of a jack-type pulling tool until the second reference mark is flush with the face of the bell.

#### **412.07.11.04 Jointing Concrete Pressure Pipe**

Bell and Spigot Joints:

A cotton or burlap diaper shall be placed around the bell end of the pipe already in place.

A rubber gasket shall be placed on the spigot end of the pipe to be laid ensuring that the stretch and volume of the gasket is equalized around the entire circumference of the pipe.

The pipe shall be aligned and the spigot end shall be inserted into the bell of the pipe already in place. Steel inserts shall be placed in the joints to prevent the spigot from entering the full depth of the bell.

The location of the rubber gasket shall be checked around the entire circumference of the joint. The steel insert shall be removed and the pipe pushed until the spigot enters the full depth of the socket and is retained in position.

Cement mortar consisting of one part Portland cement conforming to CAN/CSA- A5M and three parts mortar sand conforming to OPSS 1004 shall be poured around the assembled joint. Ensure that the diaper is carefully placed around the joint recess.

#### **412.07.11.05 Jointing Polyethylene (PE) Pressure Pipe**

Pipe shall be jointed by the thermal butt fusion process.

Procedures recommended by the pipe manufacturer shall be followed.

Flanged joints shall be made in accordance with the manufacturer's recommendations. Bolts shall be tightened to the torque specified by the manufacturer for the particular size and type of stub end.

#### **412.07.11.06 Jointing Polyvinyl Chloride (PVC) Pressure Pipe**

If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell up to but not beyond the depth of the stop reference mark.

#### **412.07.11.07 Jointing Steel Pipe**

Pipe shall be jointed by field welding conforming to AWWA C 206.

#### **412.07.12 Placing Cover Material**

Cover material shall be placed in uniform layers not exceeding 200 mm in thickness to a minimum density of 95% of the maximum dry density.

A 300 mm layer of cover material shall be provided above the pipe before using a heavy mechanical compactor on top of the pipe.

#### **412.07.13 Cutting of Pipe**

Whenever cutting of pipe is required, pipes shall be cut as recommended by the pipe manufacturer.

#### **412.07.14 Change in Line and Grade**

##### **412.07.14.01 Ductile Iron and Asbestos Cement Pipe**

Fabricated bends shall be provided for changes in line and grade of 11.25 degrees or more.

Deflections of less than 11.25 degrees shall be made by pipe joint deflection. The manufacturer's recommendation in deflecting pipe joints shall not be exceeded.

##### **412.07.14.02 Concrete Pressure Pipe**

Fabricated bends shall be provided for change in line and grade of 20 degrees or more. Bevel adaptors with laying lengths of less than 300 mm shall be used for deflections of 2.5 to 15 degrees.

Deflections of 1.5 degrees or less shall be made in the pipe joint.

##### **412.07.14.03 PVC and PE Pipe**

Pipe flexibility shall be made use of without exceeding the manufacturer's recommended maximum deflection. Pipe joints shall not be deflected. Fabricated bends shall be used otherwise.

##### **412.07.14.04 Steel Pipe**

Fabricated bends shall be provided for change in line of grade.

#### **412.07.15 Installation of Valves**

Valves shall be installed at the locations shown in the Contract.

Valves and connecting pipes shall be aligned accurately and supported as specified in the Contract.

All bolts, nuts, couplings, rubber rings and connecting pieces shall be cleaned thoroughly before installation.

#### **412.07.16 Thrust Restraint**

All connections, caps and bends that are liable to "draw" or blow-off shall be protected by means of concrete blocking, or restrained joints as specified in the Contract. Concrete for thrust blocks shall be placed against undisturbed ground making sure joints and couplings are free from concrete.

#### **412.07.17 Restoration**

When watermains, service connections and appurtenances are installed beyond the limits of general grading operations, restoration shall conform to OPSS 507.

#### **412.07.18 Hydrostatic Testing**

##### **412.07.18.01 General**

Hydrostatic testing shall be conducted under the supervision of the Engineer upon completion of the forcemain, including backfilling.

The test section shall be either a section between valves or the complete forcemain.

#### **412.07.18.02 Test Pressure**

The test pressure shall be as specified in the contract.

For polyethylene pipe, the test pressure expressed in kPa shall not exceed 1.5 times the series number expressed in kPa.

For polyvinyl chloride pipe, the test pressure expressed in kPa, shall not exceed the series or class number, expressed in kPa.

#### **412.07.18.03 Hydrostatic Leakage Test**

The test section shall be filled slowly with water and all air shall be removed from the pipeline. A period of 24 hours shall be allowed before starting the test.

The test section shall be subject to the specified continuous test pressure for two hours.

The leakage is the amount of water added to the test section to maintain the specified test pressure for the test duration. The measured leakage shall be compared with the allowable leakage as calculated for the test section. The allowable leakage is 2.22 L per mm of pipe diameter per km of pipe per day.

If the measured leakage exceeds the allowable leakage, all leaks shall be located and repaired and the test section shall be retested until a satisfactory result is obtained.

#### **412.07.19 Cleaning and Flushing Forcemains**

All forcemains shall be cleaned and flushed.

### **412.09 MEASUREMENT FOR PAYMENT**

#### **412.09.01 Actual Measurement**

##### **412.09.01.01 Forcemain (Including Fittings)**

Measurement will be in metres horizontally over the centreline of the pipe from the point of connection to a chamber, valve or existing watermain to a point vertically above the end of the new forcemain.

##### **412.09.01.02 Valves (Including Boxes as Required)**

Measurement will be by the number of units installed. The unit of measurement will be each.

#### **412.09.02 Plan Quantity Measurement**

##### **412.09.02.01 Forcemains (Including Fittings)**

Measurement is by Plan Quantity, as may be revised by adjusted Plan Quantity, measured in metres horizontally over the centreline of the pipe from the point of connection to a chamber, valve or existing forcemain to a point vertically above the end of the new forcemain.

##### **412.09.02.02 Valves (Including Boxes as Required)**

Measurement is by Plan Quantity as may be revised by Adjusted Plan Quantity for the number of Valves installed. The unit of measurement is each.

**412.10 BASIS OF PAYMENT**

**412.10.01 Forcemains (Including Fittings) - Item Valves (Including Boxes as Required) - Item**

Payment at the contract price for the above tender item(s) shall be full compensation for all labour, equipment and material to do the work.