CONSTRUCTION SPECIFICATION FOR PIPE CULVERT INSTALLATION IN OPEN CUT

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421.01 SCOPE

This specification covers the requirements for the installation of pipe culverts, pipe culvert end sections, and concrete appurtenances in open cut.

421.02 REFERENCES

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

Ontario Provincial Standards Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 411	The Cleaning and Flushing of Culverts, Pipe Sewers, Catchbasins, Maintenance Holes, Ditch Inlets, and Oil-Grit Separators
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 539	Temporary Protection Systems
OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete

Ontario Provincial Standard Specifications, Material

OPSS 1004	Aggregates - Miscellaneous
OPSS 1205	Clay Seal
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1350	Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1801	Corrugated Steel Pipe (CSP) Products
OPSS 1820	Circular and Elliptical Concrete Pipe
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

CSA Standards

G401-14 (R2019)	Corrugated Steel Pipe Products

ASTM International

B746/B746M-16	Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
C507-20	Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
F477-14(2021)	Elastomeric Seals (Gaskets) for Joining Plastic Pipe

421.03 DEFINITIONS

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

Aluminum Alloy means a material made with two or more metals in which aluminum is the predominant metal.

Backfilling means the operation of filling the trench with bedding, cover, and backfill material or embedment and backfill material.

Certification Body means an independent 3rd party agency accredited by the Standards Council of Canada that has the qualifications, skills, and expertise required to confirm that a pipe manufacturer produces pipe culvert products to the quality and requirements of an accepted standard and that has the mandate to certify the pipe culvert products produced.

Certified means pipe culvert products that have been marked with a certification body's logo confirming that the production of the pipe culvert product is according to the quality and requirements of the manufacturing standard.

Concrete Appurtenances means concrete head walls, cut-off walls, stiffeners, aprons, collars, and any other concrete fixtures associated with the pipe culvert.

Corrugated Steel Pipe Products means as defined in OPSS 1801.

Culvert Inlet Grate means a metal grate placed at the upstream end of a culvert to prevent woody debris, rocks etc from entering the culvert. Also called trash rack.

Delivered Quality means the pipe culvert products' physical condition upon arrival at the construction site in terms of the extent and degree of dents, scratches, cracks, pipe coating integrity, etc., that appear on the pipe culvert products delivered.

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

Flexible Pipe means pipe that can deflect 2% or more without cracking, such as polyvinyl chloride, polyethylene, or steel pipe.

Gravity Pipe Culvert Installation means a constructed pipe culvert conveying surface waters under the influences of gravity only.

Pipe Culvert means an installation designed to provide for the conveyance of surface water, pedestrians, or livestock using preformed or precast pipe sections, circular or non-circular in cross-section, laid end to end using suitable joint materials.

Pipe Culvert 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 culvert installations using accepted surveillance and measuring methods.

Structural Plate Pipe Culvert means a pipe culvert that consists of corrugated steel sections that are bolted together to form the required shape.

421.05 MATERIALS

421.05.01 Clay Seal

Clay seal material shall be according to OPSS 1205.

421.05.02 Concrete

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

421.05.03 Elastomeric Seal

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

421.05.04 Geotextile

Geotextile shall be according to OPSS 1860.

421.05.05 Mortar

Mortar for joints shall consist of one part Portland cement and two parts mortar sand, wetted with sufficient water to only make the mixture plastic. The mortar sand shall be according to OPSS 1004, the normal Portland cement shall be according to OPSS 1301, and the water shall be according to OPSS 1302.

421.05.06 Pipe Culvert Materials

421.05.06.01 General

Pipe size, type, and class shall be as specified in the Contract Documents.

Pipe type shall be consistent throughout the length of the pipe culvert.

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

421.05.06.02 Aluminum Alloy Pipe Culvert Products

Corrugated aluminum alloy structural plate pipe culvert products shall be according to ASTM B746M.

All corrugated aluminum alloy structural plate pipe culvert products used in the work shall be certified and supplied from a manufacturer that produces the corrugated aluminum alloy structural plate pipe culvert products according to ASTM B746M. Only products with an accepted certification body logo marking according to Figure 1 shall be used.

Inspection, testing, and record keeping for corrugated aluminum alloy structural plate pipe culvert products shall be according to ASTM B746M.

Certified corrugated aluminum alloy structural plate pipe shall be marked according to ASTM B746M and shall include as a minimum the name of the pipe manufacturer.

When requested by the Owner, a copy of the certificate of compliance issued by the certification body confirming that the manufacturer produces certified corrugated aluminum alloy structural plate pipe culvert products shall be submitted to the Contract Administrator.

Where the delivered quality of certified corrugated aluminum alloy structural plate pipe culvert products is deemed to be unacceptable by the Contract Administrator, the products shall be rejected.

421.05.06.03 Concrete Pipe Culvert

Circular concrete pipe and joints shall be according to OPSS 1820.

Elliptical concrete pipe and joints shall be according to ASTM C507.

421.05.06.04 Corrugated Steel Pipe Culvert Products

Corrugated steel pipe culvert products shall be according to OPSS 1801.

421.05.06.05 Polyethylene Pipe Culvert Products

Polyethylene pipe culvert products shall be according to OPSS 1840.

421.05.06.06 Polypropylene Plastic Pipe Culvert Products

Polypropylene plastic pipe culvert products shall be according to OPSS 1843.

421.05.06.07 Polyvinyl Chloride Pipe Culvert Products

Polyvinyl chloride pipe culvert products shall be according to OPSS 1841.

421.05.07 Steel Reinforcement

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

421.07 CONSTRUCTION

421.07.01 Site Preparation

Site preparation shall be according to OPSS 490.

421.07.02 Removals

Removals shall be according to OPSS 510.

421.07.03 Preservation and Protection of Existing Facilities

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

421.07.04 Protection Against Floatation

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

421.07.05 Cold Weather Installation

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

421.07.06 Transporting, Unloading, Storing, and Handling of Pipe

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

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

421.07.07 Excavation

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

421.07.08 Support Systems

Support systems shall be according to OPSS 404.

421.07.09 Dewatering

Dewatering shall be according to OPSS 517.

421.07.10 Protection Systems

The construction of all protection systems shall be according to OPSS 539. When the stability, safety or function of an existing Roadway, railway, other works, or proposed works may be impaired due to the method of operation, such protection as may be required shall be provided. Protection may include sheathing, shoring and driving piles, when necessary, to prevent damage to such works or proposed works.

421.07.11 Backfilling and Compacting

Backfilling and compacting shall be according to OPSS 401.

421.07.12 Pipe Culvert Installation

421.07.12.01 General

If a universal dimple coupler or any other coupler does not follow the contour of the flexible pipe culvert 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.

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.

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.

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

The pipe culvert cut-end finish, end sections, and safety slope end treatments shall be as specified in the Contract Documents.

When installing gaskets, all pipe culvert 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.

421.07.12.02 Circular Concrete Pipe Culvert

All circular concrete pipe culvert joints shall have elastomeric gaskets.

421.07.12.03 Non-Circular Concrete Pipe Culvert

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

421.07.12.04 Corrugated Steel Pipe Culvert Products

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 culvert section shall be installed next to the previous section so that the lock seam forms a continuous helix. For rerolled ends, the correct fit of the coupling system does not depend on the location of the helical lock seam and corrugation.

Corrugated steel pipe culvert sections shall be joined by means of steel couplers. The couplers shall be installed to lap approximately equal portions of the pipe culvert being connected so that the corrugations or projections of the coupler properly engage the pipe culvert 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.

Structural plate pipe culverts may be assembled in the trench or beside the excavation. If the assembled structure must be moved to its final position, it shall be moved so that no damage or distortion is caused to the structure.

When the structural plate pipe culvert has been placed to the alignment and grade specified in the Contract Documents, all assembly bolts shall be tightened so that the torque on the bolts prior to backfilling is between 200 and 340 Nm.

Before backfilling, at least 5% of the bolts used in each circumferential and longitudinal connection shall be tested after assembly.

421.07.12.05 Polyethylene Pipe Culvert

Polyethylene pipe culvert shall be jointed by one of the following methods, as recommended by the pipe manufacturer:

a) Bell and Spigot.

b) Welded Joint.

c) Thermal Fusion Joint.

d) Screw-on Coupler.

e) Split Coupler.

f) Threaded Joint.

g) Mechanical Restrained Joint with Gasket.

421.07.12.06 Polyvinyl Chloride Pipe Culvert

Polyvinyl chloride pipe culvert shall be jointed, as recommended by the manufacturer, using a bell and spigot joint with an elastomeric gasket.

At the end of a Day's work, the last pipe shall be blocked as may be required to prevent movement.

421.07.12.07 Polypropylene Pipe Culvert

Polypropylene pipe culvert shall be jointed by means of a bell and spigot joint with elastomeric gasket or a coupler joint according to the manufacturer’s recommendations to satisfy the pipe joint specification.

421.07.12.08 Corrugated Aluminum Alloy Structural Plate Pipe Culvert

Corrugated aluminum alloy structural plate pipe culvert shall be jointed by means of bolts according to the manufacturer’s recommendations to satisfy the pipe joint specification.

421.07.13 Cleaning and Flushing of Pipe Culverts

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

421.07.14 Clay Seals

Clay seals shall be placed as specified in the Contract Documents and compacted to 95% of the proctor maximum dry density.

421.07.15 Concrete Appurtenances

Concrete appurtenances shall be as specified in the Contract Documents. Concrete in concrete appurtenances shall be placed according to OPSS 904. Steel reinforcement shall be placed according to OPSS 905. Culvert inlet grates shall be installed when specified in the Contract Documents.

421.07.16 Site Restoration

Site restoration shall be according to OPSS 492.

421.07.17 Management of Excess Material

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

421.08 QUALITY ASSURANCE

421.08.01 Acceptance

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

421.08.02 Post Installation Inspection

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

a) Specified in the Contract Documents.

b) At the request of the Contract Administrator when a defective, damaged, or improperly installed pipe is encountered or suspected.

421.09 MEASUREMENT FOR PAYMENT

421.09.01 Actual Measurement

421.09.01.01 Pipe Culvert
Pipe Culvert Extension
Non-Circular Pipe Culvert
Non-Circular Pipe Culvert Extension

Measurement of pipe culverts, non-circular pipe culverts, pipe culvert extensions, and non-circular pipe culvert extensions shall be along the horizontal length of the pipe culvert in metres, from one end of the pipe culvert or pipe culvert end section to the other end of the pipe culvert or the other pipe culvert end section. When the grade of the pipe culvert is 10% or greater, the above measurement shall then be of the slope length.

421.09.01.02 Concrete Appurtenances

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

421.09.02 Plan Quantity Measurement

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

421.10 BASIS OF PAYMENT

421.10.01 “size, type, class” Pipe Culvert - Item
“size, type, class” Pipe Culvert Extension - Item
“size, type, class” Non-Circular Pipe Culvert - Item
“size, type, class” Non-Circular Pipe Culvert Extension - 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.

When post installation inspection is requested on site by the Contract Administrator and does not confirm any damages or deficiencies, the inspection shall be treated as Changes in the Work.

When post installation inspection is requested on site by the Contract Administrator and does confirm damages or deficiencies, the inspection shall be at no additional cost to the Owner.

421.10.02 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 culvert 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.

421.10.03 Clay Seal

Payment for clay seal shall be according to OPSS 902.

FIGURE 1
CSA Standards
Certification Logo