

This specification outlines the requirements for constructing pipe culverts and culvert extensions and includes the requirements for excavation, bedding and placing of the pipe, and backfilling operations. This specification does not outline the requirements for the supply and installation of structural plate pipe or pipe arch.

## PART 1 REFERENCES

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

American Association of State Highway and Transportation Officials (AASHTO)

M36	Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains
M196	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
<u>M252</u>	<u>Standard Specification for Corrugated Polyethylene Drainage Pipe</u>
M274	Standard Specification for Steel Sheet, Aluminum Coated (Type 2), for Corrugated Steel Pipe
M294	Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60- in.) Diameter
ASTM International	
A760/A760M	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
A762/A762M	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
A929/A929M	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
B209/B209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B745/B745M	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
<u>C144</u>	<u>Standard Specification for Aggregate for Masonry Mortar</u>
D698	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12400 ft-lbf/ft <sup>3</sup> (600 kN·m/m <sup>3</sup> ))
D1751	Standard Specification for Preformed Expansion Joint

Filler for Concrete Paving and Structural Construction  
(Nonextruding and Resilient Bituminous Types)

D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

CSA Group

A179 ~~Mortar and Grout for Unit Masonry~~

A257 Standards for Concrete Pipe and Manhole Sections

A3000 Cementitious Materials Compendium

B1800 Thermoplastic Nonpressure Piping Compendium

G401 Corrugated Steel Pipe and Buried Structures~~Products~~

Corrugated Steel Pipe Institute (CSPI)

Technical Bulletin 1 Performance Guideline for Corrugated Steel Pipe Culverts  
(300mm to 3,600mm Diameter)

Technical Bulletin 2 Field Repair of Polymer Laminate Barrier Coating

## PART 2 GENERAL

### 2.1 SUBMITTALS

- .1 Inform Owner at least four (4) weeks prior to commencing work, of proposed source of bedding materials and provide access for sampling.
- .2 Submit manufacturer's test data and certification at least four (4) weeks prior to beginning work.
- .3 Certification to be marked on pipe.

### 2.2 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01015 – Materials & Equipment Delivered to Site and with manufacturer's written instructions.

## 2.3 ENVIRONMENTAL PERMITS AND AUTHORIZATIONS

- .1 Authorization from the Fish and Fish Habitat Protection Program, Fisheries and Oceans Canada, is required for work in or near any watercourse or water body deemed to be viable fish habitat.
- .2 Where required by Fisheries and Oceans, a downstream pool shall be provided at the culvert outlet.
- .4.3 Where the stream is deemed to be viable fish habitat, then in order to assist fish passage during minimum flow periods, the culvert shall be installed such that the bottom of the culvert is at least 300 mm below the natural stream bed. In multiple culvert installations, then to assist fish passage, only one culvert need be installed with the invert at least 300 mm below natural stream bed.

## PART 3 PRODUCTS

### 3.1 PIPE - GENERAL

- .1 Pipe shall consist of aluminized steel pipe type 2 or polymer laminated in accordance with the CSPI Performance Guideline for Corrugated Steel Pipe Culverts (300 mm to 3600 mm diameter), corrugated aluminum, concrete, or corrugated polyethylene pipe of profile type and strength as specified in the unit price table.
- .2 Contractors are advised that consideration will be given to proposals to substitute aluminized steel type 2 pipe with corrugated polyethylene pipe for diameters of up to and including 600 mm. The pipe shall be of the type, strength and size specified in the MERX Schedule of Quantities and Prices.

### 2.23.2 ALUMINIZED OR POLYMER LAMINATED STEEL PIPE

- .1 Aluminized or polymer laminated corrugated steel pipe, couplers, wyes, tees, bends, adapters, nuts, and bolts shall conform to the requirements of the most recent revisions of the following specifications: AASHTO M274, AASHTO M36, ASTM A760/A760M, ASTM A762/A762M, ATSM A929/A929M and CSA G401.
- .4.2 Wall thickness as specified by the Owner in the MERX Schedule of Quantities and Prices, but not less than:

Pipe diameter (mm)	Wall thickness (mm)	Corrugation
100 - 500	1.6	Any
600 - 1200	2.0	Any
1400 - 1800	2.0	<u>125</u> <del>76</del> mm x 25 mm helical corrugation
	<u>3.5</u>	<u>68</u> mm x 13 mm
2000 - 2400	2.8	<del>76 mm x 25 mm helical corrugation</del> <del>125 mm x 25 mm annual corrugation</del>
	<u>4.2</u>	<u>68</u> x 13 mm
<u>2401- 3600</u>	<u>3.5</u>	<u>125</u> x 25 mm

.2.3 Provide water-tight cut-off collars as indicated on the contract drawings.

.3.4 Prefabricated end sections, wing walls as indicated on the contract drawings.

#### 2.3 ALUMINIZED TYPE-2 PIPE

.1 Aluminized corrugated steel pipe, couplers, wyes, tees, bends, adapters, nuts and bolts shall conform to the requirements of the most recent revisions of the CSA G401 specification. Wall thickness as specified by the Owner in the MERX Schedule of Quantities and Prices, but not less than:

Pipe diameter (mm)	Wall thickness (mm)	Corrugation
150-500	1.6	Any
600-1200	2.0	<del>63</del> mm x 13 mm helical
1400-1800	2.0	<del>125</del> mm x 25 mm helical
2000-2400	2.8	<del>125</del> mm x 25 mm helical
2700-3600	3.5	<del>125</del> mm x 25 mm helical

.2 Provide water-tight cut-off collars as indicated on the contract drawings.

.3 Pre-fabricated end sections, wing walls as indicated on the contract drawings.

#### 2.4 POLYMER LAMINATE PIPE

.1 Polymer laminate corrugated steel pipe, couplers, wyes, tees, bends, adapters, nuts, and bolts shall conform to the requirements of the most recent revisions of the CSA G401 specification. Wall thickness as specified

~~by the Owner in the MERX Schedule of Quantities and Prices, but not less than:~~

Pipe diameter (mm)	Wall thickness (mm)	Corrugation
150–500	1.6	Any
600–1200	2.0	63 mm x 13 mm helical
1400–1800	2.0	125 mm x 25 mm helical
2000–2400	2.8	125 mm x 25 mm helical
2700–3600	3.5	125 mm x 25 mm helical

~~.2 Provide water-tight cut-off collars as indicated on the contract drawings.~~

~~.3.5 Pre-fabricated end sections, and wing walls as indicated on the contract drawings.~~

#### 2.53.3 ALUMINUM PIPE

.1 Corrugated Aluminum Pipe and couplers shall be manufactured from coil alloy Alcad 3004-H34 with 7072 cladding and conform with the latest revisions of the following specifications: AASHTO M196~~92~~, ASTM B745/B745M, ASTM B209~~–~~/B209M. Wall thickness as specified by the Owner in the MERX Schedule of Quantities and Prices, but not less than:

Pipe diameter (mm)	Wall thickness (mm)	Corrugation
300–1000	1.91	Any
1200–1800	2.67	76 mm x 25 mm helical
2000–2400	3.43	76 mm x 25 mm helical

.2 Contact pipe manufacturer for recommended wall thickness on pipe diameters larger than 2400 mm.

.3 Provide water-tight cut-off collars as indicated on the contract drawings.

.4 Pre-fabricated end sections, wing walls as indicated on the contract drawings.

.5 Corrugated aluminum pipe shall be acceptable for use in salt water environments.

#### 2.63.4 CONCRETE PIPE MATERIALS

.1 Non-reinforced concrete pipe: CSA A257 for Class II strength.

.2 Reinforced concrete pipe: CSA A257 Class II strength.

.3 Rubber gaskets for joints: CSA A257.

- .4 Bituminous joint filler: ASTM D1751.
- .5 Cement mortar joint filler:
  - .1 Portland cement: CSA A3000.
  - .2 Sand: ASTM C144CSA A179.
  - .3 Mortar to be one part by volume of cement to two parts of clean, sharp sand mixed dry. Add sufficient water after mixing to give optimum consistency for hand application.

#### 2.73.5 **POLYETHYLENE ELASTIC PIPE MATERIALS**

- .1 Couplers, wyes, tees, bends, adapters, and plastic pipe, consisting of corrugated polyethylene pipe, shall be of a type, size and strength acceptable to the Owner and in accordance with AASHTO M252, AASHTO M294, ASTM D3350 and CSA B1800. The Contractor shall provide the plastic pipe and couplers.

#### 3.6 **DEBRIS RACK**

- .1 Debris racks to be constructed in accordance with MI drawing 04070 Debris Rack.

#### 2.83.7 **GRANULAR BEDDING AND BACKFILL**

- .1 Granular bedding and backfill material: in accordance with Section 02333 – Excavating, Trenching and Backfilling.
- .2 Bedding and gravel or sand containing no particles larger than 50 mm and not more than 10 % passing 0.075 mm sieve, unless otherwise specified. Material to be free of snow and frozen lumps. Bedding material shall not be placed on a frozen earth grade.
- .3 Concrete mixes and materials for bedding, cradles, encasement, supports to Section 03300 – Cast-in-Place Concrete.
- .4 Bedding and backfill material for polyethylene pipe shall consist of well graded common material having no more than 10 % passing the 0.075 mm sieve with a maximum particle size not exceeding 40 mm.

#### PART 3PART 4 **EXECUTION**

#### 4.1 **EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe culvert installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of the Owner.
- .2 Inform the Owner of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner.

#### 4.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
  - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, Contract Documents, and site-specific erosion and sedimentation control plan, whichever is more stringent.
  - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
  - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

#### 3.14.3 EXCAVATING AND TRENCHING AND BACKFILL

- .1 Do excavating and trenching and backfill work in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .2 Trench line and depth requires the Owner's approval prior to placing bedding material or pipe.
- .3 Where excavation for foundation is required, the excavation shall be to 150 mm below the proposed invert elevations so that granular bedding material may be placed to provide a bed for the culvert.
- .4 Where unsuitable material is encountered at the proposed pipe invert grade, obtain approval from Owner's Representative to excavate and replace the unsuitable material. Replaced material shall be compacted to a minimum of 95 % maximum dry density in accordance with ASTM D698.
- .5 Excavating and trenching shall be to 150 mm below the proposed invert elevations so that granular bedding material may be placed to provide a uniformly firm bed throughout the length of the culvert.
- .1 Do not backfill until pipe grade and alignment checked and accepted by the Owner.

#### 3.24.4 DEWATERING

.1 The Contractor shall provide, at their own expense, all means of keeping the excavations free from water to complete the bedding and culvert installation in the dry and to which affects the satisfactory placing of the pipe comply with all regulatory agency requirements.

#### 3.34.5 BEDDING

.1 Place minimum thickness of 150 mm of approved granular material on bottom of excavation and compact to minimum of 95 % of corrected maximum dry density, where the maximum dry density is determined in accordance with ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density.

.2 Shape bedding to fit lower segment of pipe exterior so that a width of at least 50 % of pipe diameter is in close contact with bedding and to camber as indicated or directed, free from sags or high points.

.2.3 Place bedding in unfrozen condition.

#### 4.6 LAYING PIPE – GENERAL

.1 Culvert pipes shall be laid to the alignment, length and grade as indicated in the Contract Documents.

.2 When extending an existing culvert, the Contractor shall brush off all soil sticking to that part of the existing pipe that will be lapped.

.3 When laying pipe, should the required culvert length be unobtainable from a combination of pipe lengths available on the site, then the Contractor shall cut a piece of pipe to obtain the required length of culvert. The cut or short section shall be placed on the downstream end.

.4 Pipe cuts shall be made neatly at right angles to the axis of the pipe.

#### 3.44.7 LAYING ALUMINIZED OR POLYMER LAMINATED STEEL PIPE

.1 Commence pipe placing at downstream end.

.2 Ensure bottom of pipe is in contact with shaped bed or compacted fill throughout its length.

.3 Lay pipe with the inside circumferential laps facing downstream and longitudinal laps shall be located in the upper half of the pipe.

.4 Do not allow water to flow through pipes during construction except as permitted by the Owner.

- .5 Riveted or annular pipe shall be laid with the inside circumferential laps pointing in the direction of the flow. The longitudinal laps shall be located in the upper half of the pipe.
- .6 Helical pipe shall be installed such that the helix angle is constant for the total length of the installation and each pipe section shall be installed next to the previous section such that the lock seam forms a continuous helix.

### **3.54.8 JOINING ALUMINIZED OR POLYMER LAMINATED STEEL CULVERTS**

- .1 Match corrugations or indentations of coupler with pipe sections before tightening.
- .2 Corrugated pipe sections shall be jointed together by means of couplers. The couplers shall be installed to lap approximately equal portions of the pipe being connected and such that the corrugations or projections of the coupler properly engage the pipe corrugations.
  - .1 Tap couplers firmly as they are being tightened, to take up slack and ensure a snug fit.
- .3 Insert and tighten bolts.
- .4 When a steel pipe is cut, drilled, or welded, the pipe shall be thoroughly cleaned with a wire brush to remove scale, rust, slag residue, weld splatter, etc., and wiped clean. The cleaned surface shall receive at least one application of metal conditioner to de-oxidize, de-grease and phosphatize the metal surface to be treated if the surface is oily. Pre-mixed, ready-to-apply, liquid-zinc compound shall be applied to the prepared clean dry metal surface in accordance with CSA G401. The cold galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold galvanizing compound should have a minimum 50 mm overlap of the surrounding undamaged aluminized metal and have a minimum dry thickness of 75 µm.
- .5 When applying metal conditioner and cold galvanizing compound near a watercourse or water body, the Contractor shall ensure that the application is carried out carefully to prevent leakage or spillage.
- .6 Any damage to aluminized coatings shall be repaired in accordance with the latest version of CSA G401. Uncoated areas wider than 50 mm shall be replaced with new material or re-dipped in accordance with CSA G401. Any damage to polymer coatings shall be promptly repaired in accordance with CSPI Field Repair of Polymer Laminate Barrier Coating. The damaged area shall receive a zinc rich coating with a minimum dry thickness of 75µm, Denso Butyl Spray Primer and Denso Tape. For coating damage exceeding 50mm in width, the Contractor shall submit an engineered repair plan which ensures a 75 year design life and is

manufacturer approved. The acceptance of the repair procedure shall be at the sole discretion of the Owner. Should the Owner find the repair procedure unacceptable then the damaged pipe culvert will be rejected and shall be replaced with a new, undamaged pipe culvert. All costs associated with preparation of repair procedures and repairing or replacing the damaged pipe culvert shall be borne entirely by the Contractor.

#### 3.64.9 LAYING CONCRETE PIPE CULVERTS

- .1 Begin at downstream end of culvert with flangedfemale end of first pipe section facing upstream.
- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its length.
- .3 Do not allow water to flow through pipes during construction except as permitted by the Owner.

#### 3.74.10 JOINING CONCRETE PIPE CULVERTS

- .1 Joints may be made with rubber gaskets, Concrete Pipe bituminous jointing compound, or Portland cement mortar where a specific joint type is not otherwise specified.
  - .1 Rubber gasket joints:
    - .1 Install to manufacturers recommendations.
    - .2 Ensure that taperedmale ends are fully entered into flangedfemale ends.
  - .2 Bituminous filled joint.
    - .1 Make joint with an excess of filler to form a continuous bead around outside of pipe and finish smooth on inside.
- .2 Mortar joints.
  - .1 Prepare mortar as specified herein.
  - .2 Clean pipe ends and wet with water before joint is made.
  - .3 Place mortar in lower half of flangedfemale end of pipe section in place.
  - .4 Apply mortar to upper half of taperedmale end of pipe section being installed.
  - .5 Join pipe ends and force joint up tight, taking care to ensure inner surfaces of abutting pipe sections are flush and even.
  - .6 Clean inside of pipe and annular space between ends of pipes after each joint is made.
  - .7 Fill joint with mortar and finish smooth and even.

- .8 For pipes 800 mm or less in diameter fill joints before mortar in joints has set.
- .9 For pipes over 800 mm in diameter postpone filling joint until backfilling has been completed. Re-clean joints before applying mortar.

3.84.11 LAYING CORRUGATED POLYETHYLENE PLASTIC PIPE CULVERTS

- .1 Commence pipe placing at downstream end.
- .2 Install pipe in trench by lowering.
- .3 Ensure bottom of pipe is in contact with shaped bedding or compacted fill throughout its length.
- .4.4 Do not allow water to flow through pipes during construction except as permitted by the Owner.
- .2.5 Plastic pipe shall be laid on a bed of 150 mm granular bedding material. Where excavation for foundation is required, the excavation shall be to 150 mm below the proposed invert elevations so that granular bedding material may be placed to provide a bed for the culvert. The granular bedding material shall be placed and shaped to conform to the underside of the culvert, and graded so as to provide a uniformly firm bed throughout the length of the culvert.
- .6 The cover shall not be less than the manufacturer's recommended minimum cover.
- .3.7 Helical corrugated pipe shall be installed such that the helix angle is constant for the total length of the installation and each pipe section shall be installed next to the previous section such that the lock seam forms a continuous helix.

3.94.12 JOINING PLASTIC PIPE CULVERTS

- .1 Install couplings in accordance with manufacturer's instructions. Plastic pipe culverts shall be joined with couplers recommended by the manufacturer of the pipe being installed.

4.13 CCTV AND CAMERA INSPECTION OF PIPELINES

- .1 Complete in accordance with Section 02300 – CCTV and Camera Inspection.

3.104.14 BACKFILLING

- .1 Do not backfill until pipe grade and alignment checked and accepted by the Owner.
- .2 Any pipe which is not in the alignment and to the grade required by the Owner's Representative after laying shall be taken and re-laid at the Contractor's expense.
- .3 Backfill around and over culverts as indicated or as directed.
- .4 Place approved backfill material in 150 mm layers to full width, alternately on each side of culvert, so as not to displace it.
- .5 Compact each layer to a minimum of 95 % of corrected maximum dry density, where the maximum dry density is determined in accordance with ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density, in accordance with ASTM D698, taking special care to obtain required density under haunches.
- .6 Protect installed culvert with minimum 600 mm cover of compacted fill before heavy equipment is permitted to cross.
- .7 During construction, of project, width of fill, at its top, to be at least twice the diameter or span of pipe and with slopes not steeper than 1:2.
- .8 For aluminized or polymer laminated corrugated steel pipe of diameter 2400 mm or less, the minimum required cover to subgrade is 300 mm.
- .9 For aluminized or polymer laminated corrugated steel pipe of diameter between 2400 mm and 3600 mm, the minimum required cover is 500 mm.
- .10 For driveway culverts minimum cover shall be as directed by the Owner.
- .11 Frozen materials are not acceptable as backfill or cover material.
- .12 Strutting will be required for corrugated steel pipe culverts of diameter or span greater than 1500 mm to ensure that the original shape is retained after completion of backfilling operations. The Contractor shall provide the necessary timber.
- .13 Strutting shall be placed to the satisfaction of the Owner's Representative. Struts shall be placed such that they bear onto longitudinally placed members. Under no circumstances shall struts be placed so that they bear directly onto the walls of the pipe.
- .14 Struts shall be left in place until ordered removed by the Owner's Representative at the completion of backfilling operations.
- .15 Should concrete headwall be installed, then backfilling against the headwalls shall not commence until the concrete has been cured to the specified design strength at 28 days. Should the Contractor wish to

commence backfilling before 28 days after pouring, then the Contractor will be required to prove that the 28 days specified design strength has been obtained before permission to commence backfilling will be granted.

### 3.114.15 PROTECTION FROM TRAFFIC

- .1 Prior to allowing the movement of construction equipment or any vehicular traffic over the completed structure, the depth of backfill over the culvert shall be at least equal to the minimum required for protection as specified in the contract.

### PART 4 PART 5 PAYMENT

#### 4.15.1 MEASUREMENT FOR PAYMENT

- .1 Supply and installation of pipe culvert including couplings and fittings, will be measured in metres in place for each size, thickness and class of pipe. Measurement to be made over surface after work has been completed.
- .2 Measurement for payment for water tight cut-off collars, prefabricated end sections, and debris racks where indicated on the contract drawings, shall be paid by the each.
- .3 Cast in place concrete headwalls shall be measured and paid by the cubic meter.

#### 4.25.2 BASIS OF PAYMENT

- .1 All costs associated with the work outlined in this specification shall be deemed to be included in the appropriate unit and lump sum prices quoted as outlined in the Measurement for Payment subsection of this section and as included in the MERX Schedule of Quantities and Prices.
- .2 Excavating and, trenching, backfill and bedding for road and driveway culverts will be measured and paid in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .3 Where Rip-rap is required for driveway culverts, measurement for payment shall be made in accordance with Section 02270 – Rip-Rap Protection.
- .4 Handrails shall be measured and paid in accordance with Section 02284 - Handrail.

Not For Construction