

INDEX FOR  
SPECIFICATIONS FOR JACKING CULVERTS THROUGH EMBANKMENTS

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SPECIFICATIONS FOR JACKING CULVERTS THROUGH EMBANKMENTS

## 410. 1 SCOPE

These specifications govern all operations necessary for and pertaining to the supply and installation of round precast concrete pipe culverts and corrugated steel pipe culverts through embankments by a combination of open trench excavation, and tunneling and jacking.

## 410. 2 DEFINITIONS

The following definitions will apply:

## 2.1 Tunneling and Jacking

Tunneling and Jacking means the culvert installation procedure whereby a culvert is advanced through an embankment by means of jacks while simultaneously excavating from inside the culvert an opening for the culvert to pass through.

## 2.2 Tunneling

Tunneling means the excavation of a passageway through an embankment without disturbing the embankment material and roadway above, by means of:

- (a) A tunneling machine;
- (b) A boring machine; or
- (c) A hand excavation.

## 2.3 Jacking

Jacking means the advancement of a culvert into the tunnel by:

- (a) Applying a pushing force to the tail end of the culvert using jacks; or
- (b) Applying a pulling force to the tail end of the culvert from an exterior source located at the destination end of the installation.

## 410. 3 MATERIALS

## 3.1 General

The Contractor shall be responsible for the supply of all materials designated in this Specification.

## 410. 3.2 Precast Concrete Culverts

Precast concrete culverts, related materials and components shall conform to the requirements of the Department's Specifications for the Supply and Delivery of Precast Concrete Culvert, No. 1290, and to the requirements of this Specification.

The size and class of culverts to be supplied shall be as specified on the Plans or in the Special Provisions. The Department will allow the Contractor to jack a larger than design diameter culvert provided that there is adequate cover (minimum of one metre unless otherwise approved) and the trenched sections are constructed to design diameter and design invert elevations (by the use of approved reducers). Grout will not be permitted as a means of achieving the design invert elevation.

Reducer rings shall fit both sections of the culvert with respect to inside and outside diameter and spigot and bell dimensions. Reducers shall be used in such a manner that the design elevation shall be maintained throughout the larger diameter culvert (the invert elevation shall be maintained throughout the entire length of the pipe installation). The Contractor shall trial fit the reducers at the manufacturer's site prior to shipping to ensure compatibility and proper seal. All reducers shall be approved by the Engineer before being placed and may be rejected at the project site if they do not meet these standards. The Engineer may adjust the culvert lengths to correspond with the increased diameter.

All additional costs incurred to install larger culverts than specified in the tender shall be at the Contractor's expense.

All culverts to be installed by tunneling and jacking shall be a minimum Class II jacking quality and shall have tongue and groove joints. Concrete pipes shall not be hauled or installed until 5 days after their fabrication date.

All joints shall be rubber-gasketed and be capable of providing a watertight seal. All culvert ends shall be smooth and concentric to properly receive the rubber gasket. Joint assembly shall be made in accordance with the manufacturer's specifications.

All joints subjected to jacking pressure shall be fitted with a suitable cushion to prevent point loading of the joint.

### 3.3 Corrugated Steel Culverts

Corrugated steel culverts, related materials and components shall conform to the requirements of the Department's Specifications for the Supply and Delivery of Corrugated Steel Culverts, No. 1285, and to the requirements of this Specification.

The diameter, corrugation depth, wall thickness and finish of the culverts to be supplied shall be as specified on the Plans or in the Special Provisions.

Corrugated steel culverts shall be riveted or helical pipe culverts. Individual culvert sections shall be connected by couplers. Couplers shall be supplied and installed in accordance with the manufacturer's specifications.

All corrugated steel culverts to be installed by tunneling and jacking shall be of a quality suitable for jacking and of such strength as required to withstand all loads applied to them during the installation procedure without being damaged. Reinforcing bands shall be supplied and installed by the Contractor at the ends of culvert sections receiving direct load. Reinforcing bands and their installation shall conform to the culvert manufacturer's specifications.

### 3.4 Culverts in Open Trench Excavations

At the Contractor's option, the culvert sections to be installed in the open trench excavations at both ends of the culvert installation beyond the shoulders, may be either jacking quality or standard quality.

The joint between the jacking quality and standard quality culvert sections shall be compatible.

### 3.5 Flowable Fill and Grout

#### 3.5.1 Flowable Fill

Flowable fill used for filling the voids between the face of the excavation and the culvert shall contain a combination of cementitious material (cement and/or fly ash), fine aggregate (sand), water and admixtures. The mixture shall be capable of filling all voids in irregular excavations, self-leveling and shall harden without the need for compaction.

The cement shall be Portland Cement (Type 10 Normal or Type 50 Sulphate Resistant). The fly ash shall meet the requirements of Class F or Class C (CSA A23.5), and shall come from an approved source.

The fine aggregate shall be natural sand consisting of mineral aggregate particles. The gradation of the fine aggregate shall be as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
4.75 mm	100 %
75 µm	0 - 3 %

The sand shall not segregate in the mix and shall stay in suspension while providing proper flow.

The Contractor shall submit a mix design for the flowable fill mix to the Department one week prior to placement, along with technical data of all admixtures, and acceptable past performance of the mix. At the Contractor's option, the fill may also contain plasticizing admixtures (meeting type 1 ASTM C1017) that produce flow without further addition of water and does not retard setting.

The slurry mixture shall contain only enough water to permit the mixture to be pumped into the culvert.

The flowable fill shall meet the following requirements:

Flowable Fill	Specification Requirement
Material Requirement	
Fine Aggregate (Sand)	4.75 mm minus – Mineral aggregate
Cementitious Content	Portland Cement – Min 25% by weight of total cementitious material. Fly Ash – Class C or F.

Mix Requirement	
Slump	200 – 300 mm
Water/Cement Ratio	1.5 Maximum
Air Content	15 – 25%
Compressive Strength	0.8 – 2 MPa at 28 days
Unit Weight	1500 – 2500 kg/m <sup>3</sup>
Admixtures	As required
Water, Potable	As required

3.5.2 Bentonite Grout

Bentonite grout used for pipe lubrication purposes or for filling the voids between the face of the excavation and the culvert shall be a high-solids low permeability approved by the Engineer.

410. 5 CONSTRUCTION METHODS

5.1 Open Trench Excavation and Backfill

Open trench excavation will be allowed no closer than two metres from the outside edge of shoulder or to other such limits as indicated on the Plans or in the Special Provisions.

Culverts in the embankment side slopes shall be installed in trenches in accordance with the Department's Specifications for Removing Culverts and Placing Culverts, No. 400.

Notwithstanding Specification No. 400, Culvert Gravel will not be paid for directly but will be considered incidental to jacking.

## 5.2 Tunnel Excavation

The tunnel shall closely fit the outside shape of the culvert and allow no more than 25 mm spacing between the pipe and the tunnel at any point.

The length of tunnel excavation preceding the culvert shall be kept to a minimum and at no time exceed one metre.

## 5.3 Adverse Soil Conditions and Obstructions

In the event that there is any substantial change in the character or nature of the subsurface soil conditions or that obstructions are encountered during tunneling operations, which adversely affect the Contractor's production or construction procedure, the Contractor shall immediately notify the Engineer.

The notice shall provide details of the change in subsurface soil conditions or obstruction encountered, any proposed construction procedure revision that the Contractor intends to undertake, as well as any other pertinent and related information.

The Engineer will review the information provided as well as other data and information as appropriate to assess any requirements for change to the Contract work. Any extra work resulting from change to the Contract work will be addressed in accordance with the General Conditions.

Where the rate of production is affected due to encountering an obstruction during tunnelling operations, compensation will be paid for at the unit price per hour for "Delay Time for Obstruction Removal".

## 5.4 Delay Time for Obstruction Removal

The cumulative first two hours of handling obstructions for each individual culvert will be at the expense of the Contractor. Additional time accumulated after the second hour will be compensated using the bid rate per hour for Delay Time with the following exceptions:

- Delay time will only be considered during the excavation phase of the jacking process.
- Frost conditions will not be considered for Delay Time.

Each individual culvert installation will be dealt with separately for the purpose of paying compensation for handling obstructions.

## 5.5 Disposal of Excavated Material

Suitable material obtained from trench excavation or tunneling shall be used for the backfill placed from the top of the culvert to the finished grade line of the embankment side slopes.

Unless otherwise indicated on the Plans or in the Special Provisions, surplus excavated material shall be spread uniformly over the slopes adjacent to the ends of the culvert.

## 5.6 Filling Existing Culverts

When specified in the Special Provisions, the Contractor shall backfill existing culverts. Prior to filling the existing culverts, the Contractor shall cut and/or remove the portion of culvert extending beyond the shoulder line of the grade. The portions of pipe removed shall be disposed of in accordance with Specification No. 400 "Removing Culverts and Placing Culverts". The remaining lengths of culvert shall be completely backfilled with a flowable fill material (see 410.3.5.1). If unsuccessful on the first attempt, the Contractor shall make a second attempt to completely fill the culvert. The second fill shall be done the following day to allow the first fill placement time to set.

The open excavation at the ends of the existing culvert shall be backfilled with suitable material and compacted to conform to the existing grade slope.

#### 5.7 Assembly and Placement of Corrugated Steel Culverts

Riveted pipe culverts shall be placed so that horizontal seams are located in the upper half of the culvert with inside circumferential laps pointing in the direction of flow.

#### 5.8 Filling of Voids

The Contractor shall fill any identified voids between the tunnel wall and the exterior surface of the culvert at the completion of tunneling and jacking operations with a flowable fill material or Bentonite grout.

Voids formed by the removal of obstructions shall be filled at the discretion of the Engineer and paid for as Extra Work.

Following completion of grouting operations, the Contractor shall fill the grout holes in the culvert walls as required with a stiff mortar made with Type 50 cement and trowel the interior culvert wall surface smooth.

### 410. 6 QUALITY CONTROL

#### 6.2 Lines, Levels and Grades

The Engineer will provide one bench mark and two alignment reference points.

The Contractor shall construct the culvert to the line and grade as shown on the Plans or in the Special Provisions.

#### 6.3 Tolerances

The finished culvert shall not deviate from grade by more than 50 mm, nor from alignment by more than 150 mm.

The return to established line and grade shall be at a rate not exceeding 50 mm per 10 metres.

#### 6.4 Final Inspection and Cleanup

After the culvert installation has been completed, the Contractor shall remove all utility lines, tracks, jacking equipment and any other temporary construction materials and debris from the culvert.

The Contractor shall leave the culvert in a clean and reasonably dry condition suitable for final inspection by the Engineer and shall make good any defective work to the satisfaction of the Engineer.

### 410. 9 METHOD OF MEASUREMENT

The length of culvert installed will be determined by linear measurement along its invert.

Metal and concrete culverts will be measured to the nearest tenth of a metre.

Delay Time for Obstruction Removal will be measured in hours from the time the obstruction is identified to the time the obstruction is removed.

410. 11 BASIS OF PAYMENT

11.1 Jacking Precast Concrete and Corrugated Steel Culverts

The unit bid price per metre for “Jacking Precast Concrete Culverts” or “Jacking Corrugated Steel Culverts” will be payment in full for supplying the culverts and for providing all labour and equipment necessary to install any combination of open trench and tunnelled culverts for a size and length as described in the Tender, for supplying culvert beds, filling localized voids and for performing all work necessary and incidental to complete the installation as described herein.

The work involved in removing unsuitable material from below the grade line of the open trench will be paid for as “Extra Work”.

11.2 Delay Time for Obstruction Removal

The unit price per hour for “Delay Time for Obstruction Removal” will be payment in full for equipment, operators, supervision, wages, meals, accommodations, fuel, lubricants, repairs, equipment service vehicles, and performing all operations necessary or incidental thereto. Materials used for blasting operations will be paid for on the basis of “Extra Work”.

11.3 Filling Existing Culverts

The lump sum price for “Filling Existing Culverts” will be payment in full for removing and salvaging the culvert ends, for supplying and placing culvert fill, for all work necessary to fill the existing culverts, for supplying extra material needed to backfill and for backfilling the excavated area.