600 INCIDENTALS

ITEM 603 - PIPE CULVERTS AND DRIVEWAY PIPES

603.01 Description. This work shall consist of the construction or reconstruction of pipe culverts, box, arched or 3 sided culverts and driveway pipes. This work shall include: Excavating for pipes and foundations for same, including clearing and grubbing and the removal of all materials necessary for placing the pipe except removals listed separately; furnishing and placing granular or concrete bedding and granular backfill as required; constructing and subsequently removing all necessary cofferdams, cribs and sheeting; pumping and dewatering; sealing or banding all pipe joints where required; furnishing and installing all necessary pipe bends and branches of a type at least equal to the conduit of which they become a part; joining to existing and proposed appurtenances as required; *providing erosion control*, and restoration of disturbed facilities and surfaces.

603.02 Materials. Pipe shall be of the size and kind specified in the proposal or as shown on the plans and meet the requirements of the pertinent Sections of 706 and 707. When the kind of pipe is not specifically itemized in the proposal or shown on the plans, any of the following types may be used.

Specific materials shall be as follows:

Concrete for bedding, (Class E) 499, 511
Granular material for bedding backfilling.....703
Cement for mortar.....701
Sand for mortar.....703.03
Bituminous pipe joint filler.....706.10
Joint wrap.....ASTM C-877
Rubber gaskets.....706.11
Resilient joints.....706.12
Non-reinforced concrete pipe.....706.01
Reinforced concrete pipe.....706.02
Reinforced elliptical concrete pipe.....706.04
Corrugated steel pipe and pipe arches ..... 707.01 or 707.02
Structural corrugated steel pipe (over 72 inches (1.8 m))
and pipe arches.....707.03
Bituminous coated corrugated steel pipe (72 inches (1.8 m)
and under) and pipe arches..... 707.05 or 707.07
Precast box sections.....706.05
Concrete for box and 3 sided sections 511

The Contractor may furnish higher strength concrete or plastic pipe of the same type where lower strength pipe is specified at no additional cost to the City.

603.03 Excavation. Excavation shall be in accordance with Sections 901.03, 901.04, 901.05, 901.06, 901.07, 901.08, 901.09 and 901.10. Excavation for box, arched, or 3 sided culverts (over 72 inch (1.8 m) clear span) shall be as follows: Where the culvert is to be placed in a trench, a minimum trench width of 2 feet (0.6 m) from the outside of the culvert shall be required. Where the culvert is to be placed within embankment, the embankment shall be constructed at least to the springline before *excavation*.

603.04 Bedding. Bedding shall be in accordance with Section 901.11, unless otherwise shown on the plans. Bedding for box or 3 sided culverts shall be as follows: The bedding shall consist of a bed of granular material having a thickness of at least 6 inches (152 mm) below the bottom of the box section and extending 2 feet (0.6 m) on each side of the box section. If the box is on a rock, slate or similar surface *the Engineer can waive* this requirement, *and direct the placement* of sufficient granular material to provide a uniform smooth bearing surface for the culvert.

603.05 Laying Conduit. The conduit shall be laid in accordance with 901.12.

603.06 Joining Conduit. The method of joining conduit shall be in accordance with 901.15. The joining of box, arched, or 3 sided culverts shall be as follows:

The exterior joint shall be filled with a minimum of a 9 inch (228 mm) wide joint wrap. The surface shall be free from dirt and foreign substances before applying the joint wrap. External wraps shall be in accordance with ASTM C-877 or be an approved alternative. One continuous roll of joint wrap shall cover the joint on the top of the culvert and extend completely down the sides to the bottom. Care shall be exercised during backfilling to keep the joint wrap in the proper location over the joint. The joint wrap shall be applied to all joint sections. The upstream end shall be a recessed type joint.

For all culverts both sides of the joint shall be primed with an asphalt based or other primer recommended by the manufacturer of the joint material and approved by the engineer.

603.07 Shop Strutting. Where required by the plans, a round flexible pipe shall be elongated by increasing its vertical diameter 5 percent. Where required by the plans the vertical elongation shall be maintained by horizontal wire struts that shall be left in place until the embankment is completed. These struts shall then be removed as directed by the Engineer.

603.08 Backfilling. Backfilling shall be in accordance with Section 901.17. The backfilling of box, arched, or 3 sided culverts shall be as follows: When the top of the trench is above the top of the culvert, backfilling shall be in accordance with Section *901.17*. When the top of the culvert section is above the top of the trench, granular material shall be placed and compacted to a minimum depth of 2 feet (0.6 m) over the top of the culvert sections (where applicable) and for a width of 4 feet (1.2 m) on each side of the box section or as directed by the engineer. The remainder of the adjacent embankment material shall be furnished, placed and paid for in accordance with Item 203. Backfill and fill material shall be placed uniformly on both sides of the culvert section.

Fill material at the sides of the culvert sections may be compacted by heavy compaction equipment.

603.09 Clearing Site and Restoring Damaged Surfaces. The clearing and restoring of surfaces shall be in accordance with Section 901.18.

603.10 Reconstructing Conduits. Where so required by the plans, existing pipe salvaged under Item 202 shall be used in constructing conduits of the types and at the locations specified. All of the provisions of these specifications shall govern the reconstruction of conduits with the same materials and by the same methods as the construction of new conduits, except for the furnishing of new pipe.

603.11 Waterproofing of Concrete Culverts Produced Under Section 706.05 "Precast Reinforced Concrete Box Sections", Arched and 3-sided Sections.

General.

Description: This work shall consist of furnishing the necessary labor, materials, tools and equipment to prepare the surface and place a membrane waterproofing. All cost associated with this work will be included in the contract unit price for the respective item.

Manufacture's Representative: The manufacture's technical representative shall be notified in order to provide the Engineer with the recommended procedures and shall be present during initial installation unless presence is waived by the Engineer. Operations and procedures which are considered by the Engineer or Manufacturer's representative as being detrimental to the integrity of the item will not be permitted.

Sheet Type 2 Membrane Waterproofing.

Description: A membrane waterproofing shall be placed on the top and sides of segmental, precast concrete three and four sided culverts. This work shall consist of furnishing all necessary labor, materials, tools, equipment and incidentals to prepare the surface and place a membrane waterproofing.

Materials: the materials shall be:

Primer:	Not needed on horizontal surfaces above 50°F (10°C). Latex emulsion as recommended by manufacturer for vertical surfaces or below 50°F (10°C).
Membrane:	Materials shall meet the following physical properties:

Thickness (Mils):	60 Mils minimum
Pliability (180 bend over 1/4 inch (6.4 mm) mandrel at 25°F (-4°C)) ASTM D146:	No effect
Tensile Strength-membrane (PSI) ASTM D412:	250 minimum
Tensile Strength-film (PSI) ASTM D412 (Die C) Modified:	4000 minimum
Elongation-Ultimate failure of Rubberized Asphalt (%) ASTM D412:	300% minimum

Cycling over crack at minus 15°F (-26°C) 100 cycles: No effect

Puncture Resistance-Membrane (lb.) (Stretched by blunt object) ASTM E154:	40 minimum
Puncture Resistance-film (in. ounce tear) ASTM D781:	150 minimum
Permeance-Perms (Grains/sq. ft./hr./in. HG) ASTM E96 Method B:	0.1 maximum
Water Absorption (% by Weight) ASTM D570:	0.2 maximum
Adhesion to Concrete - ASTM D903:	5.0 minimum
Resistance to hydrostatic head (feet of water):	150 minimum

Surface Preparation: Prior to placing the membrane, the surface to be waterproofed shall be clean, dry and free of protrusions. All dirt and dust shall be swept off and the surface air blown clean. All joints or cracks greater than 3/8 inch (9.5 mm) wide shall be filled with Portland cement mortar.

Application Procedure: Remove release liner and place adhesive side on surface. Material shall be laid smooth and free of wrinkles. Each subsequent roll shall be lapped 1 inch (25 mm) onto the previous roll. It should be noted that this material has been formulated as a very aggressive adhesive and is very difficult to re-position once it comes in contact with a surface.

Storage: Material shall be stored indoors at temperatures not to exceed 120^{o}F (49^{o}C).

Sheet Type 3 Membrane Waterproofing.

Description: A membrane waterproofing shall be placed on the top and sides of segmental, precast concrete three and four sided culverts. This work shall consist of furnishing all necessary labor, materials, tools, equipment and incidentals to prepare the surface and place a membrane waterproofing. The waterproofing membrane shall be furnished in 36 inch (0.9 m) minimum width rolls and shall be a high density asphalt mastic sandwiched between two layers of polymeric fabric.

Materials shall be:

Primer Sealant: ASTM D3405, ASTM D1190

Membrane: Materials shall meet the following physical properties:

Physical Properties:		
Density	80 lbs/ft^3 (1282 kg/m^3)	ASTM E 12-170
Weight	0.9 lb/ft^3 (4.4 kg/m^3)	
Caliper (retain 95% caliper after loading)	0.135 inches (3.4 mm)	ASTM D1777
Absorption	1% maximum	ASTM D517
Brittleness	Pass	ASTM D517
Specific Gravity (Mastic Compound)	1.67 minimum	ASTM D70-52
Weight/Gallon (Mastic Compound)	14.0 minimum	ASTM D70-52
Softening Point (Mastic)	200°F (93°C) min.	ASTM-36
Cold Flex 2" x 5" (50 - 127 mm) Specimen 180 deg. bend on 2" (50 mm) Mandrel-0 F		ASTM-D146
Heat Stability 2" x 5" (50 - 127 mm) Specimen Hung Vertically in a No Dripping or Mechanical Convention Delamination Oven - 2 hours - 190°F (88°C)		
Polymer Reinforcement: Cycles to Break (Single Fiber)	2,100,000 plus	
Flammability (Self-Extinguishing, no burn rate when tested in accordance with		

Federal Dept. of Transportation Specification 302)		
Percent Elongation	100%	*ASTM-D882*
Tensile Strength	1000 lbs/in^2 (6897 KPa)	*ASTM-D882*
Width	36 inches (0.9 m) minimum	

Surface Preparation: Prior to placing the membrane, the surface to be waterproofed shall be clean, dry and free of protrusions. All dirt and dust shall be swept off the surface and air blown clean. All joints or cracks greater than 3/8 inch (9.5 mm) wide shall be filled with Portland cement mortar. Any oil or grease deposits shall be removed using water and a detergent designed for removing oil deposits from concrete surfaces together with power or broom scrubbing. The residue and detergent shall be thoroughly flushed from the surface. Traffic shall not be permitted on the cleaned surface prior to application of primer/sealant and the membrane.

Application Procedure: The surfaces to be waterproofed shall be dry and free of dust and loose particles and the ambient surface and material temperatures shall not be less than 40^{o}F (4^{o}C) during application. The structures shall be waterproofed for the low to high side. On culverts with curbs or parapets, the sealant and the membrane shall be placed 3 inches (76 mm) up the curb or parapet face.

A uniform coating of sealant shall be applied at a rate of 1/2 gallon (1.9 L) per square yard. Sealant shall be applied over a small area of surface no further than 5 feet (1.5 m) in front of the membrane. An extra bead of sealant shall be applied at the edge of membrane to develop seal. Membrane shall be over-lapped 3 inches (76 mm) when putting down an adjoining roll. After entire surface is covered, all exposed lap edges shall be sealed with sealant and smoothed with a V squeegee.

On prestressed box beam bridges that have no approach slabs, membrane shall extend over end of beams to 6 inches (152 mm) below bridge seat. On prestressed box beams that have approach slabs, membrane shall extend out onto the approach slabs 2 feet (0.6 m).

The vertical sides of all three and four sided culverts shall first be waterproofed with Sheet Type 2 material. Sheet Type 3 material shall be applied to the top surface and extend down the sides 12 inches (305 mm) minimum (lapping over the Sheet Type 2 material).

Traffic may be allowed to operate directly on the completed membrane, with the Engineer's approval. If approved, any damage that occurs to the membrane shall be repaired at the Contractor's expense before the asphalt concrete overlay is placed.

Sealant Heating: An oil heated double-jacketed kettle shall be used for heating the sealant. The kettle shall be essentially free from other materials. While it is not necessary that the kettle be cleaned down to bare metal, any obvious buildup should be scraped out. A single jacket kettle may be used if using a sealant which has the capability of being melted and heated to application temperatures in direct fire or heated single walled melting kettles and straying within the limit of the manufacturer's recommendation.

Sealant shall be heated to a temperature between the recommended pour temperature of 380°F (193°C) and the maximum safe heating temperature of 410°F (210°C).

Storage of Material: All membrane and sealant materials shall be kept dry before installation.

603.12 Waterproofing Structural Plate Culverts (over 72-inch (1.8 m) clear span). The exterior top half of the culvert shall be waterproofed within the limits of the embankment. The waterproofing material shall be as follows:

5X Asphalt Mastic as manufactured by:
Trumbull Asphalt Company
59th and Archer Road
Summit, Illinois 60501

or

Thio-Deck Membrane SP manufactured by:
Toch Building Products Division
350 Hanley Industrial Court
St. Louis, Missouri 63144

or other as approved by the Director or owner division.

The cost of the waterproofing and application shall be included in the unit price bid for the Item 603 Conduit.

603.13 Shop Drawings. Shop drawings shall be required for all box, arched, or 3 sided culverts. The shop drawings shall conform to the requirements of Section 501.04 of the CMSC.

603.14 Method of Measurement. The length of conduit to be paid for will be the actual number of linear feet (meters) measured between open ends inclusive of lengths of pipe bends and branches. Conduits with beveled or skewed ends will be measured along the invert. Where the location of an appurtenance or open end is changed with the approval of the

Engineer to accommodate full conduit sections, the length will be measured to the plan location or changed to the location, whichever results in less cost to the city. No deduction will be made for catch basins, inlets or manholes that are 5 linear feet (1.5 m) or less across, measured in the direction of flow.

603.15 Basis of Payment. The accepted quantities of conduit of the sizes and types specified will be paid for at the contract unit prices per linear foot (meter), complete in place.

Payment will be made at the contract price for:

Item	Unit	Description
603	Linear Foot (Meter)	_____" (mm) Conduit, with Type _____ Bedding
603	Linear Foot (Meter)	_____" (mm) x _____" (mm) Conduit, with Type _____ Bedding
603	Linear Foot (Meter)	Span' x Rise' Conduit Precast Reinforced Concrete Box Sections (706.05) C-____ Table _____ (Design Earth Cover _____ ft. (m))
603	Linear Foot (Meter)	Span' x Rise' Conduit Precast Reinforced Concrete 3 Sided Arch, Flat Top or Box Sections (Design Earth Cover _____ ft. (m))