

**DELAWARE COUNTY
DELAWARE COUNTY ENGINEER'S OFFICE**

**SUPPLEMENTAL SPECIFICATION 1203
CONDUIT AND DRAINAGE STRUCTURES**

FEBRUARY 11, 2016

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1203.01 Conduit Description. This work consists of constructing or reconstructing long span structures, pipe culverts, sewers, and drains (referred to below as Type A, Type B, Type C, Type D, Type E, and Type F conduits formerly referred to as 603) per the Ohio Department of Transportation (ODOT) Construction and Material Specifications (CMS), 2010 Edition. Unless otherwise noted, any references not designated as 1203 contained within this specification are made to the ODOT CMS. ODOT CMS edition shall be as specified on the project plans, or the current edition if none is specified.

Use removed or excavated materials in the Work when the material conforms to the specifications; if not, then recycle or dispose of the material according to 105.16 and 105.17.

- 1203.02 Conduit Materials.** Furnish materials conforming to:
- Soil and granular embankment 203.02.R
 - Structural backfill, Types 1 and 2 703.11

The Engineer will allow Type 3 structural backfill, conforming to 703.11, to be used as bedding below the pipe only when pumping operations do not control severe ground water problems. Place at least 12 inches (300 mm) of Type 1 structural backfill on top of the Type 3 structural backfill to prevent piping.

Embankment.....	203.02.R
Concrete for collars and encasement, Class C	499 and 511
Concrete for field paving using aggregate No. 7, 8, or 78, Class C	499 and 511
Reinforcing steel (collars and encasement)	509.02
Mortar	602
Non-shrink mortar	705.22
Bituminous pipe joint filler	706.10
Resilient and flexible gasket joints for:	
Concrete sewer and culvert	706.11
Vitrified clay, B & S	706.12
Preformed butyl rubber joint filler	706.14
4x4 - W1.4 x W1.4 galvanized welded wire fabric for field paving	709.08
Type 2 membrane waterproofing	711.25
Type 3 membrane waterproofing	711.29
Fabric wrap, Type	712.09
Joint wrap	ASTM C 877, Type III
Buried Liner Waterproofing Membrane .	711.22

Furnish pipe of the size and kind specified in the Proposal and conforming to applicable subsections of 706 and 707. The metric equivalent pipe size may vary with material type for the same English size pipe. The difference in sizes shall not be construed as an exclusion of a material type. The kinds of pipe allowed for each of the designated types of conduit are as follows:

Type A Conduits – Culverts:

30-inch and smaller:

Reinforced concrete pipe	706.02
Reinforced concrete pipe, epoxy coated	706.03
Reinforced concrete elliptical pipe	706.04
Corrugated aluminum alloy pipe	707.21 or 707.22
Polypropylene corrugated double wall pipe	707.65

30-inch and larger:

Reinforced concrete pipe	706.02
Reinforced concrete pipe, epoxy coated	706.03
Reinforced concrete elliptical pipe	706.04
Bituminous coated corrugated steel pipe and pipe arches with paved invert	707.05 or 707.07
Corrugated aluminum alloy pipe	707.21 or 707.22
Aluminum alloy structure plate conduits	707.23
Polypropylene corrugated triple wall pipe	707.69

Type B Conduits – Storm or sanitary sewers under pavement:

30-inch and smaller:

Reinforced concrete pipe 706.02
Reinforced concrete elliptical pipe 706.04
Polypropylene corrugated double wall pipe 707.65
Ductile iron pipe (sanitary) 748.01
Polyvinyl chloride pipe (sanitary) 748.02

30-inch and larger:

Reinforced concrete pipe 706.02
Reinforced concrete elliptical pipe 706.04
Corrugated aluminum spiral rib pipe 707.24
Polypropylene corrugated triple wall pipe 707.69
Ductile iron pipe (sanitary) 748.01
Polyvinyl chloride pipe (sanitary) 748.02

Type C Conduits – Storm or sanitary sewers not under pavement:

30-inch and smaller:

Reinforced concrete pipe 706.02
Reinforced concrete elliptical pipe 706.04
Corrugated polyethylene smooth lined pipe 707.33
Polyvinyl chloride plastic pipe
(non-perforated) 707.41
Polyvinyl chloride corrugated smooth
interior pipe 707.42
Polyvinyl chloride profile wall pipe 707.43
Polyvinyl chloride sanitary pipe 707.44
Polyvinyl chloride solid wall pipe 707.45
Polypropylene corrugated double wall pipe 707.65
Ductile iron pipe (sanitary) 748.01
Polyvinyl chloride pipe (sanitary) 748.02

30-inch and larger:

Reinforced concrete pipe 706.02
Reinforced concrete elliptical pipe 706.04
Polyvinyl chloride corrugated smooth
interior pipe 707.42
Polyvinyl chloride profile wall pipe 707.43
Polypropylene corrugated triple wall pipe 707.69
Ductile iron pipe (sanitary) 748.01
Polyvinyl chloride pipe (sanitary) 748.02

Type D Conduits – Drive pipes and bikeways:

30-inch and smaller:

Reinforced concrete pipe 706.02
Reinforced concrete elliptical pipe 706.04
Corrugated polyethylene smooth lined pipe 707.33
Polyvinyl chloride plastic pipe
(non-perforated) 707.41
Polyvinyl chloride corrugated smooth
interior pipe 707.42
Polyvinyl chloride profile wall pipe 707.43
Polyvinyl chloride sanitary pipe 707.44
Polyvinyl chloride solid wall pipe 707.45
Polypropylene corrugated double wall pipe 707.65

30-inch and larger:

Reinforced concrete pipe 706.02
Reinforced concrete elliptical pipe 706.04
Corrugated aluminum alloy pipe 707.21 or 707.22
Aluminum alloy structure plate conduits 707.23
Corrugated polyethylene smooth lined pipe 707.33
Polyvinyl chloride corrugated smooth
interior pipe 707.42
Polyvinyl chloride profile wall pipe 707.43
Polypropylene corrugated triple wall pipe 707.69
Ductile iron pipe (sanitary) 748.01
Polyvinyl chloride pipe (sanitary) 748.02

Ductile iron pipe (sanitary)	748.01
Polyvinyl chloride pipe (sanitary)	748.02

Type E Conduits – Miscellaneous small drain connections and headers:

All allowable sizes:

Reinforced concrete pipe	706.02
Reinforced concrete elliptical pipe	706.04
Corrugated polyethylene drainage pipe	707.32
Corrugated polyethylene smooth lined pipe	707.33
Polyvinyl chloride plastic pipe (non-perforated)	707.41
Polyvinyl chloride corrugated smooth interior pipe	707.42
Polyvinyl chloride profile wall pipe	707.43
Polyvinyl chloride sanitary pipe	707.44
Polyvinyl chloride solid wall pipe	707.45
Polyvinyl chloride drain waste and vent pipe	707.46
Polyvinyl chloride ABS composite pipe	707.47
Polypropylene corrugated single wall pipe	707.62
Polypropylene corrugated double wall pipe	707.65

Type F Conduits – Conduits on steep slopes; underdrain outlets:

All allowable sizes:

Corrugated aluminum alloy pipe	707.21 or 707.22
Corrugated polyethylene smooth lined pipe	707.33
Polyvinyl chloride plastic pipe (non-perforated)	707.41
Polyvinyl chloride corrugated smooth interior pipe	707.42
Polyvinyl chloride solid wall pipe (underdrain outlets)	707.45
Polypropylene corrugated double wall pipe	707.65

1203.03 Conduit Definitions. For the purposes of this specification, the following definitions are used:

- A. Long span structure includes all of the following material kinds: 706.05, 706.051, 706.052, 706.053, 707.15, and 707.25.
- B. Plastic pipe includes all of the following materials kinds: 707.31, 707.32, 707.33, 707.41, 707.42, 707.43, 707.44, 707.45, 707.46, 707.47, 707.51, 707.52, and 748.02.
- C. Corrugated metal pipe includes all of the following material kinds: 707.01, 707.02, 707.03, 707.04, 707.05, 707.07, 707.11, 707.12, 707.13, 707.14, 707.21, 707.22, 707.23, and 707.24.
- D. Iron pipe includes the following material kind: 748.01.
- E. Rigid Pipe includes all of the following material kinds: 706.01, 706.02, 706.03, 706.04, 706.08, 706.09, and 748.06.
- F. Conduit includes long span structures, pipe, culverts, sewers, drains, or any other item specified herein.
- G. Backfill is soil, granular embankment, or structural backfill placed above the bedding to the elevation as describe.
- H. A cut situation is an existing field situation when the top of the conduit is below the existing ground where an embankment may be constructed.
- I. A fill situation is an existing field situation when the top of the conduit is above the existing ground where an embankment is to be constructed.
- J. A fill situation, meets the requirements of a cut if the fill is constructed to at least 2 feet (600 mm) above the top of the conduit before placing the conduit.
- K. The conduit rise is the vertical distance from outside wall to outside wall or outside corrugation measured at the middle of the conduit.
- L. The conduit span is the horizontal distance from outside wall to outside wall or outside corrugation measured at the widest point of the conduit.
- M. The conduit spring line is equal to the rise divided by two.
- N. Trench width is the horizontal distance between the vertical walls of the trench measured in feet.

1203.04 Conduit Material Provisions. The local will allow any of the following alternate material provisions:

- A. The Contractor may use Type 1 or 2 structural backfill if granular or soil embankment is required or allowed.
- B. Supply pipe of the required size or one size larger.

- C. If 707.05 or 707.07 conduit is specifically itemized or specified in the Proposal, the Contractor may provide conduit conforming to 707.04 and having a bituminous paved invert. Provide the same corrugation profile and sheet thickness listed in the Proposal.
- D. The Contractor may furnish higher strength concrete or plastic pipe of the same type where lower strength pipe is specified.
- E. The Contractor may furnish a thicker metal pipe of the same corrugation profile and type where a lesser thickness is permitted or specified.
- F. For metal pipe 54 inch (1350 mm) diameter or larger and pipe-arch, ensure the manufacturer provides match marked ends and a layout drawing.

1203.05 Submittals. Prepare shop drawings and calculations when required below. Have a Registered Engineer prepare, sign, seal and date all calculations. Submit load rating calculations to the Office of Structural Engineering for all structures with a 10 foot span and greater in accordance to the most current version of ODOT's Bridge Design Manual. Submit two copies of the shop drawings and calculations to the Engineer. The Engineer will submit one copy to the Local Authority according to the following:

- A. If Reinforced Concrete Circular Pipe, 706.02, requires a "Special Design" with a specified D-load requirement above the minimum D-load, submit shop drawings and design calculations. Design the pipe to meet the D-load requirements required to meet the performance of this specification. Include the following information in the submittal: all structural design and loading information, all material specifications, all dimensions, and the installation plan.
- B. Precast reinforced concrete 3-sided flat topped culverts, precast reinforced concrete arch culverts, or precast reinforced concrete round sections, (706.051, 706.052, or 706.053) must submit structural analysis methods, structural design criteria and calculations, structure details, and shop drawings. Include details for a precast slab bottom if required.
- C. Submit hydraulic calculations if requesting approval to substitute a precast reinforced concrete 3-sided flat topped culvert (706.051), a reinforced concrete arch culvert (706.052), or a precast reinforced concrete round section (706.053) for one another. The proposed culvert must meet or exceed the same hydraulic requirements as the specified culvert and minimum cover requirements. If the specified culvert is on pedestal walls, include the shop drawings for the pedestal wall design in the submittal because 3-sided flat topped culverts, arch culverts, and round sections require different pedestal wall designs.
- D. Submit hydraulic calculations if requesting approval to substitute either a precast reinforced concrete 3-sided flat topped culvert, a precast reinforced concrete arch culvert, or a precast reinforced concrete round section (706.051, 706.052, or 706.053) placed on a precast or cast-in-place slab bottom for a precast reinforced concrete box culvert (706.05). The proposed culvert must meet the same hydraulic requirements as the specified box culvert and minimum cover requirements. The Local Authority may allow the bottom slab to be cast-in-place but will not issue a time extension for any delays resulting from the use of a cast-in-place bottom slab.

E. The Contractor or Manufacturer shall be responsible for developing applicable Height of Cover tables. Height of Cover tables shall be included with the shop drawings and calculations submittal.

1203.06 Conduit Excavation. Measure trench width at the span of the conduit. Center the trench excavation about the centerline of the conduit.

Use Method A for a cut situation, and use Method B for a fill situation.

A. Method A. Excavate the trench for the conduit. Provide vertical trench walls.

If long span culvert is used, provide a minimum trench width of the span plus 2 feet (0.6 m) on each side.

If rigid pipe is used, provide a minimum trench width of the span times 1.33.

If plastic or corrugated metal pipe is used, provide a minimum trench width of the span times 1.25 plus 1 foot (0.3 m).

If plastic pipe is used and the ID is 8 inch (200 mm) or less furnish a minimum trench width of the OD.

Increase these minimums to a width that allows the jointing of the conduit, and the placement and compaction of the backfill.

B. Method B. Construct the embankment to a height at least equal to half of the rise and to a width on each side of the conduit two times the span of the conduit before excavating for the conduit. Excavate the trench in the constructed embankment to a width conforming to Method A above.

Furnish a firm foundation for the conduit bed for its full length. The Engineer will require the removal of unsuitable material below the conduit bedding or below the bottom of the conduit if bedding is not required for the width of the trench. Replace the unsuitable material with structural backfill. Remove rock or shale in the conduit foundation for at least 6 inches (150 mm) below the bottom of the bedding. Replace the rock or shale with structural backfill. Unless in the contract documents, the Local Authority will pay for this work according to 109.05.

If the Engineer changes the flow line by more than one foot (0.3m), the Local Authority will pay according to 109.05.

The Contractor may jack or tunnel the pipe with the written permission of the Director.

1203.07 Conduit Bedding. Type 1 bedding consists of structural backfill extending at least 6 inches (150 mm) below the bottom of the conduit for the full width of the trench. Compact the bedding according to 1203.11.

Use Type 1 bedding for 706.05, or 706.051, 706.052, and 706.053 on slab bottoms. Also use Type 1 bedding for 707.03, 707.15, and 707.25 on corrugated invert plates.

Type 2 bedding consists of structural backfill extending at least 3 inches (75 mm) for all 706 rigid pipe conduits and 6 inches (150 mm) for all other conduits below the bottom of the conduit for the full width of the trench. Extend the bedding up around the pipe for a depth of not less than 30 percent of the rise of the conduit. Shape the bedding to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe. Leave the bedding below the middle one-third of the pipe span un-compacted. Compact the remaining bedding according to 1203.11.

Use Type 2 bedding for Types A, B, C, and D conduits except for long span structures and for conduits that require Type 3 bedding.

Type 3 bedding consists of a natural foundation with recesses shaped to receive the bell of bell-and-spigot pipe. Scarify and loosen the middle one-third of the pipe span.

Use Type 3 bedding for Type C and Type D conduits of the following materials: 706.01, 706.02, or 706.03.

Type 4 bedding consists of a natural foundation shaped to fit the conduit with recesses shaped to receive the bell of bell-and-spigot pipe.

Use Type 4 bedding for Types E and F conduits.

1203.08 Laying Conduit. Lay the conduit in the center of the trench starting at the outlet end with the bell or groove-end laid upgrade. Ensure that the conduit is in contact with the bedding throughout its full length such that line and grade is maintained. Lay metal conduits according to one of the following methods:

- A. If the seam is longitudinally either riveted or welded, place the seam or weld at the spring line.
- B. If the metal pipe is fabricated helically (having a continuous seam running around the outside of the pipe), arrange the corrugations so the helix angle or twist is rotating downstream in the direction of the flow to increase hydraulic performance.

Maintain flows at all times until the new facilities are completed and in service. Maintain the flows through existing facilities to be replaced unless a temporary bypass conduit is used.

Construct the inlet and outlet ends of all conduit runs with pipe ends as normally fabricated by the manufacturer. If field cutting is necessary, locate the cut end at an interior joint within the run and provide a cradle, collar, or band to ensure a stable joint.

Construct a concrete collar on the last joint if field cutting is necessary to meet a structure or headwall.

Erect 707.03, 707.15, 707.23, and 707.25 conduits according to 522.03. Where two plate thicknesses are specified, locate the thicker plates at the bottom and corner plates in pipe-arch structures, and the bottom row, if centered, or bottom two rows, if not centered, in round structures.

Set the 706.051 units on the concrete footing shown on the plans. Unless otherwise shown on the plans, provide a 3-inch (75 mm) deep keyway centered on the precast leg. The width of the keyway shall be 6 inches (150 mm) greater than the thickness of the precast leg. Place the units in a 1/2-inch (13 mm) bed of mortar. If proper line and grade of the structure cannot be maintained on the bed of mortar, set the units on 5 × 5-inch (125 × 125 mm) masonite or steel shims. Fill the entire keyway joint with mortar.

Set the 706.052 units on the concrete footing shown on the plans. Unless otherwise shown on the plans, provide a 3-inch (75 mm) deep keyway centered on the precast leg. The width of the

keyway shall be 6 inches (150 mm) greater than the thickness of the precast leg. Place the units on 5 × 5-inch (125 × 125 mm) masonite or steel shims to provide a minimum 1/2-inch (13 mm) gap between the footing and bottom of the unit's bottom leg. Fill the entire keyway joint with mortar.

Set the 706.053 arches on the concrete footing shown on the plans. Unless otherwise shown on the plans, provide an 8-inch (200 mm) deep keyway for spans up to 24 feet (7.3 m) and a 10-inch (250 mm) deep keyway for all spans greater than 24 feet (7.3 m). Center the keyway on the precast arch base. The width of the keyway must be 8 inches (200 mm) greater than the thickness of the precast arch base. For non-vertical leg arches set on pedestal walls, a one-sided keyway is acceptable if the required pedestal wall design thickness is not sufficient for a full keyway. Place masonite or steel shims to provide a minimum of 1.5-inch (38 mm) gap between the footing and the bottom of the precast arch base. Fill the entire keyway joint with mortar. Provide 5000 psi (34.5 MPa) mortar. For arches that gain structural continuity by a cast-in-place closure at the project site, provide concrete with the same compressive strength as the precast arch.

If reinforced concrete pipe has elliptical reinforcing, the top and bottom of the pipe are clearly marked on the pipe. Handle and place reinforced concrete pipe with elliptical reinforcement and reinforced concrete horizontal elliptical pipe with single cage reinforcement with the reinforcement markings along a vertical plane as marked on the pipe. Handle and place reinforced concrete pipe with auxiliary supports (S-stirrups) with the centerline of the auxiliary support system (S-stirrups) in a vertical plane as marked on the pipe.

For 706.05, 706.051, 706.052, or 706.053 structures fill the lifting devices with mortar. Cover the exterior of the lifting devices with joint-wrap material if outside the limits of the membrane waterproofing. Use joint-wrap with a minimum width of 9 inches (225 mm). Use only lifting devices that do not require a hole through the structure.

For all 707 conduit, use only lifting devices that do not require a hole through the structure.

Immediately after placing conduit, construct the end treatments at both the outlet and inlet ends. These end treatments include headwalls, concrete riprap, rock channel protection, sod or other erosion control items.

1203.09 Joining Conduit. Join the conduit sections so that the ends are fully entered and the inner surfaces are flush and even. Furnish sealed, banded, or bolted joints for Types A, B, C, D, and F conduits. Provide open joints for Type E conduits wrapped with 4-inch (100 mm) wide tarred paper or tarred burlap with pack soil placed around this material to hold it in place during backfilling.

The Engineer may allow joint materials other than those listed below, provided the Contractor demonstrates the proposed material makes durable sealed joints.

Furnish joints that do not allow infiltration of backfill material into the conduit or use a fabric wrap on the outside of the conduit.

Install conduit so that match marks align and in accordance with the layout drawings supplied by the manufacturer.

A. Joints.

1. Metal Pipe.

If using corrugated metal pipe, provide coupling bands conforming to 707.01 or 707.02. These bands will have the same coating as the pipe being joined and use gasketed coupling bands or fabric wrap the coupling bands when using structural backfill Type 2 for the bedding or backfill. A maximum difference between adjacent pipe sections of 1/2 inch (15 mm) will be allowed before coupling bands are placed. Securely strut the end of each pipe section for pipe diameters 54 inches (1350 mm) or greater that have a wall thickness of less than 0.109 inch (2.77 mm). Install the ties or strapping in the first or second valley of the annular corrugations on each end of each piece of pipe. Install two struts per end such that they are perpendicular to one another and cross at their midpoints. Strut by using wire ties or other approved methods. Remove the strutting after securing the coupling bands.

Bell and spigot joints conforming to 707.12 may be used for corrugated steel spiral rib conduits. Ensure the spigot and bell ends are clean and free from dirt or debris prior to assembly. Place a gasket in the first corrugation of the spigot end and thoroughly lubricate the gasket and the bell end of the receiving conduit prior to assembly. Ensure the spigot is securely driven home into the bell upon final assembly.

2. Rigid Pipe.

a. For 706.01, 706.02, or 706.04, 706.05, or 706.08 that require sealed joints, use any of the following methods:

i. Apply 706.10 to the pipe in sufficient quantity to completely fill the joint once the pipe is placed in its final position at a gap of 1 inch (25.4 mm) or less. After placing the pipe in its final position, point and trowel the 706.10 to form a smooth transition on the inside and a complete seal on the outside.

ii. Apply 706.14 to the pipe in sufficient quantity to seal the joint but not necessarily fill the joint once the pipe is placed in its final position at a gap of 1 inch (25.4 mm) or less. Immediately before installing 706.14, clean the joint free of all debris then prime both sides of the joint with an asphalt based primer according to the 706.14 manufacturer's recommendations.

iii. Provide 706.11 or 706.12 as specified.

b. For 706.03 conduit, use fibrated coal tar joint compound applied according to the manufacturer's recommendations.

c. If resilient and flexible gasket joints conforming to 706.11 or 706.12 are specified on sanitary sewer conduits, test the joints for infiltration or exfiltration according to ASTM C 969. If any section of conduit fails to meet the test requirements, make corrections until the test requirements for the section are met.

B. Filling Joints. After placing 706.05, 706.051, or 706.052 in their final position with a maximum joint gap of 1 inch (25.4 mm), clean the joint gap or joint of all debris and perform the following:

1. For 706.05 joints, fill the top exterior joint gap and the bottom and side interior joint gap with mortar. Next, for any exterior joint not covered by membrane waterproofing, cover the exterior joint with a 9-inch (225 mm) wide strip of joint wrap. Center the joint wrap on the joint. Use a continuous length of joint wrap sufficient to extend from the bottom of the vertical face on one side to the bottom vertical face on the other side.

2. For 706.051, fill the top keyway joint with 705.22. The side or leg joints shall also be filled with 705.22 for the keyway type joint or filled per 706.05 for a tongue and groove type joint. Clean the joint of all debris immediately before installing the joint filling material. Wet all surfaces of the keyway joint, but do not allow free standing water in the joint. Prepare, place, and cure the 705.22 according to the manufacturer's recommendations. Next cover the exterior joint with a 12-inch (300 mm) wide strip of joint wrap. Center the joint wrap on the joint. Use a continuous length of joint wrap sufficient to extend from the bottom of the vertical face on one side to the bottom vertical face on the other side. Apply membrane waterproofing to the precast sections after they are installed.

3. For 706.052 and 706.053, install a $7/8 \times 1\ 3/8$ -inch (24×34 mm) 706.14 joint filler along the outside joint chamfer. Use a continuous length of joint filler sufficient to extend from the bottom of the vertical face on one side to the bottom vertical face on the other side. Before installing the joint filler, prime the joint chamfer with a primer according to manufacturer's recommendations. For 706.052 and 706.053, cover all exterior joints with a 12-inch (300 mm) wide strip of joint wrap centered on the joint. Use a continuous length of joint wrap sufficient to extend from the bottom of the vertical face on one side of the structure to the bottom vertical face on the other side. Next, apply all waterproofing as shown on the plans. Apply membrane waterproofing to the precast sections after they are installed.

C. Sealing Concrete Surfaces. For 706.05, 706.051, 706.052, or 706.053 apply an approved epoxy-urethane sealer per the plans to all top surfaces not covered by membrane waterproofing. Extend the sealer 1 foot (0.3 m) below the backfill on all sides of the culvert sections including the joint.

The Engineer and Contractor will visually inspect all conduit and joints before any backfill is placed. Rejoin, re-lay, or replace all conduit out of joint tolerance, alignment, settled, or damaged.

1203.10 Exterior Coatings and Membrane Waterproofing. If shown on the plans, externally apply membrane waterproofing to 706.05, 706.051, 706.052 or 706.053. Apply the membrane waterproofing to the top surface and extend it vertically down both sides of the structure. Clean the concrete surfaces when the membrane waterproofing does not adhere to the structure. Apply the membrane waterproofing to all surfaces that will be in contact with the backfill. Apply the waterproofing according to the appropriate requirements of Item 512.

Apply waterproofing to 707.03, 707.15, 707.23, and 707.25 conduits with less than eight feet (2.4 m) of cover by one of the following methods.

A. Coat the exterior of the conduit above the limits of the bedding and within the limits of backfill. Ensure that all plate seams and bolts are thoroughly sealed. The coating material and application shall conform to AASHTO M 243. Allow asphalt mastic material to dry 48 hours and

tar base material to dry 28 hours before placing the conduit backfill. Rib stiffeners do not need to be coated.

B. Construct Buried Liner Waterproofing Membrane protection in the fill per the manufacturer's recommendations. The Buried Liner Waterproofing Membrane protection will be a seamless continuous sheet placed over the conduit and extend at least 10 feet (3.3 m) outside of the paved shoulder and for the width of the trench.

1203.11 Conduit Backfilling. Place backfill to the limits described and according to the compaction requirements. Place the backfill in the trench and embankment outside the trench uniformly on both sides of the conduit for all conduit installations.

A. General. The Contractor may operate small compaction equipment with less than a total weight of 1 ton (0.9 metric ton) over the conduit to compact the backfill. Do not use hoe packs on top of the conduit until 2 feet (0.6 m) of backfill is compacted on top of the conduit. The Contractor may operate compaction equipment with less than a total weight of 8 tons (7 metric tons), but more than 1 ton (0.9 metric ton), over the conduit after placing and compacting 2 feet (0.6 m) of backfill. Do not operate equipment with a total weight of 8 tons (7 metric tons) or more, until placing and compacting a cover of 4 feet (1.2 m) over the top of the conduit. The above restrictions apply when working within one span on each side of the conduit, or 6 feet (1.8 m), whichever is less. As shown on the plans, encase conduits with the specified thickness of Class C concrete.

B. Long Span.

1. For all long span structures except 706.053 in cut, place and compact structural backfill over the top of the section to a minimum depth 4 feet (1.2 m) or to the subgrade elevation whichever is less and for a width of 2 feet (0.6 m) on each side of the section. Use soil, granular embankment, or structural backfill to construct the adjacent embankment and for the remaining depth to the subgrade. Construct the adjacent material according to Item 203.

2. For all long span structures except 706.053 in fill, place and compact structural backfill over the top of the section to a minimum depth of 2 feet (0.6 m) or to the subgrade elevation whichever is less and for a width of 2 feet (0.6 m) on each side of the section. Use soil, granular embankment, or structural backfill to construct the adjacent embankment and for the remaining depth to the subgrade. Construct the adjacent material according to Item 203.

3. For 706.053 structures in cut or fill, place and compact structural backfill on both sides of the structure to the following minimum limits: vertically from the base up to a height of 75 percent of the rise; horizontally on each side of the structure to a sloping line that begins 2 feet (0.6 m) from the base of the structure and slopes up and away from the structure at a 1H:1V slope (45 degree angle). Use soil, granular embankment, or structural backfill to construct the adjacent embankment and for the remaining depth to the subgrade. Construct the adjacent material according to Item 203.

C. Type A and B. Backfill Types A and B conduits except for long span structures as follows

1. In a cut situation, place and compact structural backfill above the bedding for the full depth of the trench. Within the trench and more than 4 feet (1.2 m) above the top of the conduit,

if the trench can accommodate compaction equipment, the Contractor may construct Item 203 Embankment. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

2. In a fill situation, place and compact structural backfill above the bedding for the full depth of the trench specified in 1203.06.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and to a depth of 2 feet (0.6 m) above the top of the conduit. Construct the embankment outside the limits of the backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

D. Type C and D. Backfill Type C and D conduits as follows:

1. In a cut situation, for plastic pipe, place and compact structural backfill above the bedding and to 6 inches (150 mm) over the top of the pipe. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

2. In a fill situation, for plastic pipe, place and compact structural backfill above the bedding for the full depth of the trench specified in 1203.06.B. Above these limits, uniformly place the lesser of one pipe span or 4 feet (1.2 m) of structural backfill on each side of the conduit and vertically to the top of the conduit. Then place for a depth of 6 inches (150 mm) structural backfill over the top of the pipe equal to the trench width centered on the pipe center line. Construct the embankment outside the limits of the backfill. All other conduit material types place and compact backfill. For plastic pipe with an ID 8 inch (200 mm) or less, place and compact structural backfill above the bedding for the full depth of the trench.

E. Type E. Place and compact backfill above the bedding to a height equal to two-thirds of the conduit rise then place and lightly compact backfill for a depth of 12 inches (0.3 m) above the pipe. Place no stones larger than 4 inches (100 mm) that will be part of the embankment in contact with the pipe.

F. Type F. Place and compact backfill above the bedding. Backfill Type F conduits for underdrain outlets according to 605.03.C.

1203.12 Conduit Placement and Compaction Requirements. Place soil, granular embankment, or Structural Backfill Type 1 or 2 in lifts not to exceed 8 inches (200 mm). The Local Authority will perform all compaction testing according to Supplement 1015. The compaction requirements per material type are as follows:

A. For soil embankment, compact each lift until 96 percent of AASHTO T 99 is achieved.

B. For granular embankment and Structural Backfill, Type 1 or 2, compact each lift of material according to 1203.12.E using mechanical devices, hoe packs, jumping jacks, hand devices, vibrating plates, or other equipment that meets the restrictions in 1203.11. Provide compaction equipment that compacts the material under the haunch of the pipe. If the compaction equipment cannot fully compact the material under the haunch, supplement the compaction equipment by using shovel slicing, spud bars, or mechanical spud bars to compact the material under the

haunch of the pipe. Use shovel slicing and spud bars in conjunction with the compaction operations to compact the material and to manipulate the material under the haunch of the pipe.

C. For Structural Backfill Type 2, compact each lift of material according to 1203.12.E using flood compaction or mechanical devices, hoe packs, jumping jacks, hand devices, vibrating plates, or other equipment that meets the restrictions in 1203.11. Provide compaction equipment that compacts the material under the haunch of the pipe. If the compaction equipment cannot fully compact the material under the haunch, supplement the compaction equipment by using shovel slicing, spud bars, or mechanical spud bars to compact the material under the haunch of the pipe. Use shovel slicing and spud bars in conjunction with the compaction operations to compact the material and to manipulate the material under the haunch of the pipe.

D. Place Structural Backfill Type 3 in layers not to exceed 12 inches (300 mm) loose depth. Vibrate, tamp, or compact to approximately 85 percent of the original layer thickness.

E. At the beginning of the work, construct a test section in the conduit trench. The Engineer will use at least 96 percent of the test section maximum dry density for acceptance of the production areas. Use at least the same number of passes or compactive effort used to construct the test section to compact the production areas. Use compaction equipment with a total weight or centrifugal force of at least 1/2 ton (0.5 metric tons). Supply the manufacture's specification for the compaction equipment. Except when using a hoe pack, use at least six passes with the compaction equipment in the production areas.

The Engineer may reduce the minimum passes if the passes are detrimental to compaction.

Construct a new test section if the pipe type, bedding material, backfill material, or trench conditions change.

F. If using trench boxes with either Type A or B conduits, configure the trench box so that the bedding and backfill material is compacted directly against the trench walls.

G. The Engineer may adjust the lift thickness to obtain the required compaction, fill all the voids, achieve the proper seating of the backfill material, and achieve the stability of the backfill material and the pipe. Do not use equipment or methods that compromise the structural integrity of the pipe.

1203.13 Clearing Site and Restoring Damaged Surfaces. Immediately after completion of the placing and compacting of the backfill remove and dispose of all surplus material according to 1203.01 and clear the site and restore all required surfaces

1203.14 Field Paving of New or Existing Conduit. Field pave the bottom of the conduit with concrete as shown on the plans.

For new pipe installations, do not pave until at least 4 feet (1.2 m) of fill is placed on top of the conduit, or the top of subgrade is reached. If the paving is placed before completion of the entire fill, clean any gaps between the conduit and concrete paving, then fill with heated bituminous material conforming to 705.04.

Reinforce the paving with 4 x 4-W1.4 x W1.4 galvanized welded wire fabric (or comparable). Provide a mesh with a width 4 inches (100 mm) less than the finished paving. Securely fasten the mesh to the conduit near each edge and at the center of the mesh at points not more than 4 feet (1.2 m) apart along the flow line of the culvert. Repair any damage to the galvanizing or other coating material caused by placement or by tack welding. Use wire brushing and paint with zinc rich paint to make the repairs.

For aluminum structural plate, securely fasten the mesh to the circumferential seam bolts with galvanized tie wire.

Provide a paving that is 3 inches (75 mm) thick measured from the top of the corrugations of the conduit to a height equal to 1/3 of the rise. Provide galvanized reinforcing steel support chairs beneath the mesh where necessary. Give special care to the mesh during concrete placement. After placing the concrete, strike it off with a template to produce the proper radius, and finish with a float to produce a smooth finish. Cure the concrete according to 451.10.

1203.15 Conduit Method of Measurement. The Local Authority will measure conduit by the number of feet (meters), measured from center-to-center of appurtenant small structures or between open ends inclusive of lengths of pipe bends and branches. The Local Authority will not deduct for catch basins, inlets, or manholes that are 6 feet (2 m) or less across, measured in the direction of flow. Where the location of an appurtenance or an open end is changed with the approval of the Engineer to accommodate full conduit sections, the Local Authority will measure the length placed. Conduits placed on slopes steeper than 3:1 or with beveled or skewed ends will be measured along the invert.

When the pay item calls for concrete encasement, payment for furnishing and placing the concrete encasement and for any additional excavation required shall be included in the unit bid price for the pertinent conduit. When the pay item calls for a new conduit to be field paved, payment for the field paving, including all work and materials necessary for the item, shall be included in the unit bid price for the pertinent conduit.

The Local Authority will measure field paving of existing pipe by the number of feet (meters).

1203.16 Conduit Basis of Payment. The Local Authority will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
1203	Foot (Meter)	___ " (___ mm) Conduit, Type ___
1203	Foot (Meter)	___ x ___ Conduit, Type ___
1203	Foot (Meter)	___ " (___ mm) Conduit Reconstructed, Type ___
1203	Foot (Meter)	Type ___ Precast Reinforced Concrete Flat Topped Three-Sided Culvert, ___' (___ mm) Span x ___' (___ mm) Rise
1203	Foot (Meter)	Type ___ Precast Reinforced Concrete Arch Sections, ___' (___ mm) Span x ___' (___ mm) Rise

1203	Foot (Meter)	Type ___ Precast Reinforced Concrete Round Sections, ___' (___ mm) Span × ___' (___ mm) Rise
1203	Foot (Meter)	___' (___ mm) Rise x ___' (___ mm) Span Conduit, Type A Corrugated Steel Box Culvert, ___' (___ mm) Minimum Cover, ___' (___ mm) Maximum Cover
1203	Foot (Meter)	___' (___ mm) Rise x ___' (___ mm) Span Conduit, Type ___ Corrugated Aluminum Box Culvert, ___' (___ mm) Minimum Cover, ___' (___ mm) Maximum Cover
1203	Foot (Meter)	___" (___ mm) Conduit, Type ___, with Field Paving of Pipe
1203	Foot (Meter)	___" (___ mm) Conduit, Type ___, Field Paving of Existing Pipe
1203	Foot (Meter)	Conduit, Type F for underdrain outlets

1203.17 Structure Description. This work consists of constructing or reconstructing manholes, catch basins, inlets, inspection wells, junction chambers or precast reinforced concrete outlets of the type and sizes specified; or adjusting existing castings to grade, as specified (formerly referred to as 604) per the 2010 CMS.

Use removed or excavated materials in the Work when the material conforms to the specifications; if not, then recycle or dispose of the material according to 105.16 and 105.17.

1203.18 Structure Materials. Furnish materials conforming to:

Structure concrete, Class C.	499, 511
Brick and masonry units	704
Precast reinforced concrete manhole, catch basin, and inlet sections	706.13
Precast reinforced concrete outlet	706.15
Preformed expansion joint fillers	705.03
Epoxy coated reinforcing steel	509.02, 709.00
Cast frames, grates, and covers	711.12, 711.13, or 711.14
Welded frames and grates	513.17, 711.01
Steps	711.13, 711.30, or 711.31
Structural backfill, Types 1, 2 and 3	703.11
Resilient and flexible gasket joints	706.11
Curing materials	705.05, 705.07
Mortar	602
Non-shrink Mortar.....	705.22

1203.19 Structure Construction Methods, General. Construct the specified structures according to the plans. Place inlets, catch basins, inspection wells, junction chambers or precast outlets at the locations and elevations shown in the plans according to the standard construction drawings or as directed by the Engineer. Place manhole castings at the elevation and station with offset to the center of the casting or as directed by the Engineer. Place the manhole base at the elevation and station with offset to agree with the pipe station, offset and pipe invert elevation according to the standard construction drawings or as directed by the Engineer. Use flat slab top manholes as shown on the standard construction drawing. Do not remove the flat slab top manhole lifting devices.

If the Engineer changes the structure elevation by more than 1 foot (0.3 m), the Local Authority will pay according to 109.05.

Thoroughly mortar with a flush mortar joint the underdrain outlet pipe to the precast reinforced concrete outlet. Furnish and place lateral sewer connections including drops and leads except pipe included in Item 1203 Conduits.

Locate or cut conduits as shown on the standard construction drawings so they do not protrude inside the structure walls.

Take adequate precautions to prevent structure concrete or mortar cement from freezing. Preheat the brick, concrete block, or precast concrete structure throughout the entire mass to a temperature between 50 to 80 °F (10 to 27 °C) before placing mortar if the ambient temperature is 40 °F (4 °C) or less.

Set iron frames, tops, and covers of the type shown on the plans in a mortar bed with a flush mortar joint.

Prevent earth or debris resulting from construction operations from entering the manholes, catch basins, junction chamber, inlets, and precast reinforced concrete outlets. Remove any debris.

A. Reconstruction to grade

1. Carefully remove and clean the existing castings.
2. Remove the existing walls of manholes down to the spring line or below as necessary.
3. Remove existing walls of catch basins and inlets below the window openings, grates, or any points of wall failure.
4. Using the salvaged casting, reconstruct the structure to the new grade, conforming as nearly as practicable to the existing dimension and type of construction.

B. Adjustment to grade

1. Carefully remove and clean the existing frame, adjust the height of supporting walls, and reset the existing frame in a bed of concrete mortar or structure concrete to the new grade.

2. Carefully remove the existing cover or grate and install a casting or an acceptable adjusting device on file at the Laboratory or an adjusting device approved by the Engineer to the new grade and install per the manufacturer's recommendations.

1203.20 Structure Excavation and Backfill. Excavate to dimensions that provide ample room for construction.

The Engineer will require the removal of unsuitable material below the structure bedding. Replace unsuitable material with 1203.12 Structural Backfill. When the Engineer requires the removal and replacement of unsuitable material below the bedding for precast structures and below the structure for cast-in-place structures, the Local Authority will provide compensation according to the Contract or by Supplemental Agreement.

Ensure that the backfilling follows the completion of the work as closely as the type of construction will permit. Do not disturb the structure while backfilling. Backfill structures located within the pavement area with structural backfill to the subgrade according to 1203.11, Type A or B conduit. Backfill structures outside of the pavement area according to 1203.11, Type C conduit.

1203.21 Structure Brick and Block Masonry. Thoroughly wet brick and concrete block masonry units before laying in the mortar, and lay the brick and masonry units with a flush mortar joint.

Take adequate precautions to prevent concrete and mortar from freezing. Do not set brick and masonry units having a temperature of 40 °F (4 °C) or less with mortar until heated. When required, heat to ensure that a temperature of 50 to 80 °F (10 to 27 °C) is obtained throughout the entire mass of the material.

Cure the exposed surfaces of all brick and block masonry by covering with wet burlap for 48 hours or by applying curing membrane according to Item 511.

1203.22 Precast Structure Concrete Modular Construction. Furnish precast structures according to the contract documents. Extra openings or excessive diameter of openings are cause for rejection of the precast structure. Furnish precast bases on a compacted structural backfill bed having a minimum thickness of 3 inches (75 mm). Ensure that the structural backfill bed is level and uniformly support the entire area of the base.

After placing the pipe, grout all openings between the pipe and structure less than 4 inches (100 mm) with mortar and grout all openings between the pipe and structure greater than 4 inches (100 mm) with non-shrink mortar. Seal all joints between modules with materials specified in 1203.11 for Type A, B, C, D, or F conduit.

Cure median inlets with the same materials and methods specified in 622.07.

The manufacturer of precast modular items must be certified according to Supplement 1073.

1203.23 Structure Concrete (Cast-In-Place). Place and furnish structure concrete as shown on the plans.

1203.24 Structure Method of Measurement. The Local Authority will measure Manholes, Inlets, Catch Basins, Monument Assemblies, Reference Monuments, Inspection Wells, Junction Chambers, and Precast Reinforced Concrete Outlets, whether new, reconstructed, or adjusted to grade, by the number of each type of structure complete and accepted.

1203.25 Structure Basis of Payment. The Local Authority will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
1203	Each	Manhole
1203	Each	Inlet
1203	Each	Catch Basin
1203	Each	Inspection Wells
1203	Each	Junction Chambers
1203	Each	Manhole, Catch Basin or Inlet Reconstructed to Grade
1203	Each	Manhole, Catch Basin, Inlet, or Monument Box Adjusted to Grade
1203	Each	Precast Reinforced Concrete Outlet