

**Attachment 11**

**NYSDOT Standard Specifications**  
**706 & 707 series**

**Solicitation 23187**

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**Scope**

It is the intent of these specifications to cover the minimum requirements for culvert and drainage system pipe, tubing, arches, bands end sections, accessories and parts for culvert and underground drain installations, service and rehabilitations, for delivery to various locations throughout the State.

This section contains links to and reproductions of appropriate guidance documents for bidders to determine suitability of Product offerings. The document includes specifically selected chapters and sections from the NYSDOT Standard Specifications most current version and all current addenda.

Should updates be made to specifications or NYSDOT Approved Lists during the contract term, Contractors are expected to update products as soon as possible in accordance with the provisions of Section 6.5 Price Update of the Solicitation.

No changes or substitution of products or pricing is permitted without the express approval of OGS Procurement Services.

Bidders Note: It is a Contractor's responsibility to make sure that all items delivered comply with the most up-to-date NYSDOT Standard Specifications. The complete NYSDOT Standard Specification for contracting may be found here:

<https://www.dot.ny.gov/main/business-center/engineering/specifications/updated-standard-specifications-us>

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## **SECTION 706 - CONCRETE, CLAY AND PLASTIC PIPE**

(Last Revised January, 2019)

### **706-01 NON-REINFORCED CONCRETE PIPE**

**SCOPE.** This specification covers the material and quality requirements for non-reinforced concrete pipe 24 inches and smaller used for culverts.

**GENERAL.** The provisions of §706-02, Reinforced Concrete Pipe, shall apply except that all references to reinforcing steel shall be deleted. In addition, physical and dimensional requirements of concrete pipe under 12 inches in diameter shall be as stated in Table 1, Class 1, of ASTM C14. Plain concrete pipe 12 to 24 inches in diameter shall conform to Table 1, Class 2, of ASTM C14.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §706-02 shall apply except that all references to reinforcing steel shall be deleted.

**FABRICATION REQUIREMENTS.** The Fabrication Requirements contained in §706-02 shall apply except as noted herein.

**Marking.** No pipe class or wall designation shall be marked on the pipe.

**PHYSICAL REQUIREMENTS.** The Physical Requirements contained in §706-02 shall apply except as noted herein.

**Strength.** The strength requirements for the respective diameter pipe sizes shall be as stated in Table 1 of ASTM C14. Details of the three-edge bearing test shall comply with ASTM C14.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §706-02 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §706-02 shall apply.

**SHIPPING.** The Shipping requirements contained in §706-02 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §706-02 shall apply.

**706-02 REINFORCED CONCRETE PIPE CLASSES II, III, IV, V**

**SCOPE.** This specification covers the material, fabrication, and physical requirements of reinforced concrete pipe and cattle pass.

**GENERAL.** Apply the requirements of AASHTO M 170, Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, Classes II, III, IV, and V, except as modified by this specification. Produce reinforced concrete pipe by either machine made or wet cast methods in accordance with working drawings approved by the Department and in full compliance with the details of this specification. Pipe manufactured for a specific class will be acceptable for any class having a lower design strength.

Methods of manufacture include the following:

**A. Wet Cast Pipe And Cattle Pass.** Wet cast units are those made from concrete placed and consolidated by conventional equipment. These units develop resistance to freeze-thaw damage through the use of entrained air in the concrete. Air content in wet cast concrete shall range between 5.0% and 9.0%.

Manufacture wet cast pipe, for Department acceptance, in accordance with this specification and the current Materials Procedure for precast concrete titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”.

**B. Machine Made Pipe.** Machine made units use very low slump concrete and methods of consolidation which produce a dense product with low permeability and good resistance to freeze-thaw damage.

Manufacture machine made pipe, for Department acceptance, in accordance with this specification and the current Materials Method titled “Quality Assurance Procedure For Concrete Pipe Items”.

**MATERIAL REQUIREMENTS**

**A. Materials**

Portland Cement (Type 1, Type 2 or Type 3)	701-01
Concrete Repair Material	701-04
Concrete Repair Material - High Early Strength	701-12
Coarse Aggregate	703-02
Concrete Sand	703-07
Bar Reinforcement, Grade 60 (Reinforcement & Stirrups)	709-01
Wire Fabric for Concrete Reinforcement	709-02
Bar Reinforcement, Grade 40	709-03
Cold Drawn Wire for Concrete Reinforcement	709-09
Admixtures	711-08
Water	712-01
Concrete Pipe Joint Sealing Compound	705-16
Concrete Pipe Joint Elastomeric Gaskets	705-17
Fly Ash	711-10
Ground Granulated Blast Furnace Slag	711-12

**B. Cementitious Content.** Use a minimum combined cementitious content of 565 lb/cy. This includes the Portland Cement and pozzolan (fly ash and/or ground granulated blast furnace slag). The maximum allowable total chloride content in concrete shall not exceed 0.10 percent by weight of cementitious material tested in accordance with written procedural directives of the Materials Bureau.

**C. Pozzolans.** Fly ash and/or ground granulated blast furnace slag may, in total, be substituted for cement up to a maximum of 20% by weight of the total amount of cement plus pozzolan in the mix.

**D. Admixtures.** Calcium Chloride is not allowed in concrete. Admixtures, other than an approved Air Entraining agent for wet cast pipe, are not allowed unless otherwise approved by the Materials Bureau.

**E. Reinforcement.** Sample the reinforcement in accordance with the written directives of the Materials Bureau. Accept stirrups based on the manufacturer's certification, unless otherwise directed by the Materials Bureau.

**F. Pipe Joint Materials**

- **Elastomeric Gaskets.** The gaskets used in the installation of round pipe shall meet the specification requirements of §705-17 and only those types and sizes designated by the pipe manufacturer on the approved drawings of the particular pipe.
- **Sealing Compounds.** Concrete pipe joint sealing compound, meeting the specification requirements of §705-16, shall be used only on elliptical pipe and reinforced cattle pass.

**FABRICATION REQUIREMENTS**

**Drawings.** Submit detailed working drawings conforming to the Materials Bureau concrete pipe templates. All diameter sizes of a particular geometric shape can be included on one drawing. Separate drawings are required for cattle pass, jacking pipe and special designs.

Full approval of the working drawings is required prior to the manufacture of any concrete pipe.

**Design, Reinforcement and Dimensions**

**A. General.** Apply the Design, Reinforcement and Permissible Variations requirements of AASHTO M 170 for Class II, III, IV and V pipe, walls B & C. The AASHTO tables show minimum reinforcement. The manufacturer may submit drawings detailing alternatives to the specified reinforcement and/or wall thickness for Materials Bureau consideration. To gain full approval of alternate designs, manufacture and test pipe samples in accordance with the written procedural directives of the Materials Bureau.

**B. Reinforced Concrete Cattle Pass.** Apply the requirements of applicable Standard Sheet with the following modification. A minimum length of 48 inches is required for each section. The maximum allowable variation in laying lengths of two opposite sides of a cattle pass section is 1/8 inch per 12 inches of diameter, not to exceed 5/8 inch in any length of cattle pass, except where beveled or curved cattle pass lengths have been specified.

**Concrete Batch Placement**

**A. Machine Made Pipe.** Clean and properly assemble the forms prior to placing any concrete. Transport and place the concrete mixture such that no segregation of the concrete materials or displacement of the reinforcing steel occurs within the form.

**B. Wet Cast Pipe And Cattle Pass.** Apply the Concrete Placement And Consolidation requirements contained in §704-03.

**Curing.** Include the type of curing, curing time and any temperature requirements on the drawing.

**A. Machine Made Pipe.** Cure the pipe in accordance with AASHTO M 170. Other methods of curing are subject to approval by the Director, Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Apply the Curing requirements contained in §704-03.

**Joints.** Use either bell and spigot or tongue and groove design. Design the joints so as to permit effective jointing to reduce leakage and infiltration and to permit placement without irregularities.

**Marking.** The pipe markings must be identified on the inside barrel for pipe diameters of 1 1/2 feet and greater. If the diameter is less than 1 1/2 feet the markings may be stenciled on the outside of the pipe. Mark each piece of pipe with the following information, as applicable.

- 1.Name or trademark of manufacturer.
- 2.Date of manufacture.
- 3.Pipe class.
- 4.Wall designation.
- 5.Pipe diameter.
- 6.NYS DOT lot number (“NYS DOT           ”) (Machine made pipe only.)
- 7.Indelibly mark the word “TOP” on the inside and outside of the barrel at the appropriate location on each pipe length with elliptical or quadrant reinforcing.

### **Repair**

**A. Machine Made Pipe.** Pipe may be repaired at the plant or in the field using 701-04 Concrete Repair Material or §701-12 Concrete Repair Material - High Early Strength. Repairs to more than 10% of a lot will not be permitted. Repairs will be acceptable if, in the opinion of the Department, the repairs are sound, properly finished and cured, and the repaired pipe conforms to the requirements of these Specifications and the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Apply the Repair requirements contained in §704-03.

### **PHYSICAL REQUIREMENTS**

**Strength.** Apply the requirements of AASHTO M 170 except that the compressive strength requirements do not apply except for cattle pass. Conduct such number and type of three edge bearing tests as the Materials Bureau deems necessary to establish the quality of pipe.

Reinforced concrete cattle pass will not require a three-edge bearing test. The minimum 28 day compressive strength for cattle pass, as determined by concrete cylinders, is 3000 psi.

**Absorption Requirements For Machine Made Pipe.** The maximum average absorption for all pipe is 8.0% by weight for the last three specimens tested.

**Freeze-Thaw Requirements.** The Materials Bureau reserves the right to test the pipe for durability by freeze-thaw testing. The test will be run in accordance with written procedural directives of the Materials Bureau.

**SAMPLING AND TESTING.** It is required that each manufacturer have a testing machine, of a type approved by the Materials Bureau, to carry out three edge bearing tests. Employ a commercial testing agency to calibrate the testing machine according to ASTM E4 at a minimum of once a year. Upon request of the Materials Bureau, furnish a record of this calibration. Sample and test reinforced concrete pipe and cattle pass units, manufactured under the requirements of this specification, as follows.

**A. Machine Made Pipe.** Separate machine made reinforced concrete pipe into specific and identifiable production lots. Follow the written procedural directives of the Materials Bureau to determine the maximum number and type of units in a lot and the number of samples to be taken per lot. Test each lot of machine made reinforced concrete pipe as follows:

**1. Three Edge Bearing Test.** Follow the requirements for strength testing indicated above using the test procedure identified in the procedural directives issued by the Materials Bureau. Perform tests in the presence of a representative of the Department.

**2. Absorption Test.** Cores from each lot, drilled by the manufacturer in the presence of a representative of the Department, will be used for this test. The cores will be tested by the Materials Bureau in accordance with the test method specified in ASTM C497 except that under “absorption test” the drying period will be 48 hours at a temperature of 230°F.

Plug the holes when cores are taken. Ensure that plugs are sound, properly finished and cured according to the requirements of “Pipe Repair.”

In addition to the above tests, pipe will be subject to inspection at any time prior to placing, and rejection may be made through failure to comply with the criteria shown in the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Sample and test wet cast reinforced concrete pipe and cattle pass in accordance with Materials Bureau requirements contained in the current Materials Procedure for precast concrete, titled “Procedures For Achieving And Maintaining Precast Concrete Manufacturer’s Approved List Status”.

**FINAL PRODUCTION INSPECTION.** For wet cast units only, follow the Final Production Inspection requirements contained in §704-03.

## **SHIPPING**

**A. Machine Made Pipe.** No units will be considered for shipment unless the units are free from defects as noted under Pipe Repair in this specification and according to the written procedural directives of the Materials Bureau.

**B. Wet Cast Pipe And Cattle Pass.** Follow the Shipping requirements contained in §704-03.

## **BASIS OF ACCEPTANCE**

**A. Machine Made Pipe.** Units will be accepted in stock lot quantities at the manufacturing location in accordance with the current version of Materials Method 1 titled “Quality Assurance Procedure For Concrete Pipe Items”.

**B. Wet Cast Pipe And Cattle Pass.** Follow the Basis Of Acceptance requirements contained in §704-03.

**706-03 REINFORCED CONCRETE ELLIPTICAL PIPE; CLASSES HE-II, HE-III, HE-IV,  
VE- IV, VE-V AND VE-VI**

**SCOPE.** This specification covers the material and quality requirements for both horizontal and vertical elliptical reinforced concrete pipe of the classes noted above for use as culvert pipe. Pipe designed for placement with the major axis horizontal is designated as horizontal elliptical pipe. Pipe designed for placement with the major axis vertical is designated as vertical elliptical pipe.

**GENERAL.** The provisions of §706-02, Reinforced Concrete Pipe Classes II, III, IV, V shall apply except as noted herein.

All references to AASHTO M 170, contained in §706-02, shall be replaced with AASHTO M 207. All reference to Classes II, III, IV and V, contained in §706-02, shall be deemed to include all classes of elliptical pipe.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §706-02 shall apply except that the pipe joint material shall be a sealing compound meeting the requirements of §705-16.

**FABRICATION REQUIREMENTS.** The Fabrication Requirements contained in §706-02 shall apply except as noted herein.

**Design, Reinforcement and Dimensions.** In the case of elliptical pipe, the working drawings indicate the equivalent round pipe diameter, rise, span and class. A tolerance of plus or minus 2% from the nominal rise and span of the pipe, as shown on the approved working drawing, will be permitted.

Variations in laying lengths of two opposite sides of a pipe section shall not be more than 1/8 inch per foot of equivalent diameter, with a maximum of 5/8 inch in any length of pipe, except where beveled or curved lengths have been specified.

**Marking.** No wall designation shall be marked on the pipe. An equivalent round pipe diameter shall be used for markings.

**PHYSICAL REQUIREMENTS.** The Physical Requirements contained in §706-02 shall apply.

**SAMPLING AND TESTING.** The Sampling And Testing requirements contained in §706-02 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §706-02 shall apply.

**SHIPPING.** The Shipping requirements contained in §706-02 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §706-02 shall apply.

**706-04 PRECAST CONCRETE DRAINAGE UNITS**

**SCOPE.** This specification covers the material and fabrication requirements for precast concrete drainage units including transverse drainage interceptors.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply except as noted herein.

The concrete used to fabricate round precast concrete drainage units shall have a minimum compressive strength of 4000 psi @ 28 days. The concrete used to produce machine made units shall have a maximum absorption of 8.0% by weight and is not required to be air entrained.

Additional materials listed below shall meet the requirements of the following subsections:

Frames And Grates	655
Concrete Grouting Material	701-05
Concrete Pipe Joint Sealing Compound	705-16
Concrete Pipe Joint Elastomeric Gaskets	705-17
Mortar For Concrete Masonry	705-21
Steps For Manholes	725-02

**DRAWINGS.** The Drawing requirements contained in §704-03 along with the following shall apply.

Fabricator Working Drawings are required for all round drainage structures. Cut sheets, showing structure heights, the size and location of pipe openings and step locations are required for all drainage structures.

**FABRICATION.** The Fabrication requirements contained in 704-03, along with the following shall apply.

**Manufacturing Process.** Precast concrete drainage units shall be wet cast or machine made.

**A. Wet Cast.** Wet cast units are manufactured from concrete, placed and consolidated by conventional equipment, containing entrained air to develop resistance to freeze-thaw damage.

**B. Machine Made.** Machine made units are manufactured with very low slump concrete, consolidated to produce a dense product with low permeability and good resistance to freeze-thaw damage. Machine made units are those made by the following methods:

- Packerhead
- Roller suspension
- Centrifugal
- Machine tamped
- Machine vibrated
- Other methods as approved by the Materials Bureau

**Reinforcing.** Reinforcing bar splices shall be lapped a minimum of 30 bar diameters and tied securely. Wire fabric splices shall be secured by one of the following methods:

**A. Tying.** Under this method the ends shall lap to a length of not less than 30 diameters of the reinforcement and the lap shall contain a longitudinal member. A sufficient number of laps shall be tied to maintain continuity of the cage through the period of placement and curing of the concrete.

**B. Welding.** Each circular member shall be lapped a minimum of 2 inches and welded. The weld shall develop a minimum of 50 percent of the specified strength of the wire.

**Round Units.** Precast bases, floors, risers, conical top sections, grade rings and flat slab tops shall conform to the design, dimension and reinforcement requirements of ASTM C478. The C478 requirements for splices, laps and welds shall not apply.

**Transverse Drainage Interceptors.** Bar reinforcement shall be epoxy coated meeting the requirements of §709-04.

**Joints.** Joints between precast riser sections shall be formed with male and female ends so that when the sections are assembled they will make a continuous and uniform unit.

**Joint Sealant Materials.** Joints between precast sections are to be sealed with flexible watertight Elastomeric Gaskets, Pipe Joint Sealing Compounds, Mortar for Concrete Masonry, Concrete Grouting Material or Concrete Repair Material meeting the requirements of the Standard Specifications. If elastomeric Gasket Sealers are used the shape, size and placement shall be recommended by the precast manufacturer.

**Steps for Drainage Units.** Steps for drainage units shall conform to §725-02, Steps for Manholes. Steps in risers and conical top sections shall be aligned to form a continuous ladder with rungs equally spaced vertically in the completed unit at a maximum spacing of 16 inches. All steps in a completed drainage unit shall be the same size. Steps shall be embedded into the walls of the section a minimum of 3 inches. The rung shall project a minimum clear distance of 4 inches from the walls of the section measured from the point of embedment. If the steps are grouted, the grouting material shall conform to §701-04 Concrete Repair Materials or §701-05 Concrete Grouting Material, or §701-12 Concrete Repair Material - High Early Strength. If plastic inserts are used for installing steps, they shall be approved by the Materials Bureau. Steps which are damaged during installation or handling shall be replaced.

**Frames for Grates.** Frames cast into the top slab or top of the uppermost riser shall be secured and held in place by a minimum of 4 stirrups or studs per frame, welded to the frame near the corners. Parallel bar frames shall contain shear stud anchors, for the purpose of transferring loads, as required and detailed on the standard sheet for parallel bar grates and frames. Shear stud anchors, when required, shall replace the frame securing stirrups or studs.

**Dimensional Tolerances.**

**A. Drainage Units (Rectangular / Square).**

- Internal dimensions +5/8 inch, -1/2 inch
- Wall thickness
  - 6 inches +3/4 inch, -1/4 inch
  - ≥8 inches +3/4 inch, -1/2 inch
- Reinforcing steel cover
  - Walls (inside face) 2 inches (min), 4 inches (max)
  - Base (inside face) 2 inches (min), 3 1/4 inches (max)
  - Roof (all faces) +5/8 inch, -1/4 inch
  - Pipe openings (2 inches) ±1 inch
- Step spacing and alignment ±3/4 inch

**B. Drainage Units (Round).**

- Internal diameter
 

≤60 inches	±5/8 inch,
>60 inches & ≤ 96 inches	±3/4 inch
>96 inches	±1 1/2 inches
- Wall thickness
 

Internal diameter ≤60 inches	+5/8 inch, -1/4 inch
Internal diameter >60 inches & ≤ 96 inches	+3/4 inch, -1/2 inch
Internal diameter >96 inches	+1 inch, -5/8 inch,
Reinforcing steel cover	
Base, Roof and Walls	+5/8 inch, -1/4 inch
Pipe openings (2 inches)	±1 inch
- Step spacing and alignment
 

	±3/4 inch
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**SAMPLING AND TESTING.** The sampling and testing requirements contained in 704-03 shall apply except as noted herein.

**A. Machine Made Units.** Testing for air content is not required. Cores shall be taken from the hardened concrete and tested for absorption. A minimum of 3 cores per 5 batches of a single mix with a minimum of three cores per day per mix shall be used to measure absorption. The average absorption of the 3 cores shall not exceed the maximum absorption specified herein. Testing shall be in accordance with ASTM C497 except that the drying period shall be 48 hours at a temperature of 230°F.

**MARKING.** The Marking requirements contained in §704-03 shall apply except as noted herein.

Markings shall be placed on the inside face of all precast pieces. Each flat slab top that doesn't have an integral frame or a design that readily indicates the top surface shall have the words “INSTALL THIS SIDE UP” placed on its top surface.

The markings on rectangular drainage units, including base slabs, bases and risers, shall include the maximum placement depth in feet (“MPD...feet”). The maximum placement depth is based on wall thickness and reinforcement and shall be in accordance with the Department’s Standard Sheets or the contract plans.

Instead of marking the contract number on each unit they may be marked with “NYSDOT”.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in 704-03 shall apply.

**706-05 POROUS CONCRETE PIPE UNDERDRAIN**

**SCOPE.** This specification covers the material and quality requirements for porous concrete pipe and extra strength concrete porous concrete pipe underdrains.

**GENERAL.** Porous concrete pipe and extra strength porous concrete pipe shall be manufactured in accordance with approved working drawings and in compliance with details set forth below.

**MATERIAL REQUIREMENTS.** All materials shall comply with the requirements of ' 706-02, Reinforced Concrete Pipe, except that reinforcement shall not be used.

**Drawings.** Drawings shall be furnished in accordance with the provisions of ' 706-02.

**FABRICATION.** Porous concrete pipe and extra strength porous concrete pipe shall conform in size and shape to the details shown on the standard sheet for porous concrete pipe underdrain and the approved working drawing.

The inside surface of the pipe shall be straight and true to dimensions with a permissible variation from the true form of not more than 1 1/2 percent. A tolerance of 5% will be permitted in the diameter of the pipe. The wall thickness of the pipe may be greater than shown on the standard sheet, but it shall not be less than 95% of the stipulated wall thickness.

High early strength cement, calcium chloride or any other additive shall not be used unless otherwise approved by the Materials Bureau.

Concrete mix proportions will be such that will produce a concrete mix of such quality that the pipe will conform to the test and design requirements of these specifications.

Each length of pipe shall be clearly marked on the outside with the name or trademark of the manufacturer. Extra strength porous concrete pipe underdrain shall be clearly marked, " Extra Strength".

**Curing.** All pipe shall be cured in accordance with the provisions of 706-02.

**Strength Requirements.** The minimum ultimate strength for the size of the pipe being tested shall be as specified on the standard sheet. Requirements of 706-02 shall apply except that no determination of a 0.01 inch crack will be required and the ultimate strength values as determined on full length specimens shall be as specified on the standard sheet.

**Infiltration Requirements.** Pipe shall be tested for rate of infiltration in accordance with the method of test outlined in AASHTO Designation M176. The minimum rate of infiltration shall not be less than 1 gallon per minute per inch of internal diameter per foot of pipe for all sizes.

All tests shall be performed by the manufacturer at their plant and shall be witnessed by a representative of the Department. The number of samples for test shall be as directed by the Materials Bureau.

**Other Requirements.** In addition to the above tests, the pipe shall be subject to inspection at all times prior to placing and rejection will be made through failure to comply with any of the following conditions:

**A. Dimensions.** The pipe shall not vary in any dimensions more than permitted by this specification.

**B. Fractures or Cracks.** The pipe shall have no fractures or cracks passing through the shell or socket of the pipe, except that a single crack not exceeding 2 inches in length at either end of a pipe shall not be considered cause for rejection unless the defect exists in more than 5% of the lot offered for sampling and testing.

**C. Quality.** There shall be no defects that indicate imperfect mixing and molding.

**D. Strength.** There shall be no cracks that are sufficient to impair the strength, durability or serviceability of the pipe.

**E. Shape.** The shape of the pipe shall be such that there shall be no variation in alignment of more than 1/8 inch per linear foot.

**BASIS OF ACCEPTANCE.** The material will be considered for acceptance in stock lot quantities at the manufacturing location in accordance with procedural directives of the Materials Bureau.

In addition, the manufacturer shall furnish the Department representative at the plant a certification for each lot manufactured certifying that all pipe in the lot was manufactured in accordance with the terms of this specification and that the pipe details conform to drawings previously approved by the Department. Pipe shall be considered ready for acceptance when a lot conforms to the indicated test requirements. The manufacturer shall be permitted to retest to determine specification compliance.

Pipe not used within two years after its original acceptance shall be retested by the Department before it can be used.

#### **706-07 REINFORCED CONCRETE PIPE END SECTIONS**

**SCOPE.** This specification covers the material and fabrication requirements for reinforced concrete pipe end sections.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply.

**DRAWINGS.** The Drawing requirements contained in §704-03 shall apply.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following, shall apply.

The barrel portion of the end section shall meet the Design, Reinforcement and Permissible Variations requirements of AASHTO M 170 for Class III Pipe, Wall Designation B.

**SAMPLING AND TESTING.** The Sampling and Testing requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**MARKING.** The Marking requirements contained in §704-03 shall apply.

**FINAL PRODUCTION INSPECTION.** The Final Production Inspection requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**SHIPPING.** The Shipping requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**BASIS OF ACCEPTANCE.** The Basis Of Acceptance requirements contained in §704-03 shall apply, unless otherwise approved by the Director, Materials Bureau.

**706-08 POLYPROPYLENE PIPE**

**SCOPE.** This specification covers the material and quality requirements for polypropylene pipe (PP) and fittings.

**GENERAL.** The corrugated polypropylene pipe covered by this specification is classified as follows:

1. Type S- This pipe shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner liner. Corrugations shall be annular.
2. Type D- This pipe shall consist of an essentially smooth waterway braced circumferentially or spirally with projections or ribs joined to an essentially smooth outer wall. Both walls shall be fused to, or continuous with, the internal supports.

**MATERIAL REQUIREMENTS.** The polypropylene material for the pipe and fittings shall meet the requirements of AASHTO M330, Type S or Type D, and be in accordance with “Materials Method 30”. When checked with a 12 inch straight edge the smoothness of the interior liner shall not deviate more than ¼ inch.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by independent lab test results in accordance to this specification or in conjunction with the National Transportation Product Evaluation Program (NTPEP), and certification that the product conforms to this specification. Approval and continued residence on the Approved List will also be subject to the requirements of “Materials Method 30”.

**BASIS OF ACCEPTANCE.** Polypropylene pipe will be accepted on the basis of the manufacturer’s name and location appearing on the Department’s Approved List. The approved Materials Details will be posted on the Department’s Approved List.

**706-10 POLYVINYL CHLORIDE PIPE (relining)**

**SCOPE.** This specification covers the material requirements for polyvinyl chloride pipe when used in rehabilitation applications of culverts and storm drains.

**General.** The polyvinyl material from which the pipe and fittings are extruded or molded will not contain any reclaimed, reground or reworked material and will be comprised of virgin polyvinyl resins only. The resins used will meet the requirements contained in this specification. The pipe and fittings will be manufactured in such a manner so that all cross sections will be dense, homogeneous, and free from any imperfections.

**MATERIALS REQUIREMENTS.** The Polyvinyl Chloride pipe materials must conform to ASTM F1803 (Profile Wall), ASTM F949 (Corrugated), ASTM F679, or ASTM D3034. All materials supplied will be clearly marked with the appropriate ASTM as certified.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer’s name appearing on the Approved List for Rehabilitation of Culverts and Storm Drains.

**706-11 HIGH DENSITY POLYETHYLENE PIPE (relining)**

(Last Revised May, 2016)

**SCOPE.** This specification covers the material requirements for high density polyethylene pipe when used in rehabilitation applications of culverts and storm drains.

**GENERAL.** The high density polyethylene material from which the pipe and fittings are extruded will not contain any reclaimed, reground or reworked material and will be comprised of virgin high density polyethylene resins only. The resins used will meet the requirements contained in this specification. The pipe and fittings will be manufactured in such a manner so that all cross sections will be dense, homogeneous, and free from any imperfections.

**MATERIAL REQUIREMENTS.** The high density polyethylene pipe and its material must conform to ASTM F894 (Profile Wall) or ASTM F714 (Smooth Wall). All materials supplied will be clearly marked with the appropriate ASTM as certified. Sizes other than those listed within the tables of the ASTM specification will be allowed subject the approval of the director of the Materials Bureau.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Approved List for rehabilitation of Culverts and Storm Drains.

**706-12 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE**

**SCOPE.** This specification covers the material and quality requirements for smooth interior corrugated polyethylene pipe and fittings.

**MATERIAL REQUIREMENTS.** The polyethylene material for the pipe and fittings shall meet the requirements of AASHTO M294, Type S or Type SP. In addition, when checked with a 12 inches straight edge the smoothness of the interior liner shall not deviate more than 1/4 inch.

**BASIS OF ACCEPTANCE.** Smooth interior, corrugated polyethylene pipe will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

The supplier shall provide two copies of the approved Materials Details through the Contractor to the Engineer as part of the evidence of acceptability for the material at least 10 days prior to shipment of the product to the job site.

**706-13 PERFORATED CORRUGATED POLYETHYLENE UNDERDRAIN TUBING**

**SCOPE.** This specification covers the material and quality requirements for corrugated polyethylene tubing and fittings.

**MATERIAL REQUIREMENTS.** The corrugated polyethylene tubing and fittings 4 thru 10 inches in diameter shall meet the requirements of AASHTO Designation: M252, Corrugated Polyethylene Drainage Tubing except that tubing manufactured from material meeting A.S.T.M. Designation D1248, Class B, shall also be acceptable.

Corrugated polyethylene tubing and fittings 12 inches in diameter shall meet the requirements of AASHTO M252 except the pipe stiffness requirement shall be 45 psi at 5% deflection.

**BASIS OF ACCEPTANCE.** Perforated corrugated polyethylene underdrain tubing will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

**706-14 CORRUGATED INTERIOR POLYETHYLENE PIPE**

**SCOPE.** This specification covers the material and quality requirements for corrugated interior polyethylene pipe and fittings.

**MATERIAL REQUIREMENTS.** The polyethylene material for the pipe and fittings shall meet the requirements of AASHTO M294, Type C.

**BASIS OF ACCEPTANCE.** Corrugated interior polyethylene pipe will be accepted on the basis of the manufacturer's name and location appearing on the Department's Approved List and a material certification that specifies the product conforms to this specification.

**706-15 PVC PLASTIC DRAIN PIPE SYSTEM**

**SCOPE.** This specification covers the material and quality requirements for poly (vinyl chloride) plastic drain pipe, fittings and solvent cement when used as a drain pipe system.

**GENERAL.** The PVC material from which the pipe and fittings shall be extruded or molded shall not contain any reclaimed, reground or reworked material whatsoever, but shall be compounded from virgin PVC resins, plasticizers, stabilizers, and such materials that when compounded, it shall meet the requirements contained in this specification.

The pipe and fittings shall be extruded or molded in such a manner that all cross sections shall be dense, homogeneous, and free from porosity or other imperfections. The solvent cement shall be a solution of unplasticized PVC tetrahydrofuran and cyclohexanone.

**MATERIAL REQUIREMENTS.** The PVC material for the pipe and fittings shall meet the requirements of ASTM D1784 for Rigid Poly (Vinyl Chloride) Compounds and Chlorinated Poly (Vinyl Chloride) Compounds, Class 12444-B.

The molded or extruded pipe shall conform to ASTM D1785 for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 80, PVC 1120.

The molded or extruded fittings shall conform to ASTM D2467 for Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80, PVC I.

The solvent cement shall meet the requirements of ASTM D2564 for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

<b>Nominal Size</b>	<b>Outside Diameter (Inches)</b>	<b>Inside Diameter (Inches)</b>	<b>Wall Thickness Schedule 80 (Inches)</b>
4	4.500	3.826	0.337
5	5.563	4.813	0.375
6	6.625	5.761	0.432
8	8.625	7.625	0.500
10	10.750	9.564	0.593

**DIMENSIONS.** The dimensions and tolerances of the pipe and fittings shall conform to ASTM D1785 and D2467 respectively.

**MARKING.** All material furnished shall be plainly marked in accordance with ASTM D1785, D2467, and D2564 for the pipe, fittings and solvent cement, respectively.

**BASIS OF ACCEPTANCE.** All pipe, fittings and solvent cement shall be accepted on the basis of the manufacturer's certification that the material conforms to this specification.

**706-16 CELLULAR POLYSTYRENE PROTECTIVE COVER**

**SCOPE.** This specification covers the material and quality requirements for cellular polystyrene when used as protective cover for pipes.

**GENERAL.** The protective cover shall be fabricated from rigid extruded cellular polystyrene such that it shall meet the requirements contained in this specification.

The polystyrene shall be extruded in such manner that all cross sections shall be uniform and free from imperfections.

**MATERIALS REQUIREMENTS.** The fabricated cellular polystyrene protective cover shall meet the following requirements:

<b>Property</b>	<b>ASTM Test Procedure</b>	<b>Requirement</b>
Density, pcf	D1622	2.0 ± 0.15
Compressive Strength, psi	D1621	30 ± 5
Flammability	D635	Self-Extinguishing

**DIMENSIONS.** The protective cover shall be fabricated in cylindrical half-sections of any convenient length for application to straight pipe and half-sections of suitable shape and length to protect any non-linear portions of the pipe or fittings.

The thickness of the protective cover shall be maintained within ± 1/16 inch of the thickness shown on the plans.

The protective cover shall be fabricated such that it mates with the pipe without leaving gaps at the seams. It shall have the following maximum clearance between outside diameter of nominal pipe and inside diameter of protective cover:

<b>Nominal Pipe Size, Inches</b>	<b>Maximum Clearance, Inches</b>
1/8 to 1 1/2 incl.	1/64
2 to 4 incl.	2/64
5 to 11 incl.	5/64
12 and over	6/64

**BASIS OF ACCEPTANCE.** All protective cover furnished shall be marked with the following information: manufacturer's name, type of material, and nominal size.

All protective cover shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification.

**706-17 PRECAST CONCRETE BOX CULVERTS**

**SCOPE.** This specification covers the material and quality requirements for precast concrete box culverts.

**MATERIAL REQUIREMENTS.** The Material Requirements contained in §704-03 shall apply except as noted herein.

The concrete used to fabricate precast concrete box culverts shall have a minimum compressive strength of 5000 psi @ 28 days. Joint gasket material shall meet the requirements of ASTM D1056, Grade # 2A1 or # 2A2.

**DESIGN.** When the contract plans contain complete design details for the culvert, alternate designs will not be considered. When the contract plans do not contain complete design details for the culvert the Contractor shall be responsible for providing them. Precast concrete box culvert designs shall meet the requirements of Highway Design Manual Section 19.5 “*Design Guidelines for Reinforced Concrete Culverts*”. Design details for bridge size culverts shall also include load rating information. The Load Rating shall be determined in accordance with the current AASHTO “Manual for Bridge Evaluation,” with all interim provisions in effect. The contractor shall show which method (allowable stress or load factor) was used in load rating computations. Load ratings shall also be computed by the Load and Resistance Factor Rating (LRFR) method. The contractor shall include all load rating computations in the design calculation submittal. Design calculations shall be stamped by a Professional Engineer. The transmittal, processing and approval of box culvert designs will be in accordance with procedural directives of the Materials Bureau.

**DRAWINGS.** The Drawing requirements contained in §704-03, along with the following shall apply.

All fabrication drawings for Contractor provided designs shall be stamped by a Professional Engineer licensed, and registered, to practice in New York State. Fabrication drawings for bridge size culverts shall include load rating information. Reproducible drawings are required for bridge size culverts only.

**FABRICATION.** The Fabrication requirements contained in §704-03, along with the following shall apply.

**Reinforcing.** Unless noted otherwise in the contract plans or approved fabrication drawings the concrete cover over reinforcing steel shall be 1 inch minimum on the walls, floor slab and roof slab of culverts and 1 1/2 inches minimum on wingwalls. When fill heights over the box culvert are less than 24 inches the concrete cover on the outside face of the roof slab shall be 2 inches minimum and all reinforcing steel in the top mat of the roof slab shall be epoxy coated or the concrete shall contain corrosion inhibitor. Fill heights shall be measured from the top of pavement to the top of the culvert roof slab. All reinforcing steel in the wall section of wingwalls shall be epoxy coated or the concrete shall contain corrosion inhibitor.

**Joints.** Precast concrete box culvert sections shall be fabricated with a female joint on the upstream end and male joint on the downstream end. Joint depth shall be a minimum of 2 inches and a maximum of 4 inches. The ends of longitudinal reinforcing steel shall have 1/2 inch minimum concrete cover at the mating surface of the joint. The circumferential reinforcing steel shall have 1 inch minimum concrete cover, as measured to the outermost bars, at the mating surface of the joint. When interferences occur which prevent this, the concrete cover shall be increased accordingly as shown on the approved fabrication drawings. Joints shall be fabricated such that when box culvert sections are fully drawn together the gap between adjacent culvert sections is 3/4 inch maximum. The outside mating surface of the joint shall have a continuous 1 x 1 inch gasket installed at the precast plant.



## SECTION 707 - METAL PIPE

(Last Revised May, 2019)

### 707-02 CORRUGATED STEEL PIPE

**SCOPE.** The material requirements of corrugated steel pipe with metallic, bituminous, portland cement concrete/or polymer coating intended for use in construction of culverts and drainage systems.

**GENERAL.** The corrugated steel pipe covered by this specification is classified as follows:

1. Type I. A full circular cross-section, with a single thickness of corrugated sheet.
2. Type IR. A full circular cross-section, with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.
3. Type II. A Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
4. Type IIR. A Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.
5. Type III. A Type I pipe which has been perforated to permit the in-flow or out-flow of water.

**MATERIAL REQUIREMENTS.** Apply the requirements of AASHTO M 36 Types I, IR, II, IIR, and III except as modified herein for all metallic coated corrugated steel pipe. Apply the requirements of AASHTO M190 except as modified herein for all bituminous coated corrugated steel pipe. Apply the requirements of AASHTO M 245 Types I and II except as modified herein for all polymer coated steel pipe.

When Type IR or Type IIR corrugated steel pipe (spiral rib) is specified, the nominal dimension of the ribs shall be 3/4 x 3/4 inch at 7 1/2 inch pitch.

**A. Coatings .** Coat pipe with one of the following:

1. **Metallic.** The steel sheet will have a protective coating of zinc galvanizing (AASHTO M 218) or of Aluminum-Coated (Type 2) (AASHTO M 274).
2. **Fully bituminous coated and paved invert (AASHTO M 190, Type C).** In addition to one of the metallic coatings, the pipe will be fully bituminous coated and have a bituminous paved invert.
3. **Fully bituminous coated and 100 percent paved (AASHTO M 190, Type D).** In addition to one of the metallic coatings, the pipe will be fully bituminous coated and have a fully paved, smooth bituminous interior.
4. **Polymer coated.** The steel sheet will have a protective coating of zinc (galvanizing). In addition, the pipe will have a minimum interior polymer coating thickness of 0.01 inch and an optional exterior polymer coating. If an exterior polymer coating is applied, it will have a minimum thickness of 0.003 inch.
5. **Polymer coated with a bituminous paved invert.** In addition to the zinc and polymer coatings, the pipe will have a bituminous paved invert.

TABLE 707-2-1 SHEET GAGE NUMBERS AND THICKNESS OF UNCOATED METAL			
Manufacturer's Standard Gage #	Thickness Equivalent(*) Inches	Manufacturer's Standard Gage #	Thickness Equivalent(*) Inches
1	0.27	15	0.067
2	0.25	16	0.060
3	0.24	17	0.054
4	0.224	18	0.048
5	0.21	19	0.042
6	0.20	20	0.036
7	0.18	21	0.033
8	0.164	22	0.030
9	0.150	23	0.027
10	0.134	24	0.024
11	0.120	25	0.021
12	0.104	26	0.018
13	0.090	27	0.016
14	0.074	28	0.015

\*NOTE: Minimum thickness shall conform to the appropriate AASHTO specifications.

**6. Portland Cement Concrete Lined.** The steel sheet will be covered with dense, homogeneous, non-segregating concrete lining. The concrete will be a minimum thickness of 1/2 inch over the crest of the corrugations of the carrier pipe. In no case will the amount of portland cement, blended cement, or portland cement plus fly ash be less than 17 pcf. Fly ash in the mix may not exceed 20% by weight of the cementitious material. When type IP cement is used, no fly ash will be added in batching. All concrete will have a water-cement ratio not exceeding 0.50 by weight. Cure the concrete lining prior to installation as per manufactures instructions.

The bituminous material for coating and/or paving will be homogeneous and have the following properties in addition to those specified by AASHTO M 190:

Penetration at 77°F, 100g, 5 seconds	AASHTO T49	25-50
Penetration Ratio (40°F /77°F x 100)	AASHTO T49	80-90
Softening Point °F (Ball & Ring)	AASHTO T53	88-110

Apply the requirements of AASHTO M 246 for polymer material. Polymer coating materials must appear on the Department's Approved List.

Apply the material requirements of 501-2.02 Materials for portland cement concrete liner material.

**B. Gauge.** The nominal metal thickness corresponding to any gauge is shown in Table 707-2-1.

**C. End Finish.** To facilitate field joining, reroll the ends of all helical corrugated steel pipe with diameters of 12 inches or greater to form a minimum of two annular corrugations of no less than 2 2/3 inch pitch by 1/2 inch depth. Reroll the ends of Type IR and IIR pipe to form only two corrugations.

**D. Coupling Bands.** Supply annular corrugated steel coupling bands for all round pipe sections (Types I, IR, and III) 12 inches or greater in diameter. The band corrugations will have the same dimensions as the pipe ends. Mesh the band with at least one full corrugation and lap it equally on each pipe end. The band width will be a minimum of 7 inches for pipe diameters up to and including 32 inches. The band width will be a minimum of 10 1/2 inches for pipe diameters greater than 32 inches. The thickness of the band cannot be less than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.05 inch.

Pipe arches (Type II and IIR) may be joined by the annular corrugated bands described above or by special projection type coupling bands. The special projection bands will consist of two rows of projections at 3 inches center-to-center that will mesh with at least one full corrugation and will lap equally on each pipe end. The thickness of the special projection bands will not be less than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.06 inch.

Regular projection type coupling bands (dimpled bands) will not be acceptable for 1 foot in diameter pipe and larger. Dimpled bands may be used on pipe diameters smaller than 1 foot, all sizes of perforated underdrain pipe (Type III), and for connecting pipe extensions to existing helical corrugated metal pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands may be one or two piece. Use two piece coupling bands on pipe 48 inches or greater in diameter.

Use one of the following coupling band connectors:

- Galvanized steel angles, 2 x 2 x 3/16 inches
- Lug connectors
- Bar and strap connectors

Rivet, bolt, or weld these connectors to the coupling bands. Any evidence of loose bolts or rivets, bearing failure, or weld or band tearing are cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above, a corrugated angle which conforms to an approved Materials Detail may be used.

Coat the steel sheet used for coupling bands with a polymer or metallic coating. If polymer or metallic coated corrugated steel pipe is being joined, the bands must have the same coating as the pipe.

Joints for concrete lined pipe will meet the requirements of '603-3.06 Joints.

**E. Coating Repair.** Repair damaged metallic, bituminous, portland cement concrete and/or polymer coating.

Metallic coating field repairs will be allowed only when the total damaged area on each piece is less than 2 sf of coated surface, excluding aluminum coated rerolled ends. Any piece having damaged areas totaling more than 2 sf, excluding aluminum coated rerolled ends, will be rejected.

Repair metallic coatings as follows:

- Power disk sand or mechanically wire brush areas of damaged coating to bright metal
- Remove oil, grease, and corrosion products from repair areas
- Spray or brush a zinc-rich paint on clean, dry repair areas. The paint brand must appear on the Department's Approved List, Materials for Use in Repairing Galvanized Surfaces 719-01. The dry film paint thickness shall be at least 0.005 inch. Do not apply paint below 40°F.

Repair aluminum coatings damaged during rerolling at the manufacturing location. The rerolled ends may be either spot repaired or completely painted to repair small areas of damaged coating. Make repairs to the rerolled ends of aluminum coated pipe as referenced above. These rerolled end repairs, when properly completed, will not be counted toward the 2 sf of allowable damaged coating described above.

Repair damaged interior bituminous coatings using the original material or a Corrugated Metal Pipe Bituminous Coating Repair Material appearing in the Department's Approved List. Exterior damage to a bituminous coated pipe requires repair to the metallic coating only.

Repair damaged interior polymer coatings using Polymer Repair Materials for Steel Sheet used for Corrugated Pipe appearing in the Department's Approved List. Exterior damage to a polymer coated pipe requires repair to the metallic coating only.

Repair damaged portland cement concrete linings with Item 701-08, vertical and overhead patching material. The lining will be free of cracks exceeding 0.04 inch in width or the pipe will be rejected.

**F. Marking.** Mark or tag each length of corrugated steel pipe over the coating as approved by the Department to properly cross-reference the supplier's certification.

**G. Additional Defects.** In addition to coating damage and other criteria established in Materials Bureau procedural directives, the following additional defects along with those listed in AASHTO will be cause for rejecting the pipe when inspected at the project:

- Variation from a straight centerline of more than 3/4 inch in 20 feet.
- Any dents greater than 3 inches in diameter
- Any punctures
- Loosely formed or cracked lock seams
- Cracks through the metal
- Sharp bends in pipe arches that are less than the specified minimum corner radius for that size.

**BASIS OF ACCEPTANCE.** Corrugated steel pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. Certification will accompany all shipments arriving at the project in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification will be rejected.

The Engineer will measure gauge and coating thicknesses at the project. The pipe will be rejected if the metal and/or coating thickness is less than required or certified. The Contractor will supply equipment required to measure metal and coating thicknesses as detailed in '603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval will be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

Polymer coatings, coating applicator facilities, and application methods are subject to Materials Bureau approval. Samples are required for laboratory and field testing. Field testing will be a minimum of two years duration. Upon approval, the brand of polymer coating and applicator will be placed on the Department's Approved List. Certifications for polymer coated pipe received at the project will include the brand and applicator of polymer coating, which must appear on the Department's Approved List. Corrugated connecting angles will be accepted provided an approved Materials Detail appears on the Department's Approved List from that supplier.

**707-03 DUCTILE IRON PIPE (NON-PRESSURE)**

**SCOPE.** This specification covers the material and quality requirements for 14 to 54 inches Ductile Iron Culvert Pipe.

**GENERAL.** Ductile Iron Pipe. (Non-Pressure) shall be a centrifugally cast iron pipe conforming to the requirements of ASTM A716, Ductile Iron Culvert Pipe.

**BASIS OF ACCEPTANCE.** Ductile Iron Pipe (Non-Pressure) shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the job site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

**707-04 DUCTILE IRON PIPE (PRESSURE)**

**SCOPE.** This specification covers the material, and quality requirements for 3 to 54 inches Ductile Iron Pipe (Pressure).

**GENERAL.** Ductile Iron Pipe (Pressure) shall be a centrifugally cast iron pipe conforming to the requirements of ANSI A21.51., Ductile-Iron Pipe, Centrifugally Cast In Metal Molds or Sandline Molds, for Water or Other Liquids.

**BASIS OF ACCEPTANCE.** Ductile Iron Pipe (Pressure) shall be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification shall accompany the material delivered to the job site.

The Department reserves the right to sample and test this material subsequent to delivery at the project site.

**707-05 TUNNEL LINER PLATE (RELINING)**

**SCOPE.** This specification covers the material and fabrication requirements for tunnel liner plate.

**MATERIAL REQUIREMENTS.** Tunnel liner plate steel must conform to ASTM A1011. Tunnel liner plate aluminum must conform to AASHTO M219 (ASTM B746). Before cold forming into tunnel liner plate the plates must conform to the following mechanical requirements:

	STEEL	ALUMINUM	
		(0.125-0.15 in.)	(0.173-0.25 in.)
Tensile Strength, psi	42,000 min.	35,000 min.	34,000 min.
Yield Point, psi	28,000 min.	24,000 min.	24,000 min.
Elongation in 2 inch, percent	30 min.	6 min.	8 min.

Prepare test specimens in accordance with ASTM A1011 for steel sheets or ASTM A283 for steel plates and ASTM B209M for aluminum plates. Deliver the Mill test reports, for each heat and thickness to the Engineer with each shipment of liner plates.

**Galvanizing.** Galvanize steel plates in accordance with AASHTO M167 M. Galvanize after the plates are formed, punched and curved. Hot dip galvanize all bolts and nuts, when used with galvanized tunnel liner plate in accordance with ASTM A153.

**Liner Plate.** Punch all plate for bolting on both the longitudinal and circumferential seams or joints and fabricate so as to permit complete erection from the inside of the tunnel liner plate structure. The minimum edge distance from the center of a bolt hole to the edge of a plate will be in accordance with the manufacturer's standard spacing. Provide a sufficient number of plates with 2 inches, or larger, grouting holes with pipe plugs, and spaced so that when the plates are installed there will be one line of holes at the crown of the pipe and one line on each side at approximately the midpoint. The holes in each line will not be more than 6 feet apart, and they will be staggered along the tunnel length.

**Tunnel Liner Plate (Two-Flange).** The minimum moment of inertia in inches<sup>4</sup> per inch of plate width, based on the average of one ring of plates is as follows:

<b>STEEL</b>		<b>ALUMINUM</b>	
<b>Uncoated</b>			
<b>Plate Thickness (in.)</b>	<b>Moment of Inertia (in.<sup>4</sup>/in.)</b>	<b>Thickness (in.)</b>	<b>Moment of Inertia (in.<sup>4</sup>/in.)</b>
0.135	0.064	0.125	0.0579
0.164	0.079	0.150	0.071
0.180	0.087	0.175	0.084
0.210	0.103	0.210	0.097
0.240	0.118	0.225	0.110

The longitudinal seams will be of the lap type. The depth of the offset will be equal to the thickness of the metal for the full width of plate, including flanges. Fabricate the lap to allow the cross section of the plates to be continuous through the seam. The lapped longitudinal joints will contain at least five (5) bolts per 18 inch plate width, with bolts in ridges and valleys staggered. Circumferential bolt spacing will be in accordance with the manufacturer's standard spacing and will be a multiple of the plate length so that the plates having the same curvature are interchangeable. Bolts and nuts for liner plate assemblies will not be less than 0.63 inch in diameter. Circumferential (flange) seams will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A and dimensions conforming to Grade B. Bolts and nuts for longitudinal seams will have square heads with a square shoulder to engage the plate. Longitudinal seams of plates 0.078 to 0.177 inches thick, inclusive will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A. Bolts for longitudinal seams of plates 0.2 to 0.25 inches or thicker will conform to the chemical and mechanical requirements of ASTM A449. Nuts, for use on ASTM A449 bolts, will conform to ASTM A307, with chemical and mechanical requirements conforming to Grade A, and dimensions conforming to Grade B.

**BASIS OF ACCEPTANCE.** Acceptance of this material will be based on the manufacturer's name appearing on the Approved List.

**707-09 CORRUGATED STRUCTURAL STEEL PLATE FOR PIPE, PIPE ARCHES AND  
UNDERPASSES**

**SCOPE.** This specification covers corrugated structural steel plates intended for use in the construction of pipe, pipe arches and underpasses.

**MATERIAL REQUIREMENTS.** Structural steel plate, nuts and bolts shall conform to the requirements of AASHTO M167 except as herein specified and shall be of the thickness and shape shown of the plans. When a gauge number is specified in the contract documents it shall conform to Table 707-2-1.

Plates shall have approximately a 2 inch lip beyond each end crest, which will result in the actual length of a given structure being approximately 4 inches longer than the nominal length, except where skewed or beveled.

If directed by the Engineer, the Contractor shall, at its own expense, repair damaged spelter on plate items as directed under 719-01, Galvanized Coatings and Repair Methods.

This repair method shall be allowed only when it is in the best interest of the Department. All repairs shall be made at no cost to the State.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. Certification format and fabrication shop approval shall be in accordance with procedural directives issued by the Materials Bureau. At the option of the Department, this material may be subjected to shop inspection.

**707-10 GALVANIZED STEEL END SECTIONS**

**SCOPE.** This specification covers galvanized steel end sections to be attached to the inlet and outlet ends of corrugated steel pipe.

**MATERIAL REQUIREMENTS.** Galvanized steel end sections shall be manufactured from material meeting the requirements of AASHTO M218. The units shall conform to the shape, dimensions, and thickness shown on the applicable standard sheet and/or contract plans. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1. Marking and coating repair shall meet the requirements of 707-02, Corrugated Steel Pipe.

**BASIS OF ACCEPTANCE.** End sections will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. All shipments shall arrive at the project with certification prepared in accordance with Materials Bureau procedural directives.

Shipments arriving without certification, or with improper certification, will be rejected.

Metal and coating thicknesses will be measured at the project by project inspectors. If the metal and/or coating thickness is less than required or certified, the material shall be rejected. Equipment required to measure metal and coating thickness shall be supplied by the contractor as detailed in '603-3.02G, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

**707-11 ALUMINUM END SECTIONS**

**SCOPE.** This specification covers aluminum end sections to be attached to the inlet and outlet ends of corrugated aluminum pipe.

**MATERIAL REQUIREMENTS.** Aluminum end sections shall be manufactured from material meeting the requirements of AASHTO M197. The units shall conform to the shape, dimensions, and thickness shown on the standard sheet for galvanized steel end sections and/or contract plans. The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1. Marking shall meet the requirements of 707-13, Corrugated Aluminum Pipe.

**BASIS OF ACCEPTANCE.** End sections will be accepted on the basis of certified documentation issued by a fabrication shop appearing on the Department's Approved List. All shipments shall arrive at the project with a certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, will be rejected.

Metal thickness will be measured at the project by project inspectors. If the metal thickness is less than required or certified, the material shall be rejected. Equipment required to measure thickness shall be supplied by the contractor as detailed in 603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection.

**707-13 CORRUGATED ALUMINUM PIPE**

**SCOPE.** This specification covers corrugated aluminum pipe intended for use in the construction of culverts and drainage systems. The corrugated aluminum pipe covered by this specification is classified as follows:

**Type I.** This pipe shall have a full circular cross-section with a single thickness of corrugated sheet fabricated with annular (circumferential) or helical corrugations.

**Type IA.** This pipe shall have a full circular cross-section with an outer shell of corrugated sheet fabricated with helical corrugations and an inner liner of smooth (uncorrugated) sheet attached to the shell at helical lock seams.

**Type IR.** This pipe shall have a full circular cross-section with a single thickness of smooth sheet fabricated with helical ribs projecting outwardly.

**Type II.** This pipe shall be a Type I pipe which has been reformed into a pipe-arch having an approximately flat bottom.

**Type IIR.** This pipe shall be a Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.

**Type III.** This pipe, intended for use as underdrains or for underground disposal of water, shall be a Type I pipe which has been perforated to permit the in-flow or out-flow of water.

**MATERIAL REQUIREMENTS.** Corrugated aluminum pipe shall conform to the requirements of AASHTO M196 Types I, IA, IR, II, IIR, and III except as modified herein. When Type IR and Type IIR corrugated aluminum pipe (spiral rib) is specified, the nominal dimension of the ribs shall be  $3/4 \times 3/4$  inch at  $7 \frac{1}{2}$  inches spacing.

**Gauge.** The nominal metal thickness corresponding to any gauge shall be as shown in Table 707-2-1.

**End Finish.** To facilitate field joining, the ends of all helical corrugated aluminum pipe with 12 inches or greater diameters shall be rerolled to form a minimum of two annular corrugations of no less than  $2 \frac{2}{3}$  inch pitch by  $1/2$  inch depth. When the ends of Type IR or Type IIR pipe are rerolled, there shall be only two such corrugations. Rerolled pipe ends shall be uniquely and indelibly labeled so the pipe may be assembled in the field in the same order it was manufactured.

**Coupling Bands.** All round pipe sections (Types I, IA, IR, and III) 12 inches or greater in diameter shall be field joined with aluminum coupling bands. Helical corrugated pipe without rerolled ends may be joined with helical corrugated bands. Pipe with rerolled ends or annular corrugations shall be joined with annular corrugated coupling bands.

All bands shall have corrugations with the same dimensions as the pipe ends. Annular corrugated bands shall mesh with at least one full corrugation and shall lap equally on each pipe end. The band widths shall be a minimum of 7 inches for pipe diameters up to and including 32 inches. The band widths shall be a minimum of  $10 \frac{1}{2}$  inches for pipe diameters greater than 32 inches.

The bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.05 inch.

Pipe arches (Type II and Type IIR) may be joined by the annular corrugated bands described above or by special projection type coupling bands. The special projection bands shall consist of two rows of projections at 3 inches center-to-center that will mesh with at least one full corrugation and will lap equally on each pipe end. The special projection bands shall not be more than 2 nominal sheet thicknesses thinner than the pipe and in no case thinner than 0.063 inch.

Regular projection type coupling bands (dimpled bands) will not be acceptable for pipe 12 inches in diameter and larger. Dimpled bands may be used on pipe smaller than 12 inches in diameter, all sizes of perforated underdrain pipe, and for connecting pipe extensions to existing helical corrugated pipe without rerolled ends, unless otherwise shown on the plans.

Coupling bands may be one or two piece. Two piece coupling bands shall be used on pipe 48 inches or greater in diameter.

Coupling band connectors shall be one of the following types:

- Aluminum angles,  $2 \times 2 \times 3/16$  inches
- Aluminum lug connectors
- Aluminum bar and strap connectors.

These connectors shall be riveted, bolted, or welded to the coupling bands. Evidence of loose bolts or rivets, bearing failure, or weld or band tearing shall be cause for rejection and replacement of that coupling band. As an alternate to the coupling band connectors stated above, an aluminum corrugated angle which conforms to an approved Materials Detail may be used.

**MARKING.** Each length of corrugated aluminum pipe shall be marked or tagged as approved by the Department to properly cross-reference the supplier's certification.

**Additional Defects.** In addition to criteria established in Materials Bureau procedural directives and defects listed in AASHTO, the following defects will be cause for rejecting the pipe when inspected at the project:

- Variation from a straight centerline of more than 3/4 inch in 20 feet.
- Any dents greater than 3 inches in diameter
- Any punctures
- Loosely formed or cracked lock seams
- Cracks through the metal
- Sharp bends in pipe arches that are less than the specified minimum corner radius for that size.

**BASIS OF ACCEPTANCE.** Corrugated aluminum pipe will be accepted on the basis of certified documentation issued by a supplier appearing on the Department's Approved List. All shipments shall arrive at the project with certification prepared in accordance with Materials Bureau procedural directives. Shipments arriving without certification, or with improper certification, shall be rejected.

Gauge shall be measured at the project by project inspectors. If the gauge is less than required, the pipe shall be rejected. Equipment required to measure gauge shall be supplied by the contractor as detailed in ' 603-3.02H, Thickness Measuring Equipment.

Acceptance requirements including thickness measurements, visual inspection instructions, certification format, and fabrication shop approval shall be in accordance with Materials Bureau procedural directives. At the option of the Department, this material may be subjected to shop inspection. Corrugated connecting angles will be accepted provided an approved Materials Detail appears on the Department's Approved List from that supplier.

#### **707-14 CORRUGATED ALUMINUM STRUCTURAL PLATE FOR PIPE AND PIPE ARCHES**

**SCOPE.** This specification covers corrugated aluminum structural plates for use in the construction of pipe and pipe arches.

**MATERIAL REQUIREMENTS.** Structural plate, nuts and bolts shall conform to the requirements of AASHTO M219 except as herein specified, and shall be of the thickness and shape shown on the plans. When a gauge number is specified in the contract documents, it shall conform to Table 707-2-1.

The corrugations shall run at right angles to the longitudinal axis of the structure. Plates shall have approximately a 1 3/4 inch lip beyond each end crest, which will result in the actual length of a given structure being approximately 3 1/2 inches longer than the nominal length, except where skewed or beveled.

All sections which are damaged from any cause, including handling, or where any dimension varies from that specified, shall be replaced at the Contractor's expense in a manner approved by the Engineer.

**BASIS OF ACCEPTANCE.** This material will be accepted on the basis of certification by the fabricator. Each fabricator shall furnish upon request by the Materials Bureau a certified analysis and guarantee executed by the manufacturer of the base metal as described in AASHTO M219.

At the option of the Department, structural plates may be subjected to shop inspection or may be shipped to the project site accompanied by certified documentation executed in a form prescribed by the Department.

**707-20 ANCHOR BOLTS FOR CORRUGATED CULVERTS**

**SCOPE.** This specification covers the material details and quality requirements for the anchorage system securing the ends of corrugated metal pipe, arch pipe, and structural plate to reinforced or plain concrete headwalls.

**MATERIAL REQUIREMENTS.** Anchor bolts shall be 3/4 inch diameter heavy hex bolts, ASTM A307. Grip shall be 5 1/2 inches threaded over at least the first 2 1/2 inches. The bolts shall be fitted with two nuts, ASTM A563 heavy hex. Nuts shall be chamfered on at least one face using a 1 inch spherical radii. The nuts and bolts shall be so assembled that in the final assembly, the bolt and one of the nuts is embedded in concrete, that the chamfered faces of the nuts face each other, and secure the pipe between them. Nuts and bolts shall be galvanized as per ASTM A153 after all machining operations are completed. Following galvanization, threads shall be cleaned to produce a free running fit.

When 19 inch hook bolts are used as anchor bolts they shall be detailed on the plans and shall conform to the requirements of ASTM A36.

Anchor bolts shall be spaced around the periphery of the pipe at intervals not exceeding 18 inches. At least two anchor bolts shall be provided.

**BASIS OF ACCEPTANCE.** Anchor bolts and nuts for corrugated metal pipes, pipe arches, and structural plate pipe will be accepted on the Manufacturer's Certification that they conform with these specifications.