

**Attachment**

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

**Award 23372**



**Department of  
Transportation**

# **STANDARD SPECIFICATIONS**

(US CUSTOMARY UNITS)

**VOLUME 4  
SECTION 700**

**CONSTRUCTION  
AND  
MATERIALS**

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# STATE OF NEW YORK

## DEPARTMENT OF TRANSPORTATION

### ENGINEERING DIVISION

Contained herein are:  
General Provisions of Contract;  
Contract forms of Proposal, Agreement and Bonds;  
General Construction Specifications;  
Materials of Construction;  
Payment Items

Adopted  
by

The Commissioner of Transportation  
and Short Titled

## **"STANDARD SPECIFICATIONS" (USC)**

*Note: While these specifications may be used for general construction work, they have been compiled in US customary units with particular emphasis placed upon their use for highways, parkways, bridges and similar work. Necessary modifications of the contents hereof will be incorporated in the "Contract Documents" covering dissimilar work.*

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## 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:

A. **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.

B. **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.

## 706-09 CURED IN PLACE PIPE (CIPP) LINER

(Last Revised May, 2016)

**SCOPE.** This specification covers the material requirements for cured in place pipe liners, or a resin and hardener system, used in rehabilitation of culverts and storm drains.

**GENERAL.** The flexible liner will be fabricated from one or more layers of polyester felt, or from an alternate material approved by the Director of the Materials Bureau. An impermeable material will be bonded to one or both sides of the liner. A styrene or a non styrene based thermoset resin and catalyst or an epoxy resin and hardener system, compatible with the proposed process or other system and/or process approved by the Materials Bureau must be used. If indicated in the contract documents, a resin (or other material approved by the Materials Bureau) containing less than five percent volatile organic compounds (VOCs) with less than 0.1 percent hazardous air pollutants (HAPs) and less than 0.1 percent of water quality pollutants *as listed in 6 NYCRR Parts 700-705* shall be supplied. The proposed resin must be compatible with the inversion process or other Materials Bureau approved installation process.

**MATERIAL REQUIREMENTS.** Supply a system material as described above, conforming to the following minimum values:

Property	Standard	Required*
Tensile Stress, psi	ASTM D638	2,500
Flexural Stress, psi	ASTM D790	4,500
Flexural Modulus, psi	ASTM D790	250,000

\* If the submitted design calculations indicate that higher values for the above listed material properties have been assumed, then the above listed values will become the minimum values for these liner material properties.

**BASIS OF APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the Manufacturer or installer. This application will be accompanied by independent lab test results in accordance with 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 the Materials Procedure “Approval Process for Cured in Place Pipe (CIPP) Liner (706-09)”

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

Application for approval and entering into the aforementioned list shall be in accordance with the Materials Procedure, “Approval Process for Cured In Place Pipe (CIPP) Liner (706-09)”.

#### **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.

**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:

- A. Type I.* A full circular cross-section, with a single thickness of corrugated sheet.
- B. Type IR.* A full circular cross-section, with a single thickness of smooth sheet, fabricated with helical ribs projecting outwardly.
- C. Type II.* A Type I pipe which has been reformed into a pipe-arch, having an approximately flat bottom.
- D. Type IIR.* A Type IR pipe which has been reformed into a pipe-arch having an approximately flat bottom.
- E. 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.

<b>TABLE 707-2-1 SHEET GAGE NUMBERS AND THICKNESS OF UNCOATED METAL</b>			
<b>Manufacturer's Standard Gage #</b>	<b>Thickness Equivalent(*) Inches</b>	<b>Manufacturer's Standard Gage #</b>	<b>Thickness Equivalent(*) Inches</b>
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, nonsegregating 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 flyash be less than 17 pcf. Flyash in the mix may not exceed 20% by weight of the cementitious material. When type IP cement is used, no flyash 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
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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.

## 707-05 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.

**A. 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.

**B. 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.

**C. 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:

STEEL		ALUMINUM	
Uncoated Plate Thickness (in.)	Moment of Inertia (in. <sup>4</sup> /in.)	Thickness (in.)	Moment of Inertia (in. <sup>4</sup> /in.)
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.

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## **707-08 STRUCTURAL STEEL PLATE FOR PIPE, PIPE ARCHES AND UNDERPASSES**

**SCOPE.** This specification covers structural steel plate(s) intended for use in the construction of pipe, pipe arches and underpasses.

**MATERIAL REQUIREMENTS.** Structural steel plate, and all associated accessories and other similar items shall conform to the requirements of ASTM A36 or ASTM A572. This item shall be of the thickness and shape shown on the contract plans and joined only via certified welders. Welded connections are required throughout the system unless otherwise approved by the Materials Bureau. When directed by the Engineer, the Contractor shall, at their own expense, repair or replace any damaged item(s). 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 APPROVAL.** Application for approval shall be submitted to the Materials Bureau by the manufacturer, accompanied by certification to this specification, or in conjunction with the National Transportation Product Evaluation Program (NTPEP).

**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 in the event that a list is established. Certification format and fabrication shop approval shall be in accordance with procedural directives issued by the Materials Bureau. The rehabilitation of any host conduit with a span of 5 feet or greater must be a PE stamped LRFD design, with a minimum LRFR Inventory Rating of 1.2, and is subject to review by DCES and DCETS. At the option of the Department, this material may be subjected to shop inspection. *Buy America requirements apply.*

## **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.

**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:

**A. 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.

**B. 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.

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

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

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

**F. 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  $7\ 1/2$  inches spacing.

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

**B. 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  $2\ 2/3$  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.

**C. 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  $10\ 1/2$  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 x 2 x 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.

**A. 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 appearing on the Department's Approved List. 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.