

**SECTION 02610**  
**PIPE CULVERTS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. Materials and procedures for installing pipe culvert.
- B. Class, type, size, and thickness designations.
- C. Asphalt coating for pipe culvert.

**1.2 RELATED SECTIONS**

- A. Section 00820: Legal Relations and Responsibility to Public.
- B. Section 02317: Structural Excavation.
- C. Section 02330: Embankment.
- D. Section 03055: Portland Cement Concrete.
- E. Section 03310: Structural Concrete.

**1.3 REFERENCES**

- A. AASHTO M 36M: Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
- B. AASHTO M 55: Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
- C. AASHTO M 86M: Concrete Sewer, Storm Drain, and Culvert Pipe.
- D. AASHTO M 170: Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- E. AASHTO M 190: Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
- F. AASHTO M 196M: Corrugated Aluminum Pipe for Sewers and Drains.

- G. AASHTO M 197M: Aluminum Alloy Sheet for Corrugated Aluminum Pipe.
- H. AASHTO M 198M: Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.
- I. AASHTO 207: Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
- J. AASHTO M 243: Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe Arches, and Arches.
- K. AASHTO M 245M: Corrugated Steel Pipe, Polymer Precoated, for Sewers and Drains.
- L. AASHTO M 246M: Steel Sheet, Metallic-Coated and Polymer Precoated for Corrugated Steel Pipe.
- M. AASHTO M 274 M: Steel Sheet, Aluminum-Coated (type 2) for Corrugated Steel Pipe.
- N. AASHTO M 294M: Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter.
- O. AASHTO M 304M: Polyvinyl Chloride (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter.
- P. AASHTO Standard Specifications for Bridge Construction.
- Q. ASTM A 849: Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe.
- R. ASTM C 923M: Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- S. ASTM D 3212: Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
- T. ASTM F 477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

## **PART 2      PRODUCTS**

### **2.1      PIPE CULVERT CLASSES**

- A.    Pipe Culvert Classes:
  - 1.    Class A:      Pipe used in mostly non-reactive soils, and which require no special materials, treatment, or coating.
  - 2.    Class B:      Pipe used in moderately reactive and corrosive soils.
  - 3.    Class C:      Pipe used in soils which are highly reactive and corrosive.
  - 4.    Class D:      Untreated structural plate pipe used in mostly non-reactive and non-corrosive soils.
  - 5.    Class E:      Structural plate pipe used in highly reactive and corrosive soils.
  
- B.    Pipe Culvert Class Substitutions: May be made at no additional cost to the Department.
  - 1.    Class B and C may be substituted for Class A.
  - 2.    Class C may be substituted for Class B or A.
  - 3.    Class E may be substituted for Class D.
  
- C.    Refer to Table 1.

**Table 1: AASHTO Reference Specifications for Pipe Culverts**

Pipe Culvert Type		Pipe Culvert Class					
		A	B	C	D	E	
<b>Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class C.</b>							
<b>1.0</b>	<b>Corrugated Pipe Culverts and Pipe Arch Culverts:</b>						
1.1	Corrugated steel pipe.	M 36M	M 36M	M 36M	N/A	N/A	
1.1(a)	Corrugated steel pipe arch. (1)		Asphalt Coating (Type A) M 190M OR Polymeric Coating 0 Fm (inside) / 250 Fm (outside) M 245M & M 246M ASTM A 849 or Aluminized Type II Steel M 274 (2)	Asphalt Coating (Type A) M 190M OR Polymeric Coating 250 Fm (inside)/250 Fm (outside) M 245M & M 246M ASTM A 849			
1.2	Corrugated aluminum pipe.	M 196M	M 196M	M 196M	N/A	N/A	
1.2 (a)	Corrugated aluminum pipe arch. (1)	M 197M	M 197M	M 197M			
1.3	Corrugated polyethelene (HDPE) pipe	M 294M Cell class # 335420C ASTM D 3350	M 294M Cell class # 335420C ASTM D 3350	M 294M Cell class # 335420C ASTM D 3350	N/A	N/A	
<b>2.0</b>	<b>Smooth-Lined Pipe Culverts and Pipe Arch Culverts:</b>						
2.1	Concrete lined corrugated steel pipe  (Use Type V cement. Refer to Section 03055)	M 36M	M 36M Asphalt Coating (Type A) M 190M OR Polymeric Coating 250 Fm (inside) /250 Fm (outside) M 245M & M 246M ASTM A 849	M 36M Asphalt Coating (Type A) M 190M OR Polymeric Coating 250 Fm (inside) /250 Fm (outside) M 245M & M 246M ASTM A 849	N/A	N/A	

Pipe Culvert Type		Pipe Culvert Class				
		A	B	C	D	E
<b>Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class C.</b>						
2.2	Smooth lined polyethylene pipe.	M 294M Cell Class # 334433C and 335434C ASTM D3350	M 294M Cell Class # 334433C and 335434C ASTM D3350	M 294M Cell Class # 334433C and 335434C ASTM D3350	N/A	N/A
2.3	Smooth lined Poly Vinyl Chloride (PVC) pipe	M 304M Cell Class # 12454C ASTM T 1784	M 304M Cell Class # 1245C ASTM T 1784	M 304M Cell Class # 1245C ASTM T 1784	N/A	N/A
2.4 2.4 A	Asphalt smooth lined corrugated steel pipe Pipe arch	M 36M	M 36M Asphalt Coating (Type D) M 190M	M 36M Asphalt Coating (Type D) M 190M	N/A	N/A
2.5 2.5 a	Spiral rib steel pipe  Spiral rib steel pipe arch	M 36M	M 36 M Asphalt Coating (Type A) M 190M OR Polymeric Coating 0F m (inside) / 250 Fm (outside) M 245M and M 246M, ASTM A 849 or Aluminized Type II Steel M 274 M (2)	M 36 M Asphalt Coating (Type A) M 190M OR Polymeric Coating 250 Fm (inside)/250 Fm (outside) M 245M and M 246M ASTM A 849	N/A	N/A
2.6	Spiral rib aluminum pipe and pipe arch	M 196& and M 197M	M 196& and M 197M	M 196& and M 197M	N/A	N/A
2.7	Reinforced concrete pipe	M 170M Type II Cement	M 170M Type II Cement	M 170M Type V Cement	N/A	N/A
2.8	Non-reinforced concrete pipe	M 170M Type II Cement	M 170M Type II Cement	M 86M Type V Cement	N/A	N/A
2.9	Elliptical reinforced concrete pipe	M 207M Type II Cement	M 207M Type II Cement	M 207M Type V Cement	N/A	N/A

Pipe Culvert Type	Pipe Culvert Class				
	A	B	C	D	E
<b>Substitutions: Class B and C may be substituted for Class A, Class C may be substituted for Class B or A, Class E may be substituted for Class C.</b>					
<b>3.0</b>	<b>Structural Plate Pipe and Pipe Arch Culverts</b>				
3.1	Structural steel plate pipe culverts and pipe arch	N/A	N/A	N/A	M 167M M 243M
3.2	Aluminum alloy structural plate pipe culverts and pipe arch	N/A	N/A	N/A	M 219M M 219M
<b>Footnotes:</b> (1) Minimum corner radii conforming to the details shown on the standard drawings. (2) Acceptable Soil Conditions, Class B, Aluminized Type II Steel are: 1.6mm minimum thickness of metal acceptable where pH is greater than 7 and less than 8.5, and soil resistivity is greater than 1500 ohm-centimeters.					

## 2.2 PIPE CULVERT TYPES

- A. Pipe, Pipe Arch, Structural Plate Pipe and Structural Plate Pipe Arch Culvert Types: Refer to Table 1.

## 2.3 RELATED PRODUCTS

- A. Asphalt Coating: Furnish Material Class M-Mastic, either asphalt or tar base, cold applied. ASTM A 849.
  - 1. Asphalt base mastic design criteria:
    - a. Functions as a cool-applied waterproofing membrane.
    - b. Provides a protective coating to aluminum or steel highly resistant to corrosion and chemical fumes.
    - c. Is not affected by freezing temperatures and does not flow in hot weather.
    - d. Has high cohesive strength and readily hardens in to a tough elastic seal after application.
    - e. Is mixed until the mineral stabilizers and fillers are uniformly dispersed. Follow AASHTO M 243 M.

## 2.4 PIPE SELECTION

- A. At the preconstruction conference, declare choice of pipe, type, diameter and thickness to be used.
- B. Use the same type and strength of concrete pipe or thickness of steel, aluminum, polyethelene or polyvinyl chloride (PVC) pipe for the entire run of pipe.
- C. Use the maximum height of cover to determine the strength or thickness. Refer to Standard Drawings DG 1, DG 2, and DG 3.
- D. Do not use aluminum pipe culvert when a paved invert is required, unless protective measure are taken. Follow 3.7 - C.
- E. Corrugated and smooth-lined polyethylene pipes and PVC pipes: Use only 12 inch to 36 inch diameter.
- F. Precast, non-reinforced concrete pipe: Use only 18 inch to 36 inch diameter.
- G. Do not allow pipes of different types of metal to contact each other. Use matching materials to make direct extensions of existing pipes.
- H. Do not use pipe containing longitudinal lap seams if watertight pipe or watertight joints are called for.

- I. Do not use thermoplastic pipe manufactured without UV inhibitors approved by the Materials Engineer in applications subject to direct sunlight.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Excavating, Trenching, Bedding and Backfill:
  1. Refer to Section 02317.
  2. Refer to Standard Drawings DG 5, DG 6, and DG 9.
  3. Comply with Utah Occupation Safety and Health regulations when excavating and trenching. Note safety restrictions for trenches deeper than 4 feet. Follow Section 00820.
  4. Use Type I bedding unless Type II or Type III is required due to foundation conditions.

### **3.2 INSTALLATION**

- A. Lay culvert starting at the downstream end.
- B. Keep the bottom of the culvert in contact with the bedding throughout its length.
- C. When indicated on the drawings, camber pipe culverts upward from a chord through the inlet and outlet inverts an ordinate amount equal to one percent of the pipe length. Develop camber on a parabolic curve. If the mid-point elevation on the parabolic curve as designed exceeds the elevation of the inlet invert, reduce the amount of camber or increase the pipe culvert gradient.
- D. Place bell or socket end of culvert facing upstream.
- E. Place culverts fabricated with longitudinal laps or seams so that such seams are located approximately 45 degrees away from the invert or crown.
- F. Place paved invert or partially lined culvert so that the centerline of the paved segment matches the flow line.
- G. Place elliptical culvert with the major axis within 5 degrees of a vertical plane through the longitudinal axis of the culverts.
- H. Place outside circumferential laps of flexible corrugated (annular corrugations) culvert facing upstream.

- I. Close the joints to meet the specified joint integrity in accordance with manufacturer's recommendations.
- J. Install pipe to conform to AASHTO Standard Specifications for Highway Bridges:
  - 1. Section 26 for Corrugated Metal Pipe
  - 2. Section 27 for Concrete Pipe
  - 3. Section 30 for Thermoplastic Pipe

### **3.3 JOINTS OR COUPLING BANDS FOR CULVERTS**

- A. General:
  - 1. All joints must sustain 3 psi minimum pressure.
  - 2. Connection of culvert to concrete headwalls, catch basins, etc. must also comply with manufacturer's recommended installation practices.
- B. Concrete Culverts:
  - 1. Meet AASHTO M 198M.
- C. Metal Pipe:
  - 1. Use standard joints or coupling bands unless special joints or special coupling bands are called for on the plans. Refer to Standard Drawing DG 7.
  - 2. Conform to AASHTO Standard Specifications for Highway Bridges and AASHTO M 36M or AASHTO M 245M with the following modifications:
    - a. Use connecting bands of the same class as the pipe. Maintain a minimum thickness of 0.06 inch for the connecting bands.
    - b. Use bands with projections (dimple bands) only in extension of the existing pipes where annular corrugations do not exist.
    - c. The ends of helically corrugated pipe must be re-rolled to form at least two full annular corrugations each before being joined.
    - d. Use flat bands only when approved in writing by the Engineer.
    - e. Follow Standard Drawing DG 7.
- D. Joints for Polyethylene (HDPE) Pipe Culverts: Unless otherwise specified, use standard joints conforming to Section 7 "Requirements," and Section 9 "Test Methods" of AASHTO M 294M.
- E. Joints for PVC Pipe Culverts: Show no leakage when tested in accordance with ASTM D3212.
  - 1. Meet ASTM F 477 for gaskets.

### **3.4 WATERTIGHT CULVERTS AND JOINTS**

- A. Provide watertight joints as follows:
  - 1. Pass AASHTO M 86M paragraph 10.6 test requirements by sustaining a 10 psi minimum pressure for a 10 minute period with no leakage observed.
- B. Use one of the following water tight culverts:
  - 1. Reinforced and non-reinforced concrete pipe. Meet AASHTO M 198M for watertight rubber gaskets. Do not use elliptical pipe. Meet ASTM C 443.
  - 2. Corrugated metal pipe culvert (O-ring gasket placed in lock seam).
  - 3. Helical rib metal pipe (O-ring gasket placed in lock seam).

### **3.5 SMOOTH LINING FOR CORRUGATED STEEL PIPE AND PIPE ARCH CULVERTS**

- A. Clean all surfaces to be lined including removal of all oil and grease from the metal. Allow the surface to dry before proceeding.
- B. Concrete Lining: Follow ASTM A 849, Subsections 5 and 9.
- C. Asphalt Lining: Follow Table 1.

### **3.6 PIPE AND PIPE ARCH CULVERTS**

- A. Use materials described in Table 1.
- B. Remove moisture, dirt, oil, un-bonded or incompatible paint, grease residual oil, alkalies, or other foreign matter from the surface to be coated.
- C. Spray or brush-coat all aluminum culvert contacting concrete with an asphalt mastic or tar base material to a minimum thickness of 0.05 inch.

### **3.7 STRUCTURAL PLATE PIPE AND PLATE PIPE ARCH CULVERTS**

- A. Use materials described in Table 1.
- B. Repair or replace all damaged plates or coatings before installation.
- C. Installation: Follow Standard Drawings DG 5 and DG 6. Embankment: Refer to Section 02330.

- D. Assembly:
1. Give the Engineer a copy of the detail plan showing the position of each plate and the assembly order.
  2. Follow the manufacturer's instructions.
  3. Clearly mark each modified plate, designating its position in the finished structure.
  4. Place outside circumferential pipe-laps facing upstream.
  5. Attain approved seam fit-up. All bolts must be in place and have a torque ranging from 5 lb/ft to 10 lb/ft for aluminum pipe and 10 lb/ft to 28 lb/ft for steel pipe.
  6. Form structural plates so that the finished pipe is elliptical with the vertical diameter approximately 5 percent greater than the nominal diameter.
- E. Asphalt Coating (structural plate pipe, and plate pipe arch, and arches):
1. Thoroughly clean all plates to be coated. Remove any oil or grease from the surface of the plates. Keep plates clean and dry prior to coating.
  2. Apply coating to dry plates:
    - a. Spray or brush-coat the entire exterior surface of the culverts with an approved post-applied mastic coating to a minimum .08 inch wet thickness. Follow AASHTO M 243.
    - b. Spray or brush-coat the inside invert for 1/4 of the circumference of round pipe and the full span width of pipe arch with the same compound.
    - c. Spray or brush coat all metal surfaces in contact with the ground at the time of erection before assembly. The remaining surfaces may be treated after erection.
  3. Apply uniformly to a minimum thickness of 0.6 inch dry thickness to structural plate for pipe, pipe arches, or arches on inside and outside surfaces measured on the crest of the corrugations.
  4. Furnish as follows, according to the application used:
    - a. Spraying consistency: Spray with an air gun without the use of additional thinners when temperatures are 39 degrees F and above.
    - b. Troweling consistency: Apply with a knife or trowel.
    - c. Brushing consistency: Apply with an ordinary roofing brush.

### **3.8 INVERT PROTECTION**

- A. Paved Invert:
1. Use corrugated steel pipe or pipe arch and structural steel plate pipe or pipe arch culverts.
  2. Complete backfill and embankment over the pipe before placing paved invert material.

3. Use 10-gage wire fabric with wire spaced at 6 inch centers. AASHTO M 55.
4. Arc-weld the wire mesh reinforcement to the corrugation at not more than 2 ft centers.
5. Place concrete at least 2 inches above the crest of the corrugations, at least 1/4 the width of the circumference of round pipe, or the span width of arch pipe. Refer to Section 03055.
6. Finish the concrete to a floated surface finish. Follow Section 03310.
7. After curing, coat the joint between the culvert and concrete with liquid asphalt at a rate 0.9 gal/yd<sup>2</sup> of residual asphalt. Coat 6 inches above and below the joints.

### **3.9 QUALITY CONTROL**

- A. Provide adequate cover or protection for all culvert to protect them during project construction. Replace all damaged culverts before acceptance by UDOT.
- B. The following constitute poor workmanship and any one is cause for rejection:
  1. Irregular or distorted shape (not as provided or designed)
  2. Dents or bends
  3. Damaged, broken, or scaled coating
  4. Loose bolts or nuts
  5. Uneven laps
  6. Improper fitting joints
  7. Any damage which compromises the functionality and design life of the pipe.
- C. Coatings:
  1. Furnish a Certification of Compliance from the manufacturer.
  2. Department will take a representative sample from each lot furnished to conduct verification testing.
- D. Joints: Furnish a Certificate of Compliance from the manufacturer of the type specified.

END OF SECTION