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## CORRUGATED METAL CULVERT PIPE

### **GENERAL**

Corrugated steel culvert pipe, aprons, end sections, coupling bands, special fittings, and associated hardware shall meet the requirements of [Specification 4141](#) and the requirements of AASHTO M 36, Type I for circular pipe and Type II for Arch shape, AASHTO M 218 for the steel sheet zinc coated and AASHTO M 196 corrugated aluminum pipe, Type I circular and Type II arch shape. Minimum sheet thickness will be shown on the plans.

Mixing galvanized pipes with aluminized pipes will not be allowed, nor can be allowed on any other accessories.

Coated corrugated steel pipe shall meet the requirements of [Article 4141.02](#) of the Specifications and the requirements of AASHTO M 245 (Polymeric coating) with a minimum thickness of 0.010 inch on inside surfaces and a minimum thickness of 0.030 inch on the outside surfaces.

Bituminous coated corrugated culvert pipe and pipe arches can be used if so designated in the contract document. Bituminous coated corrugated culvert pipe and pipe arches shall meet the requirements of AASHTO M 190 for the type specified.

End of Job Report ([Appendix F](#)) must be completed by the contractor and submitted to the project engineer.

Materials (sheet metal) used to fabricate corrugated pipe, end sections, aprons, coupling bands, special fittings, and all associated hardware shall be of a domestic origin, melted and manufactured in the USA.

### **ACCEPTANCE**

Acceptance shall be based on the following requirements:

- A. Fabricator and source must be on the approved list prior to contract letting.
- B. Material from an approved fabricator
- C. Use of approved brands of metal
- D. Fabricator certificate of compliance
- E. Compliance of test results on monitor samples of metal and hardware
- F. Satisfactory fabrication plant inspection
- G. Proper storage and storage techniques
- H. Proper and complete pipe identification (each pipe, end section, apron, and coupling device shall have the fabricating plant name engraved and / or has a permanent tag attached)  
Note: Engraving shall be placed at the end of the pipe or end section and on the top of the corrugation.
- I. Certified Mill Test Reports

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### **FABRICATOR APPROVAL**

Fabricator approval will be based on information supplied by the fabricator and an inspection of fabricated pipe. The fabricator shall submit the request for approval in writing to the Central Materials Office in Ames, Iowa, and include the following information:

1. Brands of metal to be used
2. Diameters and corrugation size of pipe to be furnished
3. Fabrication methods used
4. Coupling devices furnished
5. Description of quality control procedures used
6. A copy of a typical invoice or bill of lading containing the certification statement of compliance as outlined in this IM
7. Quality Control Plan/Program
8. Qualified QC Personnel
9. Plant approval (equipment, machinery, etc.)

### **ACCEPTED BRANDS OF METAL**

No metal will be accepted until after the sheet manufacturer certified analysis and manufacturer guarantee have been reviewed by the Central Materials Office and accepted. A list of accepted brands of metal is contained in [Appendix A](#). The metallic coated cut sheets or coils furnished shall meet the requirements of, and be marked in accordance with ASTM A-929 Specifications that cover steel sheets used in the manufacture of corrugated metal pipe culvert.

### **FABRICATOR CERTIFICATE OF COMPLIANCE**

The pipe fabricator shall furnish an identification list, invoice or bill of lading for each shipment to an Iowa project or shipment to an intermediate distributor intended for use in Iowa. It shall list the project number, quantities and description of fabricated materials, corrugation size, and thickness of metal used for each pipe size shipped, and contain a certification statement of compliance with Iowa DOT Specifications and AASHTO requirements. When different metal thicknesses are used in bituminous-coated pipe of the same size for any one project, each pipe shall be tagged or marked in a manner that will identify the metal thickness used. The certificate of compliance shall be stated as follows:

#### **FABRICATOR CERTIFICATE OF COMPLIANCE**

- The material covered by this certificate of compliance was manufactured in conformity with Iowa Department of Transportation [specifications section 4141](#) and AASHTO M 36 and M 218. Based on mill certificates and quality control testing, it is certified that representative samples of the listed materials have been tested in accordance with these

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specifications and that the results meet the requirements. (Material description and shipping destination are as shown.)

○                      Authorized Signature                      \_\_\_\_\_                      Date                      \_\_\_\_\_

An authorized representative of the company shall sign the certificate of compliance.

One copy of the document described above shall accompany each shipment and this copy shall be retained in the project engineer file or in the distributor records. Additional copies shall be forwarded at the time of shipment to the Central Materials Office in Ames, Iowa, the District Office responsible for monitor inspections, and the District Office responsible for project administration. Copies of this original document shall be furnished as described above along with the invoice or bill of lading when shipments are made to a project from a distributor.

The fabricator or the intermediate distributor shall also provide summary quantity documentation to the District Materials Engineer at the completion of shipments to a project. A designated representative shall sign the summary documentation. It shall include type and size, the total quantity of each and the project number.

### **MONITOR SAMPLING & TESTING**

Continued acceptance of brands of metal on the basis of the sheet manufacturer certified analysis and guarantee will be based on satisfactory test results obtained on monitor samples.

Monitor samples of metal may be secured from cut sheets or coils at the fabricator plant or from fabricated pipe at a distributor yard or project site. Monitor samples shall be taken at a minimum frequency of one sample annually from the approved fabricator site or supplier site. Additional monitoring inspection may be required for deficient test results on verification samples, inadequate documentation, or identification of materials.

Monitor samples of metal taken from cut sheets or coils shall be at least 4 inches (100 mm) in length by the "as coated" width. Samples taken from fabricated pipe shall consist of about 6 inches (150 mm) cut from the end of the pipe. The fabricator or distributor shall provide certified mill test reports and coating weights when monitor samples are secured.

Failing test results on a monitor sample will be considered sufficient cause to discontinue approval of pipe fabricated from the heat or lot represented and to require additional sampling and testing for the purpose of evaluating the continuance of metal brand acceptance.

Monitor samples shall include the following, sheet metal (of different thicknesses), coupling band, bolts, nuts, washers, rivets, and gaskets.

The bituminous coating and materials for connections and special fittings will be subject to monitor sampling and testing.

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## **WELDING**

Welding of the corrugated metal culvert pipes shall be subject to the following requirements:

- Welding and / or spot welding on 0.037", 1/16", and 1/8" thick materials should be referenced to the AWS D 9.1 sheet metal welding code.
- Welding on 1/4" and / or 1/2" (or thicker) thick materials, should be referenced to the AWS D1.1 Structural Steel Welding Code.
- Weld procedure specifications (WPS) shall be submitted for approval prior to the start of welding.
- Certified welders shall be required.
- Repair of damaged galvanizing shall be required (refer to [IM 410](#) requirements)

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## **MATERIALS**

	Bolts	Nuts	Rivets	Coupling Bands	Gaskets
For M 36 (Steel Pipe)	F568 Class 8.8	A 563 DH	Same as base metal requirements	Band M-36 Bolt F 568 Class 4.6 Nut A 563 D or DH	ASTM D-1056 For "RE" Closed Cell grades or O-ring ASTM C 443
For M 196 (Aluminum Pipe)	F 468 Alloy 6061-T6 (for aluminum) F 738 Alloy group a-1, A- 2, or A-4 (For Stainless Steel)	F 467 Alloy 6061-T6 (For Aluminum) F 836 Alloy Group A-1, A- 2, or A-4 For Stainless Steel	ASTM B-316 Alloy 6056- T4	Band M 197 Bolt F463 Alloy 6061- T6	ASTM D 1056 for "RE" Closed cell grades or O- rings ASTM C-443

**Steel sheets:** All fabricated pipe shall be formed from zinc-coated sheet conforming to AASHTO M218 or aluminum-coated type 2 sheet conforming to AASHTO M274M and / or AASHTO M 196 Type I or Type II as specified. **NOTE:** All pipe furnished to a project shall have the same type of sheeting and metallic coating, unless otherwise specified.

**Steel sheet for coupling bands:** The sheets used in fabricating coupling bands shall have the same coating and shall conform to the same specifications as the pipe requirements.

**Coating Thickness:** 610 g/m<sup>2</sup> (min) the mass coating is the total amount on both surfaces of the sheet.

**Physical Requirements (Flat Sheet Prior to Fabrication):** Tensile strength minimum is 45 ksi (310 MPa). Yield Strength minimum is 33 ksi (230 MPa). Elongation in 2-inch minimum is 20%.

### **Metal Pipe Aprons and Beveled End Sections**

Materials for the pipe aprons and beveled end sections shall meet the chemical and physical requirements of AASHTO M218.

The Galvanized sheet metal of the aprons and end sections shall be comparable to the pipe sections in type, grade sheet thickness, corrugations, dimensions, and coatings.

**Note:** Galvanized sheet metal cannot be mixed with aluminized sheet metal.

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Aprons and end sections shall meet the requirements of Iowa DOT current standard road plans RF5 and RF44.

Bolts and nuts (hardware) shall meet the requirements of this IM (page 3).

Approved sources for apron and end sections are listed in [Appendix E](#) of this IM.

### **FABRICATION INSPECTION**

Continued acceptance of certified fabrication compliance shall be based on compliance with the workmanship and other specified requirements as determined by monitoring inspection of the fabricated pipe. These inspections may be conducted at the fabricator plant, the distributor storage area, or the project site. All systems for handling the galvanized/aluminized pipes shall have padded contact areas. Coated pipes shall be stored above the ground on wooden or padded supports with timbers placed between pipes when stacking is necessary.

### **CORRUGATIONS**

Corrugations shall be either annular or helical. Corrugations shall be smooth, continuous curves and tangents. Dimensions of corrugations shall be follows:

<u>Nominal Size (mm)</u>	<u>Maximum Pitch (mm)</u>	<u>Minimum Depth (mm)</u>
38 x 6.5	48	6.0
68 x 13	73	12.0
75 x 25	83	24.0
125 x 25	135	24.0

**NOTE:** Pitch is measure from crest to crest of corrugations at 90° to the direction of corrugation.

**Sawed Joints:** Cut ends of all pipes and aprons shall be free of notches, gouges or burrs and shall have a workman-like finish.

**NOTE:** All structural plates, cut ends, including fittings and cut ends, shall be zinc-coated after cutting.

Unsatisfactory workmanship or failure to meet other specified pipe requirements will be considered sufficient cause for rejection of the faulty pipe. Evidence that the fabrication problem has been corrected will be required for the purpose of evaluating the continuance of certified fabrication compliance.

**NOTE:** If bituminous coating is specified, then the material shall meet AASHTO M-190 Specifications. If polymer coating is specified, material shall meet AASHTO M-245/245M.

### **WORKMANSHIP**

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The completed pipe shall show careful, finished and acceptable workmanship. Pipe that has been damaged, either during fabrication or in shipping, may be rejected unless repairs are made that are satisfactory to the engineer.

Among others, the following defects shall be considered as basis for rejection:

- Variations from straight center line
- Dents or bends in the metal
- Ragged/rough, sheared edges
- Elliptical shape in pipe intended to be round
- Metallic coating which has been bruised, scuffed, broken or otherwise damaged
- Illegible markings on the steel sheets
- Uneven laps in riveted or spot-welded pipe
- Loosely formed lock seams
- Defective welds

Noncompliant pipes shall be segregated, marked and shall not be used on any projects.

### **PRODUCT MARKING**

- Brand's Name
- Manufacturer's Name
- Sheet thickness, gage, and grade
- AASHTO Designation
- Heat number and coating lot number

Note: Marking shall be applied by a permanent method. The identification shall appear on the outside of the pipe.