



Standard Specification
for



**Corrugated Aluminum Alloy Structural Plate for
Field-Bolted Pipe, Pipe-Arches, and Arches**

AASHTO DESIGNATION: M 219M-92 (1995)
(ASTM DESIGNATION: B 746/B 746M-92)

1. SCOPE

1.1 This specification covers corrugated aluminum alloy structural plate used in the construction of pipe, pipe-arches, arches, underpasses, and special shapes for field assembly. Appropriate fasteners are also described. The pipe, arches, and other shapes are generally used for drainage purposes, pedestrian and vehicular underpasses, and utility tunnels.

1.2 This specification does not include requirements for bedding, backfill, or the relationship between earth cover load and plate thickness of the pipe. Experience has shown that the successful performance of this product depends upon the proper selection of plate thickness, type of bedding and backfill, controlled manufacture in the plant, and care in the installation. The purchaser must correlate the above factors and also the corrosion and abrasion requirements of the field installation with the plate thickness. The structural design of corrugated aluminum structural plate pipe and the proper installation procedures are given in *AASHTO Standard Specifications for Highway Bridges*.

2. REFERENCED DOCUMENTS

2.1 AASHTO Standards:

- M 164 High-Strength Bolts for Structural Steel Joints
- M 232 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- M 291M Carbon and Alloy Steel Nuts [Metric]

- M 298 Coatings of Zinc Mechanically Deposited on Iron and Steel
- R 11 Practice for Indicating Which Places of Figures Are to Be Considered Significant in Specified Limiting Values

2.2 ASTM Standards:

- B 209M Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]
- B 221M Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes [Metric]
- B 666M Practice for Identification Marking of Aluminum Products [Metric]
- F 467M Specification for Nonferrous Nuts for General Use [Metric]
- F 468M Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use [Metric]
- F 568 Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
- F 593 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- F 594 Specification for Stainless Steel Nuts
- F 738 Specification for Stainless Steel Metric Bolts, Screws,

- and Studs
- F 836 Specification for Stainless Steel Metric Nuts

2.3 American National Standards:

- B 18.2.3.6M Bolts, Metric Heavy Hex
- B 18.2.4.6M Hex Nuts, Heavy, Metric

3. DESCRIPTIONS OF TERMS SPECIFIC TO THIS STANDARD

3.1 Arch—a part circle shape spanning an open invert between the footings on which it rests.

3.2 Box culvert—a rectangular box with short-radius in upper corners and a long-radius crown. It can be with full invert or with footings pads.

3.3 Fabricator—the producer of the components for the finished product.

3.4 Flat plate—sheet or plate used to fabricate structural plate.

3.5 Manufacturer—the producer of the flat plate and accessories.

3.6 Pipe—a conduit having full circular shape; also, in a general context, all structure shapes covered by this specification.

3.7 Pipe-arch—an arch shape with an approximate semicircular crown, small-radius corners, and large-radius invert.

3.8 Pipe, horizontal ellipse—an elliptically shaped pipe with the horizontal diameter approximately 20 percent greater than the nominal diameter.

3.9 Pipe, vertically elongated—an



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TABLE 1 Mechanical Properties of Aluminum Structural Plate, Alloy 5052-H141^A

Specified Thickness, mm	Tensile Strength, min, MPa	Yield Strength (0.2-Percent Offset), min, MPa	Elongation, Percent min in 50 mm
2.54–3.81	245	165	6
4.44–6.35	235	165	8

^A To determine conformance with this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 percent, both in accordance with the rounding method of AASHTO R 11.

elliptically shaped pipe with the vertical diameter up to 10 percent greater than the nominal diameter.

3.10 Purchaser—the purchaser of the finished product.

3.11 Special shape—a shape, other than described elsewhere in this section, suitable for fabrication with structural plate.

3.12 Structural plate—a corrugated and curved plate which is field assembled with other structural plates to form the required structure.

3.13 Vehicular underpass—a high arch shape with an approximate semicircular crown, large-radius sides, small-radius corners between sides and invert, and large-radius invert.

4. ORDERING INFORMATION

4.1 Orders for material under this specification shall include the following information as necessary to adequately describe the desired product:

4.1.1 Name of material (aluminum alloy structural plate and accessories),

4.1.2 Description of structure (see Section 3),

4.1.3 Number of structures,

4.1.4 AASHTO designation and year of issue,

4.1.5 Dimensions of structure (diameter or span and rise, and length, etc.) (see Section 7.2),

4.1.6 Thickness of plate (see Section 7.1),

4.1.7 Type of bolts; whether aluminum, stainless steel, or steel bolts are required or permitted. If not specified, steel bolts and nuts shall be furnished (see Section 5.3 and Note 2),

4.1.8 End treatment (bevel, skew, grade or slope corrections, or other special provision if required by the project plans or specifications),

4.1.9 Special requirements (includ-

TABLE 2 (M 219M) Bolt and Nut Requirements

	Bolts	Nuts
General dimensions	ANSI B 18.2.3.6M Heavy Hex	ANSI B 18.2.4.6M Heavy Hex
Steel bolts and nuts	F 568 Class 4.6 ^A	M 291M Class 5
Zinc coating	M 232 or M 298 Class 50	M 232 or M 298 Class 50
Stainless steel bolts and nuts	F 738 Alloy Group A1, A2, or A4	F 836 Alloy Group A1, A2, or A4
Aluminum bolts and nuts	F 468M Alloy 6061-T6	F 467M Alloy 6061-T6
Nominal diameter, metric size	M 20	M 20

^A Bolts through Class 8.8 with suitable nuts may be substituted.

ing extrusion reinforcement locations and shapes), if required, and

4.1.10 Certification, if required.

NOTE 1—Typical ordering descriptions are as follows: Structural plates and fasteners for one aluminum alloy structural plate pipe arch, conforming to AASHTO M 219M—, 3860-mm span by 2460-mm rise, 3.81-mm plate thickness, 27.0-m nominal centerline length with square ends.

5. MATERIALS

5.1 Flat Plate—Insofar as applicable, flat plate shall conform to the requirements of ASTM B 209M. The plates shall be fabricated from alloy 5052-H141. The mechanical properties for alloy 5052-H141 shall conform to the requirements of Table 1.

5.2 Extrusions—The extrusions for circumferential or longitudinal stiffeners, or secondary structural components, shall be fabricated from aluminum alloys 6061-T6 or 6063-T6 conforming to ASTM B 221M.

5.3 Assembly Fasteners—Except as provided elsewhere in this section, bolts and nuts shall conform to the requirements specified in Table 2. The bearing surface of both bolts and nuts shall be shaped to a 25-mm radius spherical surface, or to a uniform taper of approximately 22 degrees to form a conical sur-

face. In lieu of bolts and nuts with the special bearing surface, standard type bolts and nuts with special washers may be used. The number of nuts and bolts of each size and length furnished shall be 2 percent in excess of the theoretical number required to field erect the structure or structures. Bolt lengths shall be such as to result in at least “full nut” engagement when tightened in place.

NOTE 2—Aluminum bolts and nuts, due to lower strength properties than steel bolts, have lower allowable design seam strengths in pipe with all plate thicknesses, but especially so for plate thicknesses greater than 4.5 mm. The purchaser should indicate which bolts and nuts are acceptable or required based on his design calculations. Corrosion should be considered in selecting bolt types for use in corrosive environments.

6. FABRICATION

6.1 Structural plates shall be fabricated from flat sheets or plates, corrugated in accordance with Section 6.2, punched for bolted lap seams in accordance with Section 6.3 and curved to the required radius.

6.2 Corrugations—Corrugations shall form smooth continuous curves and tangents. Corrugations shall form annular rings (complete or partial) about the axis of the