
Standard Specification for Steel Components for Highway Guardrail

AASHTO Designation: M 180-23

Technically Revised: 2023

Technical Subcommittee: 4d, Safety Devices



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This specification covers steel components used in non-proprietary highway guardrail, including corrugated sheet steel prepared for use as guardrail beams, transition beams, end sections, buffer sections, terminal connectors, and backup plates; fasteners including standard and high-strength bolt, nuts, and washers; steel guardrail posts; and anchorage wire rope and swage fittings.
- 1.2. This specification covers coating, storage, and handling requirements for zinc-coated, zinc-alloy coated, uncoated, and atmospheric corrosion-resistant components used in highway guardrail.
- 1.3. *Although some of the components covered under this specification are used in proprietary guardrail systems, these specifications do not purport to address all components of proprietary guardrail systems.*
- 1.4. The values stated in U.S. customary units are to be regarded as the standard. The values given in parentheses are mathematical conversions to metric units that are provided for information only and are not considered the standard unless otherwise noted.

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
 - M 30, Metallic-Coated Steel Wire Rope and Fittings for Highway Guardrail
 - M 111M/M 111, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - M 232M/M 232, Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - M 270M/M 270, Structural Steel for Bridges
 - T 65M/T 65, Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- 2.2. *ASTM Standards:*
 - A36/A36M, Standard Specification for Carbon Structural Steel
 - A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
 - A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot Dip)
 - A563/A563M, Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)
 - A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
 - A572/A572M, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel

- A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality
- A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance
- A606/A606M, Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
- A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot-Dip Process
- A992/A992M, Standard Specification for Structural Steel Shapes
- A1046/A1046M, Standard Specification for Steel Sheet, Zinc-Aluminum-Magnesium Alloy-Coated by the Hot-Dip Process
- B6, Standard Specification for Zinc
- B695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
- E376, Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods
- F436/F436M, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
- F568M, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners (withdrawn 2012; no replacement)
- F2329/F2329M, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- F3125/F3125M, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

2.3. *ANSI/ASME Standards:*

- B1.1, Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
- B1.13M, Metric Screw Threads: M Profile
- B18.21.1, Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
- B18.22M, Metric Plain Washers

3. CLASSIFICATION

3.1. *Six types and two classes of guardrail beams, transition beams, end sections, buffer sections, terminal connectors, and backup plates are provided as follows:*

3.1.1. *Types:*

Type I—Zinc-coated, 1.80 oz/ft² (550 g/m²) total both sides coating weight (mass) minimum single-spot.

Type II—Zinc-coated, 3.60 oz/ft² (1100 g/m²) total both sides coating weight (mass) minimum single-spot.

Type III—Paint-coated.

Type IV—Atmospheric corrosion-resistant steel (weathering steel).

Type V—Zinc-aluminum-magnesium alloy coated, 0.80 oz/ft² (245 g/m²) total both sides coating weight (mass) minimum single-spot.

Type VI—Zinc-aluminum-magnesium alloy coated, 1.00 oz/ft² (305 g/m²) total both sides coating weight (mass) minimum single-spot.

3.1.2. *Classes:*

Class A—Base metal nominal thickness of—0.105 in. (2.67 mm), 12 gauge.

Class B—Base metal nominal thickness of—0.135 in. (3.43 mm), 10 gauge.

3.2. *Tolerances:*

3.2.1. Tolerances for Types I, II, V, and VI coatings shall conform to the values in Table 1.

Table 1—Coating Weight and Thickness Requirements

Type	Coating Weight (Total Both Sides) ^a				Minimum Single-Spot Single Side Coating Thickness ^b	
	Minimum Single-Spot		Minimum Triple-Spot		mils	μm
	oz/ft ²	g/m ²	oz/ft ²	g/m ²		
I	1.80	550	2.00	610	1.5 ^c	38.5 ^c
II	3.60	1100	4.00	1220	3.0 ^c	77.0 ^c
V	0.80	245	0.90	275	0.8 ^d	20.4 ^d
VI	1.00	305	1.15	350	1.0 ^d	25.4 ^d

^a The spot shall be a randomly selected location on the finished sheet steel component. The weight is deemed to be the combined coating weight on both sides of the sheet steel component at that spot.

^b Values in these columns correspond to the thickness value converted from the minimum single-spot column divided by 2 which results in a single sided thickness value.

^c Galvanized coating thickness conversion: 1.00 oz/ft² = 1.68 mils (7.14 g/m² = 1.00 μm)

^d Zinc-aluminum-magnesium alloy coating thickness conversion: 1.00 oz/ft² = 2.00 mils (6.01 g/m² = 1.00 μm)

3.2.2. Thickness tolerance for Classes A and B base metal shall conform to ASTM A568M Table 4.

4. ORDERING INFORMATION

4.1. *Orders for guardrail beams, transition beams, end sections, buffer sections, terminal connectors, and backup plates under this specification shall include the following information, as required, to adequately describe the desired sheet steel component:*

4.1.1. Quantity (linear feet or number of pieces),

4.1.2. Class,

4.1.3. Type,

4.1.4. Effective length of section for guardrail beams 12.5 ft or 25.0 ft (3.8 m or 7.6 m); or backup plates 6 in. or 12 in. (152.4 mm or 304.8 mm),

4.1.5. Shape (W, thrie, symmetrical, asymmetrical),

4.1.6. Component (beam, transition beam, end section, buffer section, terminal connector, backup plate),

4.1.7. Radius and direction of curvature (convex or concave) for curved guardrail beams, if applicable, and

4.1.8. Exceptions to this specification or special requirements, if any.

4.2. *Orders for fasteners under this specification shall include the following information, as required, to adequately describe the desired fastener:*

4.2.1. Quantity (number of pieces),

4.2.2. Coating requirement to match guardrail type (zinc-coated, atmospheric corrosion-resistant, zinc alloy coated),

4.2.3. Grade of fastener (ASTM or ANSI/ASME designation),

4.2.4. Size of fastener ($\frac{5}{8}$ -in. UNC, 16-mm coarse thread, etc.),

4.2.5. Fastener type (splice bolt [alternative 1 or 2], splice nut, post bolt [alternative 1 or 2], post nut, high strength anchor bolt, or washer),

4.2.6. Overall bolt length and threaded length of bolt, and

4.2.7. Exceptions to this specification or special requirements, if any.

4.3. *Orders for steel guardrail posts under this specification shall include the following information as required to adequately describe the steel guardrail post:*

4.3.1. Quantity (number of pieces),

4.3.2. Coating requirement,

4.3.3. Material grade (AASHTO or ASTM designation),

4.4. Shape and size of post cross , Section 4.

5. BASIS OF ACCEPTANCE

5.1. All material shall be subject to inspection and sampling at the fabricating plant, warehouse, or after delivery to the site of construction.

5.2. *Acceptance by Sampling:*

5.2.1. The engineer may take one piece of each sheet steel component, steel guardrail post, and anchor wire rope and swage fitting from each 200 pieces in a lot, or from each lot if less than 200 pieces are included therein, for determination of compliance with specification requirements. If one piece fails to meet the requirements, two other pieces shall be tested. If either of these pieces fails to conform to the requirements of this specification, the lot of material represented by these samples shall be rejected. A lot shall be considered that quantity of material offered for inspection at one time that bears the same heat and coating identification.

5.3. *Acceptance by Brand Registration and Guarantee:*

5.3.1. By mutual agreement between the fabricator and engineer, acceptance may be based on a brand registration and guarantee filed with the engineer by the fabricator. For acceptance of a brand, the fabricator shall furnish a brand registration and guarantee meeting the approval of the engineer and showing the brand name or designation; the manner in which it will appear on the fabricated sheet steel components, steel guardrail posts, or anchor wire rope and swage fittings; the typical mechanical properties; chemical composition if specified; the class and type; and other specified properties. The fabricator shall also guarantee that as long as material is furnished under that brand

and designation, it will conform fully to the requirements of the specification and shall be replaced without cost to the engineer when found not in conformity with any of the specified requirements. The brand registration and guarantee shall be sworn to for the fabricator by a person having legal authority to bind the company. Upon approval of a brand registration and guarantee, that brand will be accepted without further certification. If, in subsequent actual field use, there is evidence of misbranding as determined by random sampling and detection of inadequate tensile strength, yield strength, elongation, improper coating, deficient thickness, or improper fabrication, the material will be rejected and approval for further use withdrawn until subsequently reapproved. Samples for test of any material offered for use may be taken at any time deemed desirable by the engineer.

- 5.3.2. The manufacturer or fabricator shall make such tests and measurements as necessary to ensure that the material produced complies with all specification requirements. These tests and measurements shall be so identified by the identification symbols or code used on the sheet steel components, steel guardrail posts, or anchor wire rope and swage fittings that the manufacturer can produce specific reports showing these test results. Copies of reports of these tests shall be kept on file and shall be submitted to the engineer on request.
- 5.3.3. The brand shall be removed or obliterated by the manufacturer or fabricator on all material where control tests, as outlined herein, do not show conformance to this specification.

6. MATERIALS

- 6.1. *Base Metal for Sheet Steel*—The guardrail beams, transition beams, end sections, buffer sections, terminal connectors, and backup plates shall consist of sheet produced from electric arc furnace or basic oxygen furnace steel and shall meet the mechanical properties specified in Section 8. The chemical composition of the base metal for Type IV shall be as approved by the engineer.
 - 6.1.1. All sheet steel components including guardrail beams, transition beams, end sections, buffer sections, terminal connectors, and backup plates shall be the same type (i.e., coating) as the guardrail beam to which it is attached.
 - 6.1.2. *End Section or Buffer Section*—The material for end sections and buffer sections shall be of the same or greater metal thickness (i.e., class) as the guardrail beam to which it is attached, unless otherwise specified by the engineer.
- 6.2. *Zinc*—The zinc used for the coating of Types I and II shall be as prescribed in ASTM B6 and shall be at least equal to the grade designated as “Prime Western.”
- 6.3. *Zinc-Aluminum-Magnesium Alloy*—The zinc-aluminum-magnesium alloy for Types V and VI shall contain 5–13 percent aluminum, 2–4 percent magnesium, and up to 1 percent total additional alloying elements (except iron), and the balance shall be zinc as prescribed in ASTM A1046/A1046M Section 6.2.
- 6.4. *Fasteners:*
 - 6.4.1. *Standard Strength Bolts:*
 - 6.4.1.1. Unless otherwise specified, standard strength bolts used with Types I, II, III, V, and VI sheet steel components or steel guardrail posts shall conform to or exceed the requirements of ASTM A307 Grade A (ASTM F568M Class 4.6) and shall be coated in accordance with Section 9.2.2 of this specification.