
Standard Specification for

Corrugated Sheet Steel Beams for Highway Guardrail

AASHTO Designation: M 180-00

1. SCOPE

- 1.1. This specification covers corrugated sheet steel prepared for use as beams in highway guardrails.
- 1.2. The values stated in SI units are to be regarded as the standard.
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2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards:*

- M 120, Zinc
- M 232M/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
- T 65M/T 65, Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

2.2. *ASTM Standards:*

- A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- A 653/A 653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
- E 376, Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods
- F 568M, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

2.3. *ANSI Standards:*

- B1.13M, Metric Screw Threads D M Profile
- B18.2.4.1M, Hex Nuts, Style 1, Metric
- B18.2.4.6M, Hex Nuts, Heavy, Metric

2.4. *Military Standards:*

- DOD-P-21035, Paint, High Zinc Dust Content, Galvanizing Repair (Metric)
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3. CLASSIFICATION

- 3.1. Four types and two classes of guardrail are provided as follows:

- 3.1.1. *Types:*
Type I—Zinc coated, 550 g/m² (1.80 oz/ft²) minimum single-spot.
Type II—Zinc coated, 1100 g/m² (3.60 oz/ft²) minimum single-spot.
Type III—Beams to be painted.
Type IV—Beams of corrosion resistant steel.
- 3.1.2. *Classes:*
Class A—Base metal nominal thickness—2.67 mm (0.105 in.).
Class B—Base metal nominal thickness—3.43 mm (0.135 in.).

4. ORDERING INFORMATION

- 4.1. Orders for guardrail under this specification shall include the following information, as required, to adequately describe the desired material:
- 4.1.1. Quantity (linear meter or number of pieces),
- 4.1.2. Class of Guardrail,
- 4.1.3. Type of Guardrail,
- 4.1.4. Effective length of beam section 3.8 or 7.6 m (12.5 ft or 25.0 ft),
- 4.1.5. Shape (W-Beam or Thrie Beam), and
- 4.1.6. Exceptions to this specification or special requirements, if any.

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 guardrail, a backup plate, and end or buffer section 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, 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 which 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 upon 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 beams, the typical mechanical properties, chemical composition if specified, the class and type of guardrail, 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 insure 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 beam 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 upon 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*—The beam, transition, end and buffer sections shall consist of sheet made of open hearth, electric furnace or basic oxygen steel and shall meet the mechanical properties specified in Section 8. The chemical composition of the base metal for Type IV beams shall be as approved by the engineer.
- 6.2. *Zinc*—The zinc used for the coating of Type I and II sections shall be as prescribed in M 120, and shall be at least equal to the grade designated as “Prime Western.”
- 6.3. *Bolts and Nuts:*
- 6.3.1. Unless otherwise specified, bolts and nuts for Types I, II, and III beams shall conform to or exceed the requirements of ASTM A 307 and shall be coated in accordance with Section 9.4.
- 6.3.2. Bolts and nuts for Type IV beams shall be of an approved corrosion resistant material and conform to or exceed the requirements of ASTM A 307.
- 6.3.3. All connections or splices shall be formed with oval shoulder button headed bolts to minimize projections on the road side of the guardrail. Splice and post bolts and nuts shall conform to one of the configurations shown in Figure 3 or Figure 4. Either of the alternate configurations may be furnished unless otherwise specified by the engineer.
- 6.4. *Washers and Backup Plates:*
- 6.4.1. Washers shall be rectangular as shown in Figure 1. Washers for Types I, II, and III beams shall be galvanized in accordance with Section 9. Washers for Type IV beams shall be of an approved corrosion resistant steel. Back-up plates if specified for use at non-splice points shall consist of 305-mm (1-ft) sections of beams and shall be of the same Class and Type specified for the full-length beams.
- 6.5. *End or Buffer Sections:*

- 6.5.1. End or buffer sections shall be of the same or greater thickness of metal and the same type as the beam to which it is attached or the engineer may specify the minimum thickness of metal and type.

7. MANUFACTURE

- 7.1. The beams and end or buffer sections shall be shaped and punched in conformance with the requirements shown in Figures 1 and 2. Transition sections shall be fabricated in accordance with Figure 5 and shall provide a smooth and uniform transition between beams. They shall be ready for assembly when delivered. Only drilling or cutting necessary for special connections and for sampling will be permitted in the field. Warped or deformed beams will be rejected. Beams to be erected on a radius of 46 m (150 ft) or less shall be shop curved to the appropriate curvature of the installation.

8. MECHANICAL PROPERTIES

- 8.1. The mechanical properties of the base metal shall conform to the following requirements:

8.1.1. *Beams and transition sections:*

- Yield Point, minimum, 345 MPa (50000 psi);
- Tensile Strength, minimum 483 MPa (70000 psi); and
- Elongation, in 50 mm (2 in.), minimum, 12 percent.

8.1.2. *End and buffer sections:*

- Yield Point, minimum, 227 MPa (33000 psi); and
- Tensile Strength, minimum 310 MPa (45000 psi).

- 8.1.3. Test specimens for mechanical properties shall be prepared and tested as specified in ASTM A 653 except that correction for thickness of zinc-coated specimens shall be 0.08 mm (0.003 in.) for Type I beam and 0.15 mm (0.006 in.) for Type II beam.

9. COATING REQUIREMENTS

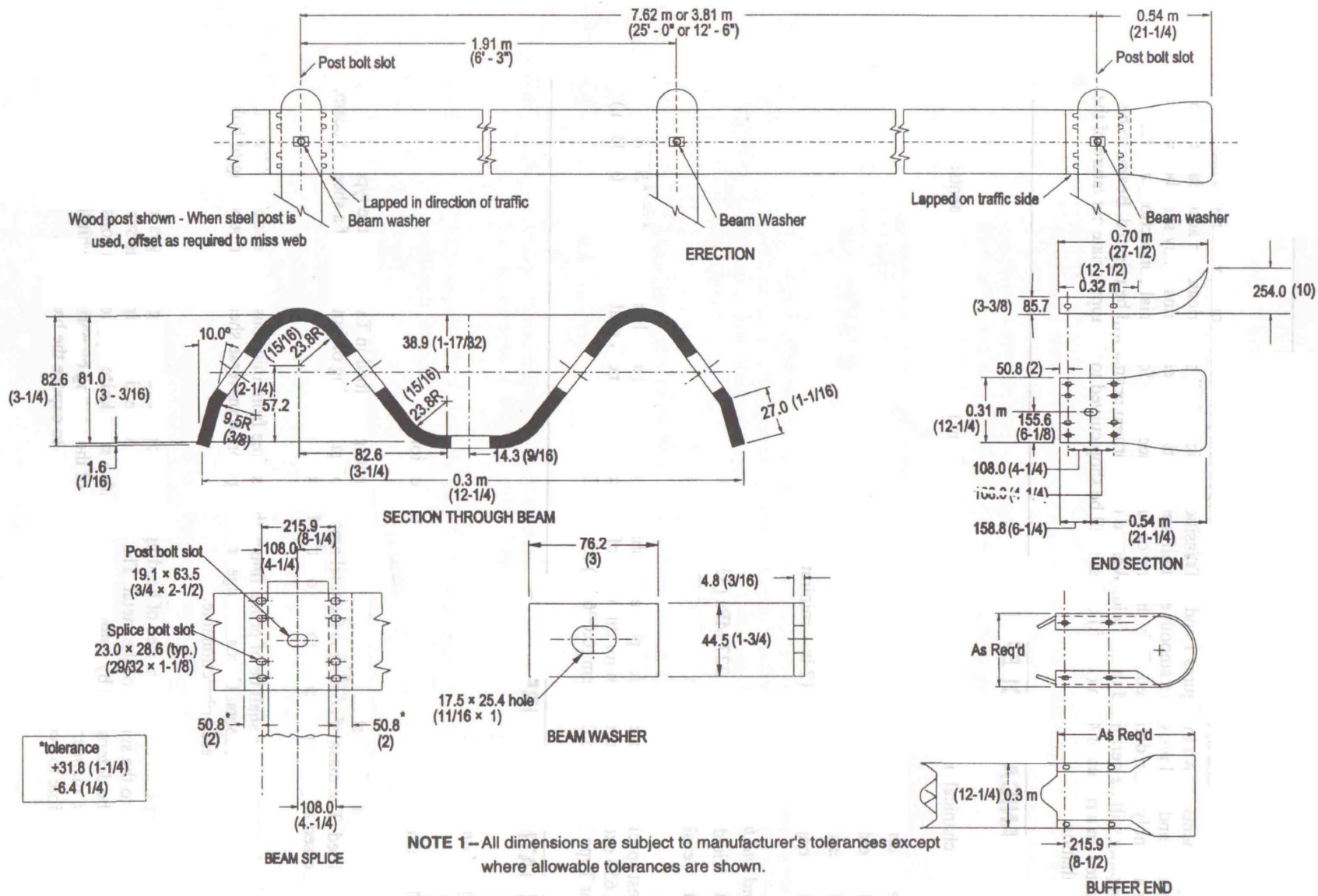
9.1. *Type I and II Beams:*

- 9.1.1. The beams may be galvanized before or after fabrication.

- 9.1.2. The mass of coating shall conform to the requirements prescribed in Table 2 for the types specified. The mass of coating is the total amount of galvanizing on both sides of a sheet or beam, expressed as grams per square meter (oz/ft²) of sheet.

- 9.1.3. The sheets or beams shall be of prime finish, that is, free from injurious defects such as blisters, flux, and uncoated spots. Uncoated edges resulting from transverse shearing or punching of holes will not be considered objectionable.

- 9.1.4. The coating shall be smooth, free of beading or sharp projections along the edges and shall adhere tenaciously to the surface of the metal. The adherence of the zinc coating to the surface of the base metal shall be determined by cutting or prying with a stout knife, applied with considerable pressure in a manner tending to remove a portion of the coating by paring or whittling, and it shall not be possible to peel any portion of the coating so as to expose the base metal.



*tolerance
 +31.8 (1-1/4)
 -6.4 (1/4)

NOTE 1— All dimensions are subject to manufacturer's tolerances except where allowable tolerances are shown.

NOTE 2— All dimensions are in millimeters unless specified otherwise (all parenthetical values are in inches, unless specified otherwise).

NOTE 3— Rectangular plate washers are optional only in the transition sections. They are not to be used in the main sections of strong post guardrail.

Figure 1—W-Beam

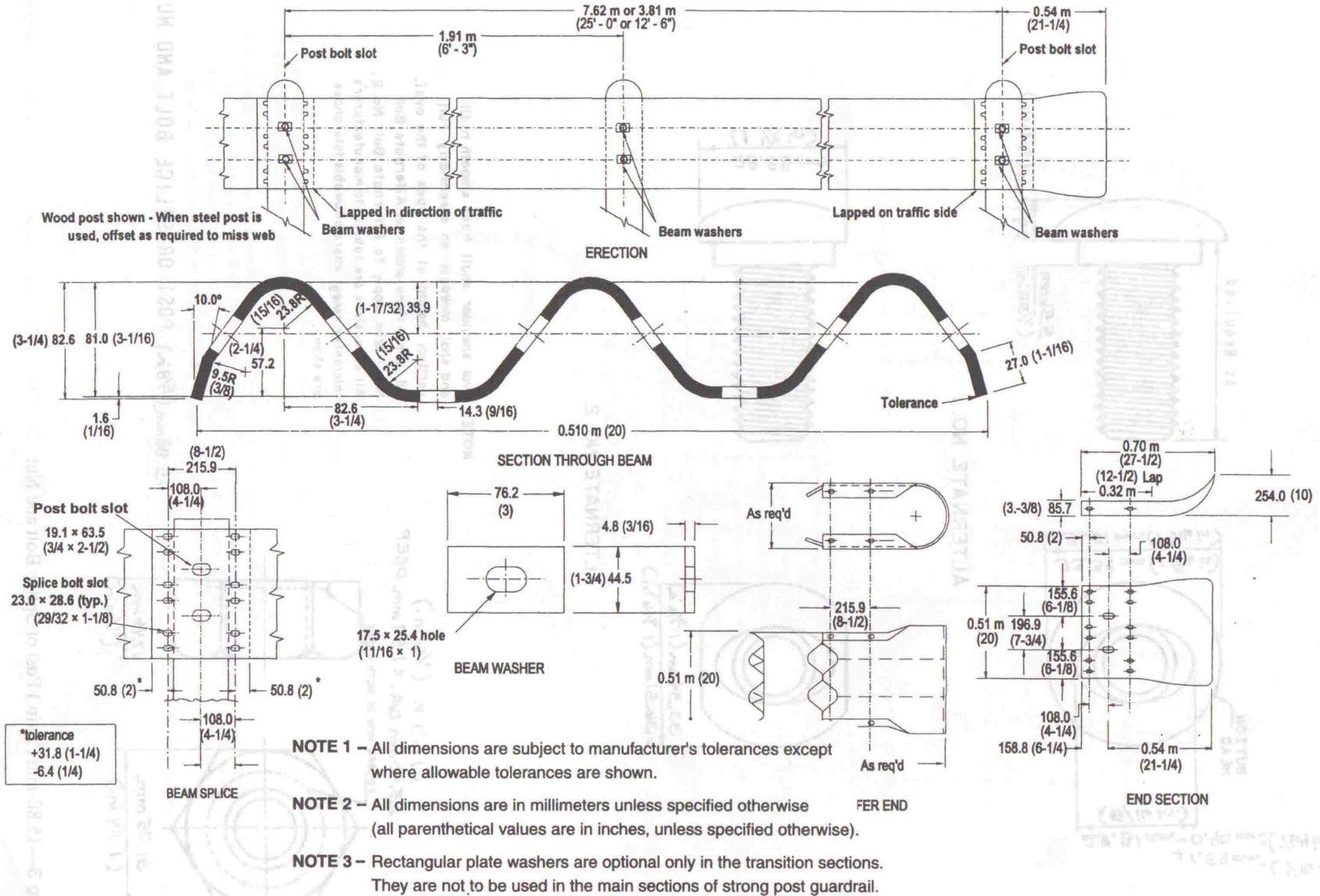
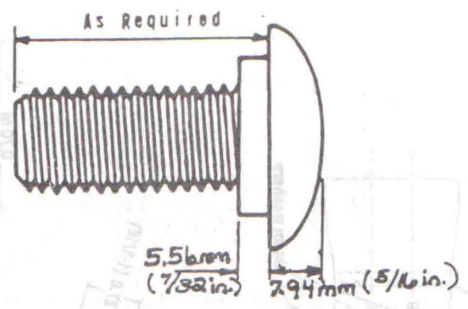
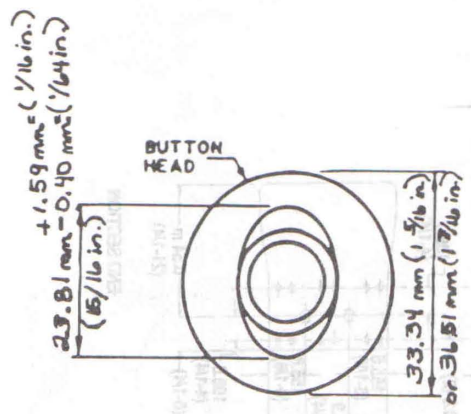
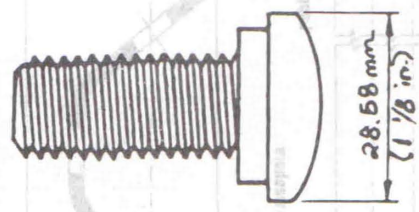
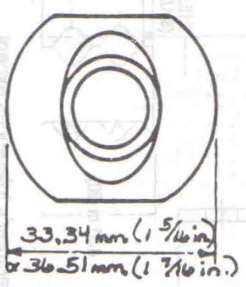


Figure 2—Thrie Beam

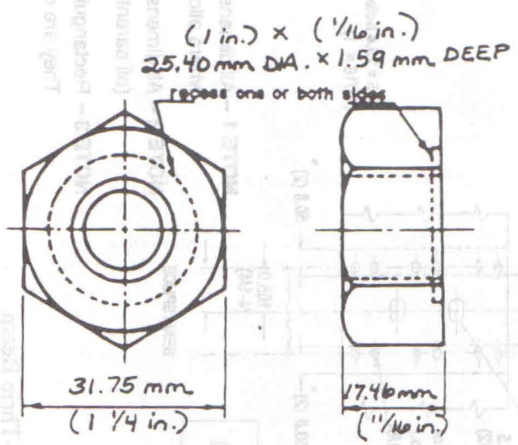


ALTERNATE NO. 1



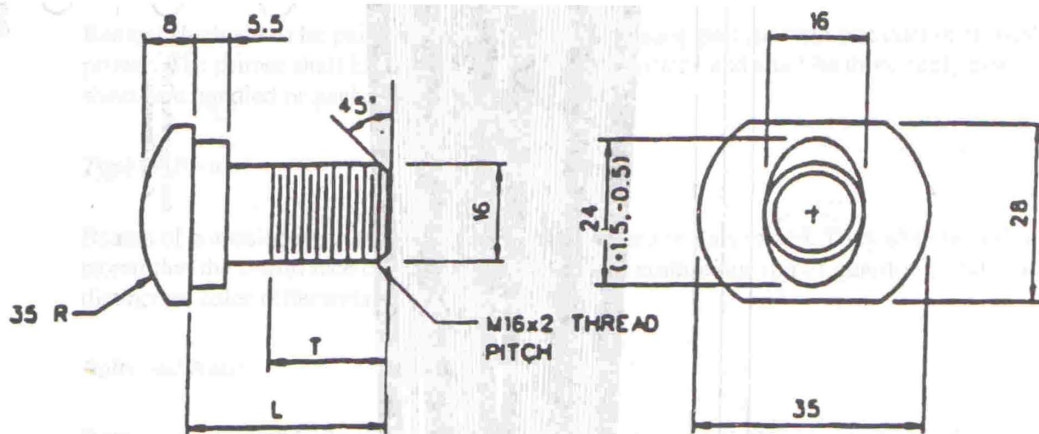
ALTERNATE NO. 2

NOTE: Oval shoulder shall have smooth radii and shall maintain an essentially full vertical height at the apex of the oval. All dimensions shown on Alternate Bolt No. 1 also apply to Alternate Bolt No. 2. All dimensions are subject to manufacturer's tolerances except where allowable tolerances are shown.

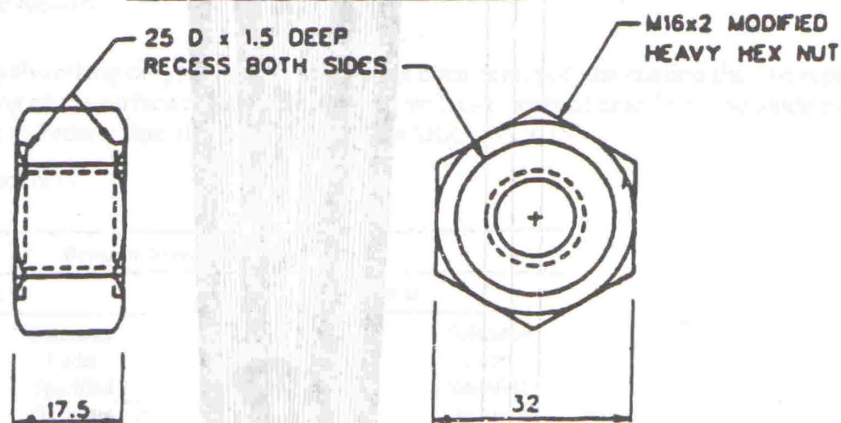


15.88 mm (5/8 in.) POST OR SPLICE BOLT AND NUT

Figure 3—15.88-mm (5/8-in.) Post or Splice Bolt and Nut



DESIGNATOR	L	T (MM)
FBB01	35	30
FBB02	50	45
FBB03	255	100
FBB04	460	100
FBB05	640	100



NOTE—The bolt shall have M16x2 threads as defined in ANSI B1.13M for Grade 6g tolerances. Bolt material shall conform to ASTM F 568M for Class 4.6. Material for corrosion resistant bolts shall conform to ASTM F 568M for Class 8.8.3 bolts.

Nuts shall have ANSI B1.13M M16x2 Grade 6H threads. The geometry of the nuts, with the exception of the recess shown in the drawing, shall conform to ANSI B18.2.4.1M Style 1 for zinc-coated hex nuts and ANSI B18.2.4.6M heavy hex corrosion resistance nuts. Material for zinc-coated nuts shall conform to the requirements of AASHTO M 291M for Class 5 and material for corrosion resistant nuts shall conform to the requirements of AASHTO M 291M for Class 8S3. Zinc-coated nuts shall be tapped over-size as specified in AASHTO M 291M except that a diametrical allowance of 510 mm shall be used instead of 420 mm.

Dimensional tolerances not shown or implied are intended to be those consistent with the proper functioning of the part, including its appearance and accepted manufacturing practices.

Figure 4—16-mm Post or Splice Metric Bolt and Nut

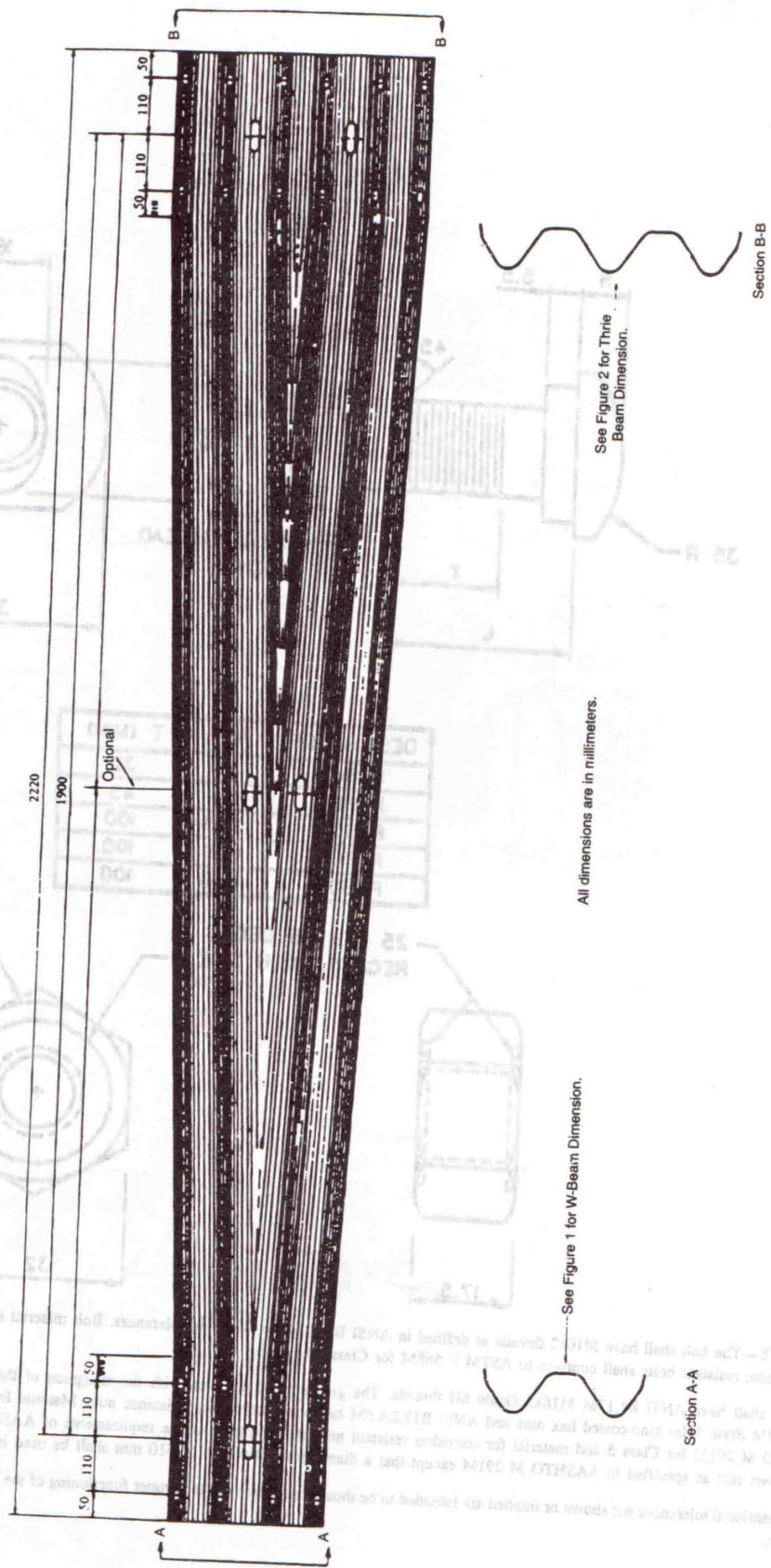


Figure 5—Transition Section

- 9.1.5. The test specimen size and method of tests for determining the mass of coating shall be as prescribed in T 65. At the option of the Engineer, material may be accepted on the basis of magnetic gage determinations made in accordance with ASTM E 376.
- 9.2. *Type III Beams:*
- 9.2.1. Beams which are to be painted shall be cleaned and shop painted with one coat of rust-inhibitive primer. The primer shall have a tough and durable surface and shall be thoroughly dry before the sheets are handled or packed for shipment.
- 9.3. *Type IV Beams:*
- 9.3.1. Beams of corrosion resistant steel shall not be painted or galvanized. They shall be so handled and stored that the traffic face of these beams, used in a continuous run of guardrail, shall not show a distinctive color differential.
- 9.4. *Bolts and Nuts:*
- 9.4.1. Bolts and nuts shall be hot-dip zinc coated in accordance with the requirements of M 232M/M 232, Class C or mechanically zinc coated in accordance with M 298, Class 50, Type 1.
- 9.5. *Washers:*
- 9.5.1. Washers shall be hot-dip zinc coated in accordance with the requirements of M 232M/M 232.
- 9.6. *Galvanizing Repair:*
- 9.6.1. Where the galvanizing on guardrail or fittings has been damaged, the coating shall be repaired by regalvanizing or the surface repaired by painting with two coats of zinc dust-zinc oxide paint conforming to Federal Specification TT-P-641 or DOD-P-21035.

Table 1—Beam or Sheet Thickness

Type	Beam or Sheet Thickness							
	Class A				Class B			
	Thickness		Tolerance Under Specified Thickness, No Limit for Over Thickness		Thickness		Tolerance Under Specified Thickness, No Limit for Over Thickness	
	mm	in	mm	in	mm	in	mm	in
I	2.74	0.108	0.23	0.009	3.51	0.138	0.25	0.010
II	2.82	0.111	0.23	0.009	3.58	0.141	0.25	0.010
III	2.67	0.105	0.23	0.009	3.43	0.135	0.25	0.010
IV	2.67	0.105	0.23	0.009	3.43	0.135	0.25	0.010

Table 2—Weight of Coating

Type	Weight of Coating			
	Min Check Limit		Min Check Limit	
	Single-Spot Test		Triple-Spot Test	
	g/m ²	oz/ft ²	g/m ²	oz/ft ²
I	550	1.80	610	2.00
II	1100	3.60	1220	4.00

10. DIMENSIONS**10.1. Sheet or Beam Thickness:**

10.1.1. The nominal thickness for the finished beam or sheet shall conform to the requirements as prescribed in Table 1.

10.1.2. For fabricated beams, thickness measurements will be made on tangent portions of the cross section.

10.2. Sheet Width:

10.2.1. The beam elements shall be formed from sheets having nominal widths of 483 mm (19 in.) for W-Beams and 749 mm (29½ in.) for Thrie Beams. Tolerance from the nominal width of minus 3.2 mm (1/8 in.) will be permissible.

Note 1—The requirements of paragraph 10.2.1 are intended to define the minimum width sheet permissible. Calculation of exact width dimensions from Figures 1 and 2 shows that the finished product may slightly exceed these widths. However, the dimensions of Figures 1 and 2 can be met within allowable tolerance by using the nominal widths. Use of sheets slightly greater than the nominal widths is permissible provided the tolerances in Figures 1 and 2 are met.

11. MARKING

11.1. Each beam element shall be identified by the following:

- Name or Brand of Manufacturer,
- Identification Symbols or Code for Heat,
- Number and Coating Lot,
- AASHTO Specification Number, and
- Class and Type.

11.2. Markings shall not be placed at such a location that they will be obscured after erection, or in a manner that the brand will be conspicuous to any traffic. Markings placed on the traffic face of the beam shall be placed in the valley of the center corrugation and shall be die imprinted with letters and numerals having a maximum height of 32 mm (1¼ in.) and a minimum height of 19 mm (¾ in.) and shall be clearly legible after galvanization of the rail elements.

11.3. Marking material shall be such as to resist obliteration during storage, transportation, and erection.