

**Standard Specification for Corrugated  
Sheet Steel Beams for Highway guardrail**

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## **DKS 2962-2022**

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The following organizations were represented on the Technical Committee:

Kenya Urban Roads Authority

Asphalt Institute of East Africa Ltd

Kenya National Highways Authority

Roads Division, State Department of Infrastructure, Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works

Kenya Builders & Concrete Company Limited

University of Nairobi

Pelican Signs Ltd

State Department of Public Works, Ministry of Transport, Infrastructure, Housing, Urban Development and Public Works

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### **REVISION OF KENYA STANDARDS**

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# **Standard Specification for Corrugated Sheet Steel Beams for Highway guardrail**

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DRAFT FOR PUBLIC REVIEW

## Foreword

This Kenya Standard was prepared by the Roads and Road Furniture Technical Committee under the guidance of the Standards Projects Committee and in accordance with the procedures of the Kenya Bureau of Standards.

**CD/ENG/09/2017** Gives Standard Specification for Corrugated Sheet Steel Beams for Highway guardrail. Its characteristics are defined in terms of Classification, Ordering information, Basis of Acceptance, materials, Manufacture, Mechanical Properties, Coating Requirements, Dimensions and Marking.

In drafting this standard, assistance was sought from the following publications and their use is acknowledged with appreciation.

AASHTO Designation: M180-12(2017).



# Clay Masonry units — Specification

## 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.

## 2. Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies or **EQUIVALENT KENYAN STANDARD**.

### 2.1. AASHTO Standards:

- ❖ M 111 M/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
- ❖ T 65M/T 65, Mass [Weight] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

### 2.2. ASTM Standards:

- ❖ A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
- ❖ A563M, Standard Specification for Carbon and Alloy Steel Nuts (Metric)
- ❖ A653/ A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized), or Zinc-Iron Alloy-Coated (Galvannealed) 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
- ❖ F568M, Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners (withdrawn 2012)

### 2.3. ANSI Standards:

- ❖ B 1.13M, 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. Federal Standard:

- ❖ TT-P-641, Type II Zinc Dust Primer for Steel or Galvanized Metal Surfaces

### 2.5. Military Standard:

- ❖ DOD-P-21035, Paint, High Zinc Dust Content, Galvanizing Repair (Metric)

## 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/m<sup>2</sup> minimum single-spot.

- ❖ Type II-Zinc-coated, 1100 g/m<sup>2</sup> 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.
- ❖ Class B-Base metal nominal thickness-3.43 mm.

#### **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), Class of guardrail,

**4.1.2.**Type of guardrail,

**4.1.3.**Effective length of beam section 3.8 or 7.6 m,

**4.1.4.**Shape (W-beam or thrie beam), and

**4.1.5.**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 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 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 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 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 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** - 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.

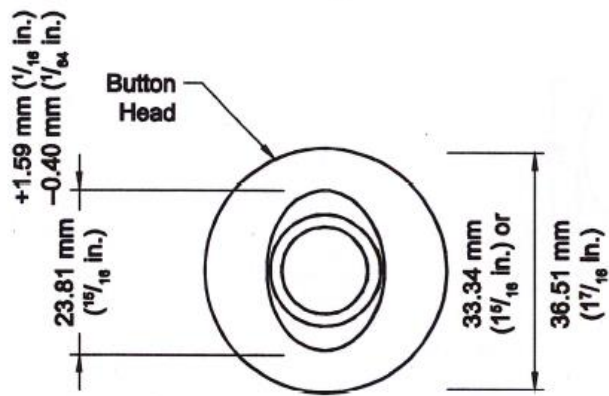
**6.2. Zinc** - The zinc used for the coating of Type I and II sections shall be as prescribed in ASTM B6, and shall be at least equal to the grade designated as "Prime Western."

### **6.3. Bolts and Nuts:**

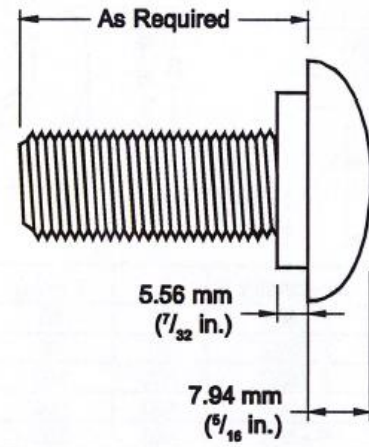
**6.3.1.** Unless otherwise specified, bolts and nuts for Types I, II, and III beams shall conform to or exceed the requirements of ASTM A307 and shall be coated in accordance with Section 9.4.

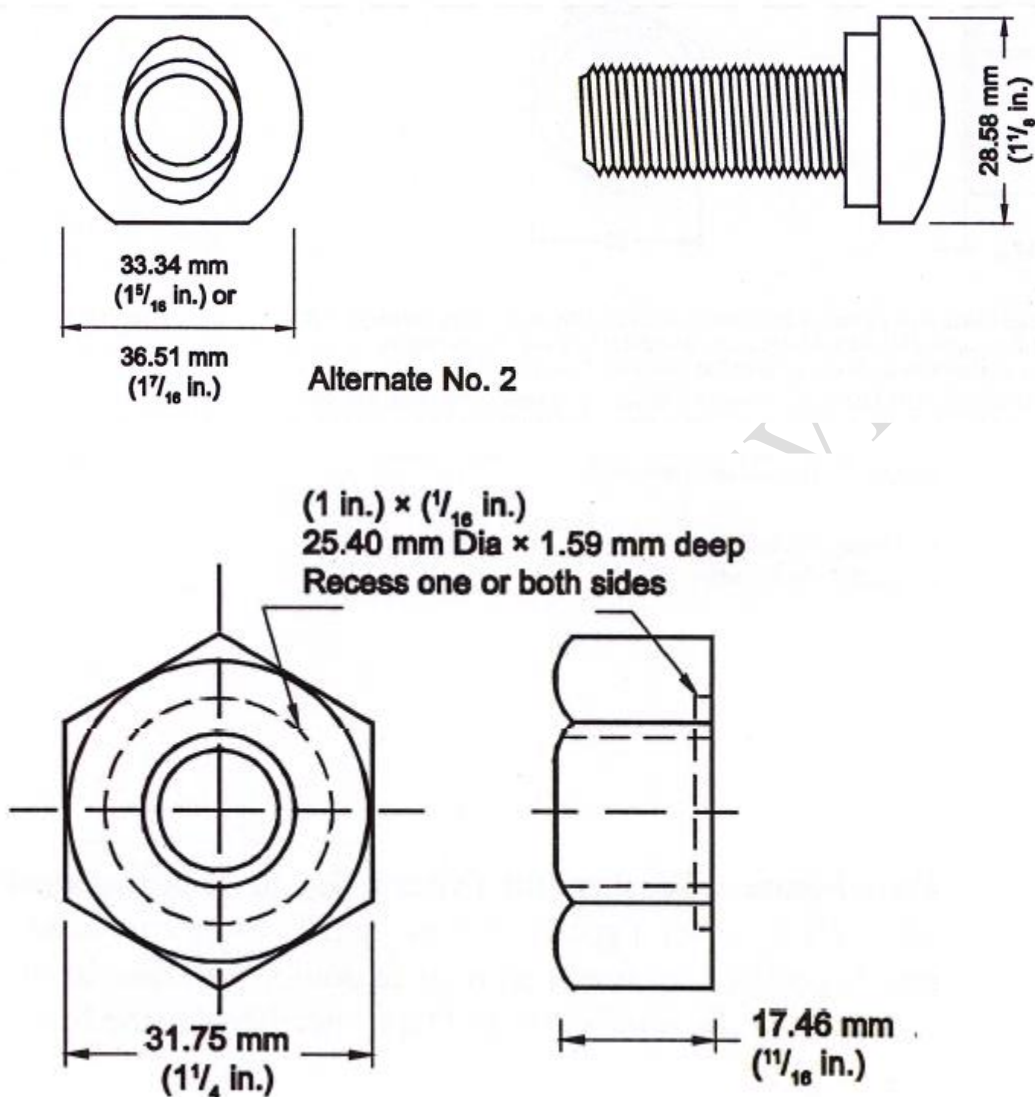
**6.3.2.** Bolts and nuts for Type IV beams shall be of an approved corrosion resistant material and conform to or exceed the requirements of ASTM A307.

**6.3.3.** All connections or splices shall be formed with oval shoulder button headed bolts to minimize projections on the roadside of the guardrail. Splice and post bolts and nuts shall conform to one of the configurations shown in Figures 1 or 2. Either of the alternate configurations may be furnished unless otherwise specified by the engineer.



Alternate No. 1

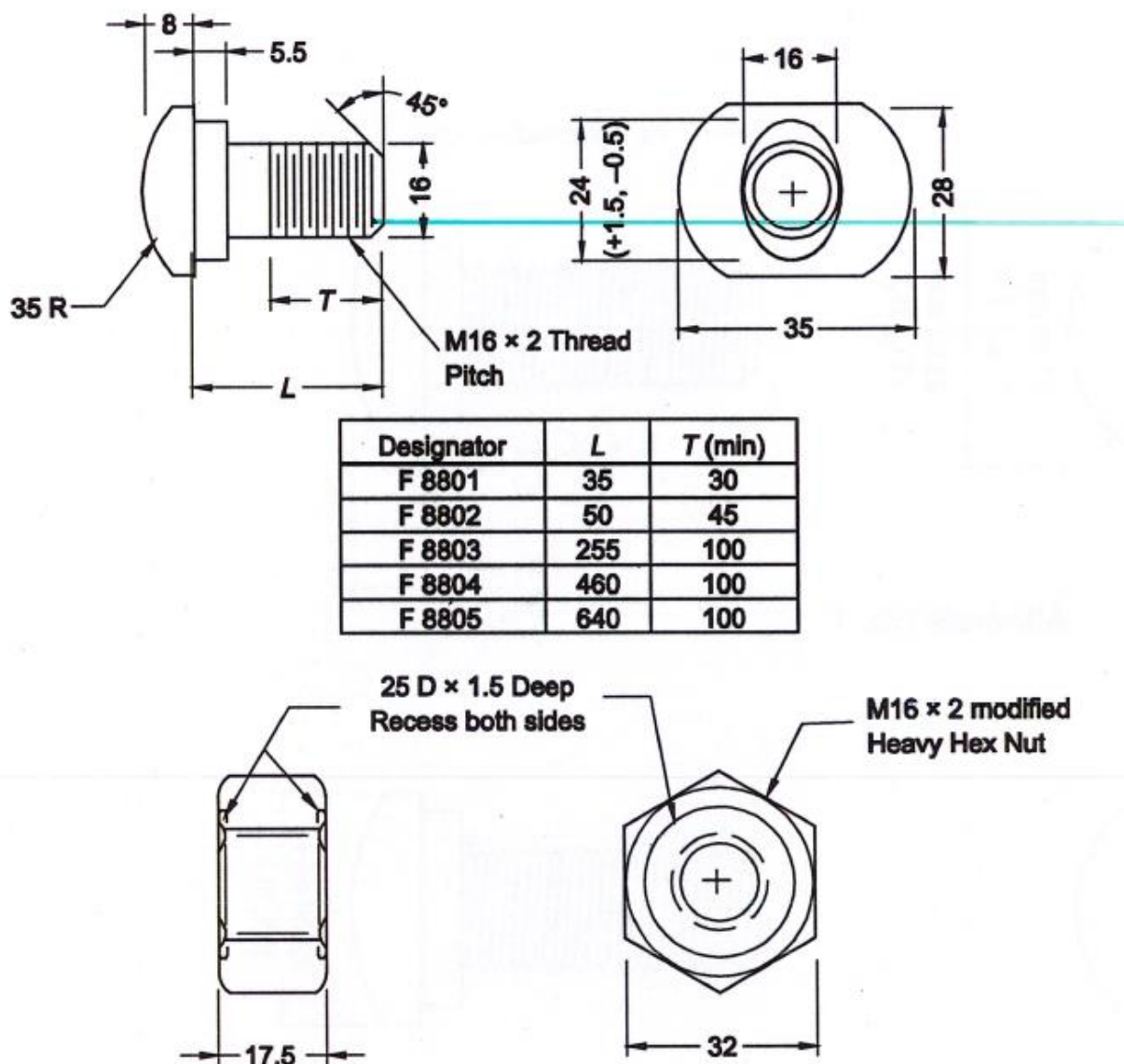




**Note:**

- ❖ Oval shoulder shall have smooth radii and shall maintain an essentially full vertical height of 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.

**Figure 1 - 15.88 mm Post or Splice Bolt and Nut**



**Figure 2 -16-mm Post or Splice Metric Bolt and Nut**

**Notes:**

- ❖ The bolt shall have M 16 x 2 threads as defined in ANSI B1.1 3M for Grade 6 g tolerances. Bolt material shall conform to ASTM F568M (withdrawn 2012) for Class 4.6. Material for corrosion resistant bolts shall conform to ASTM F568M for Class 8.8.3 bolts.
- ❖ Nuts shall have ANSI B1.1 3M M 16 x 2 Grade 6H threads. The geometry of the nuts, with the exception of the recess shown in the drawing, shall conform to ANSI B 18.2.4.1 M Style I for zinc-coated hex nuts, and ANSI B1 8.2.4.6M heavy-hex corrosion-resistant nuts shall conform to the requirements of ASTM A563M for Class 8S3. Zinc-coated nuts shall be tapped oversize as specified in ASTM A563M, except that a diametrical allowance of 510 mm shall be used instead of 420mm.
- ❖ 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.

**6.4. Washers and Backup Plates:**

**6.4.1.** Washers shall be rectangular as shown in Figure 3. 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. Backup plates if specified for use at non-splice points shall consist of 305-mm 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 the metal and the same type as the beam to which it is attached, or the engineer may specify the minimum thickness of the 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 3 and 4. 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 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;
- ❖ Tensile strength, minimum 483 MPa; and
- ❖ Elongation, in 50 mm, minimum, 12 percent.

**8.1.2.** End and Buffer Sections:

- ❖ Yield point, minimum, 227 MPa ; and
- ❖ Tensile strength, minimum 310 MPa.

**8.1.3.** Test specimens for mechanical properties shall be prepared and tested as specified in ASTM A653/ A653M except that correction for thickness of zinc-coated specimens shall be 0.08 mm for Type I beam and 0.15 mm for Type II beam.

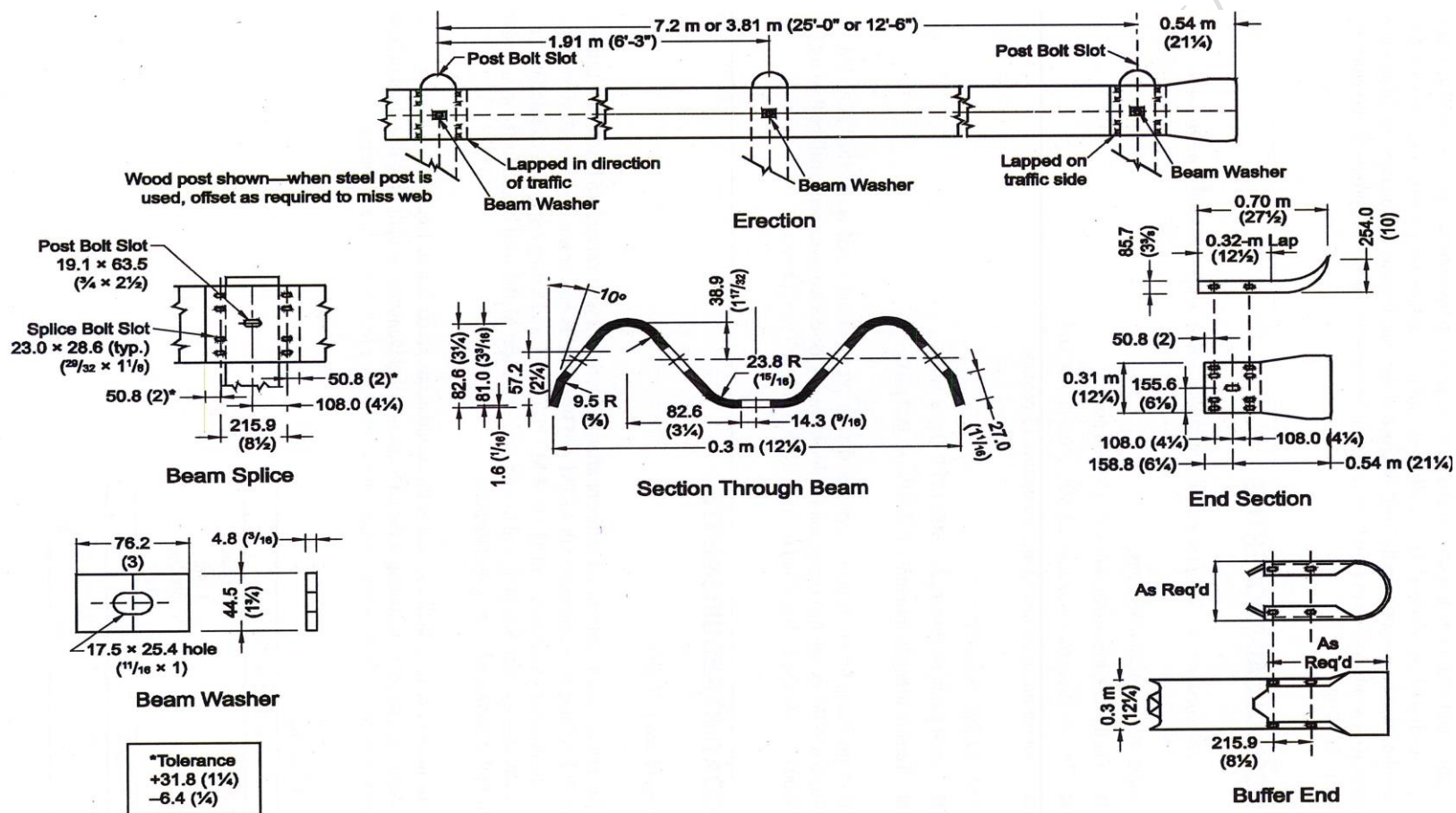
**9. COATING REQUIREMENTS****9.1.** Type I and II Beams:

**9.1.1.** The beams may be galvanized before or after fabrication. Beams galvanized before fabrication shall be coated in accordance with ASTM A653/A653M. Beams galvanized after fabrication shall conform to the requirements of M 111 M/M 111. Coating and testing requirements listed under M 180 shall govern. Sampling and testing not listed under M 180 shall be conducted in accordance with the referenced coating specification.

**9.1.2.** The mass of coating shall conform to the requirements prescribed in Table 1 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 (ounces per square foot) of the sheet or beam.

**Table 1—Weight of Coating**

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



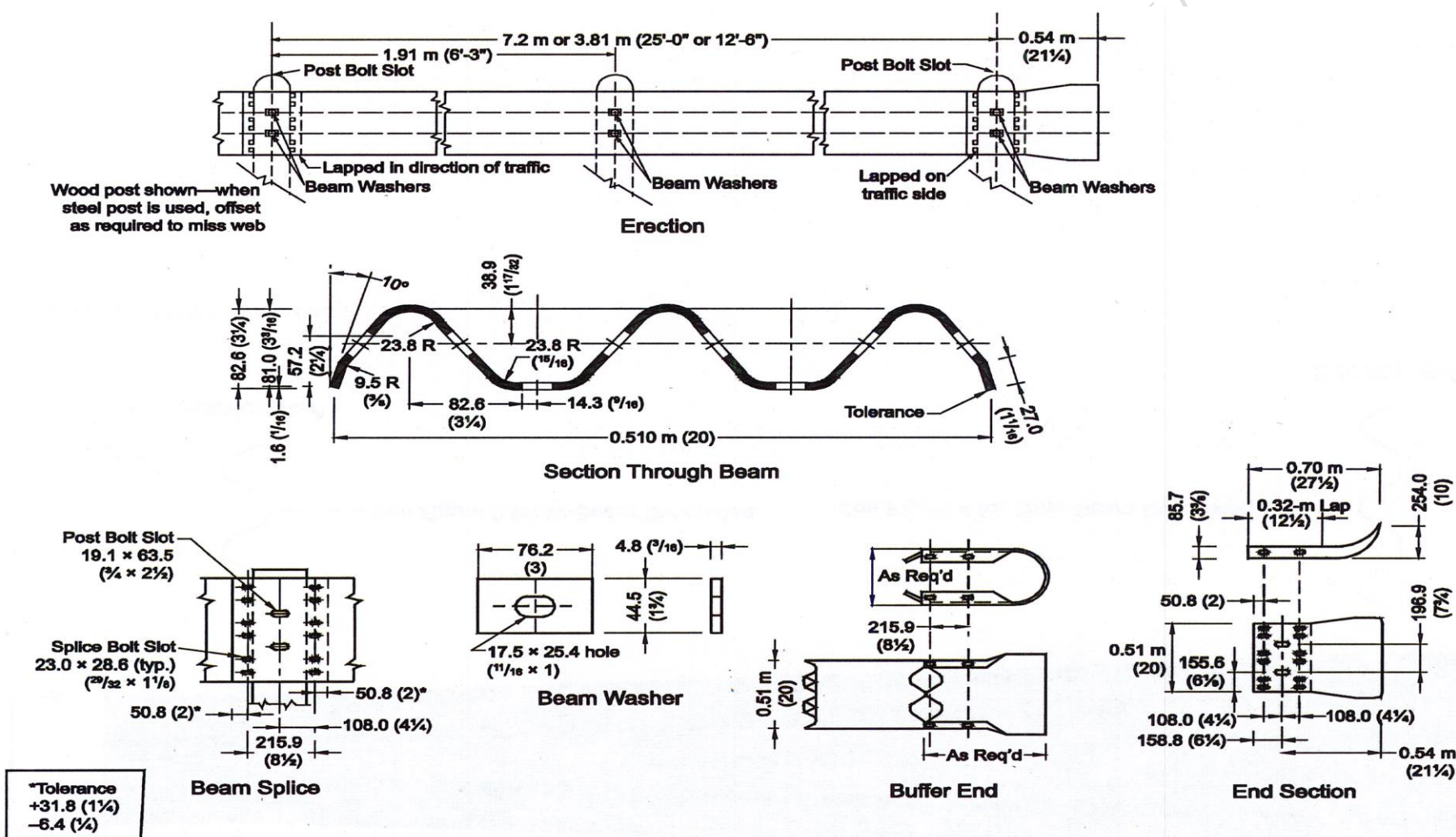
Notes:

1. All dimensions are subject to manufacturer's tolerances except where allowable tolerances are shown.
2. All dimensions shown in millimeters unless otherwise noted. (All parenthetical values are in inches unless otherwise noted.)
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 3—W-Beam







- Notes:
1. All dimensions are subject to manufacturer's tolerances except where allowable tolerances are shown.
  2. All dimensions shown in millimeters unless otherwise noted. (All parenthetical values are in inches unless otherwise noted.)
  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 4—Thrie Beam



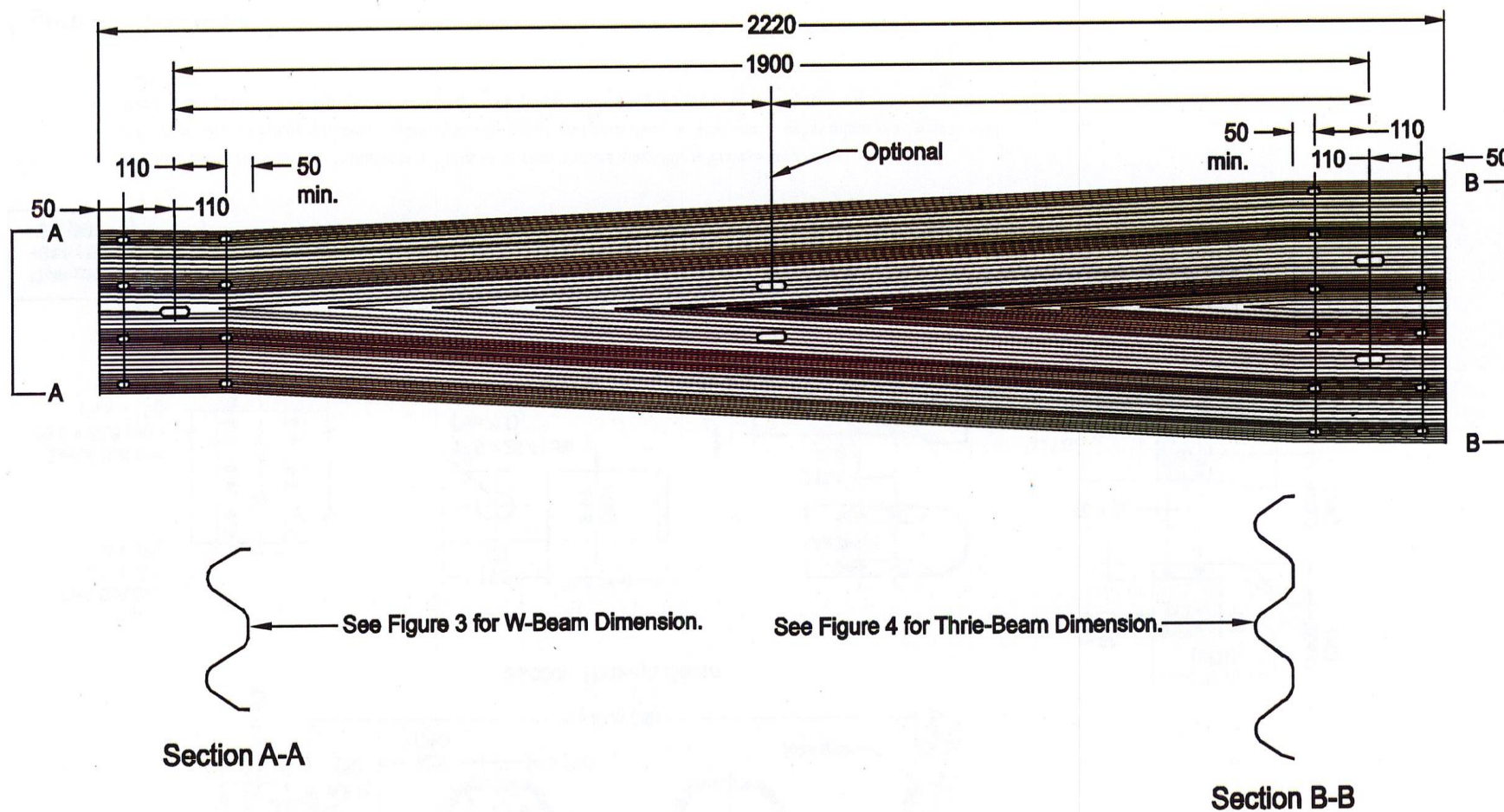


Figure 5—Transition Section



**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.

**9.1.5.** The test specimen size and method of tests for determining the mass of coating shall be as prescribed in T 65M/T 65. At the option of the engineer, material may be accepted on the basis of magnetic gauge determinations made in accordance with ASTM E376.

**9.2. Type III Beams:**

**9.2.1.** Beams that 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 colour 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 ASTM B695, 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.

**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 2.



**Table 2**—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





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 for W-beams and 749 mm for thrie beams. Tolerance from the nominal width of minus 3.2 mm will be permissible.

**Note 1** –The requirements of Section 10.2.1 are intended to define the minimum width sheet permissible. Calculation of exact width dimensions from Figures 3 and 4 shows that the finished product may slightly exceed these widths. However, the dimensions of Figures 3 and 4 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 3 and 4 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,
- ❖ Kebs 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 centre corrugation and shall be die-imprinted with letters and numerals having a maximum height of 32 mm and a minimum height of 19 mm, 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.

11.4. Markings for end sections and backup plates may be on durable tags securely attached to each section or bundle, except that when specified by the engineer, each individual piece shall be marked.