I. Call to Order and Opening Remarks –
   A. Chair Intro and thanks and awards
      i. Brief Intro from New Chair

II. Roll Call (Voting Members) – Sign in Sheet & Introductions
   States present at the meeting are highlighted:
   - Ron Stanevich  WV  Chair
   - Brian Egan  TN  Vice Chair
   - Jason Davis  LA  Member
   - Jim Trepanier  IL  Member
   - Leo Fontaine  CT  Member
   - Lisa Zigmund  OH  Member
   - Brandi Mitchell  KY  Member
   - Jose Lima  RI  Member
   - Richard Douds  GA  Member
   - Kurt Williams  WA  Member
   - Tim Ruelke  FL  Member
   - William Bailey  VA  Member
   - Curt Turgeon  MN  Member
   - John Grieco  MA  Member
   - Darren Hazlett  TX  Member
   - Becca Lane  ON  Associate

Friends of TS-4d & Introductions – (non Voting)
   - Evan Rothblatt  AASHTO  AASHTO Staff
   - Dennis Dvorak  FHWA  Ex Officio
   - Chris Gaudette  Orafol Am.  Friend
   - Todd Ballen  3M  Friend
   - Robert Lutz  AASHTO  Liaison
   - Tracy Barnhart  AASHTO  Liaison
   - Kelly Morse  IL  Member
   - Steven Lenker  AASHTO  Member
   - Maria Knake  AASHTO  Member
   - Henry Lacinak  AASHTO  Member
   - David Ahlvers  MO  Member
   - Danny Lane  TN  Member
   - Art Bertol  Wheeling- Nisshin  Friend
III. Approval of Technical Section Minutes from 2016
   A. No Midyear Meeting for 2016/2017
   B. Meeting Minutes, August 2, 2016. (attachment A and link: 2016 annual meeting minutes) Motion: FL Second: TN

IV. Old Business
   A. Vice Chair – Since volunteering to vice chair TS-4d last year, Mr. Egan has also decided to Chair another Tech Section for 2017. Thus we would like for someone else to step forward as Vice Chair for TS-4d to allow Mr. Egan to be able to focus his time as chair. Danny Lane – TN volunteered (WV nominated, VA second); discussion later in the meeting: change to Tim Ruelke/FL as Vice Chair
   B. Are there any other TS4d committee positions that need filled? Kurt Turgeon volunteered to be research liaison
   C. SOM Ballot / Queries / Items
      i. TS4d Ballot Items?
      ii. 3.8.17 – Two Technical Queries: from March 2017
         1. T 257: 1 Tech Query – Action taken: Re-Confirm 2017/2018? Related to Significance and Use and Terminology, editorial, Ron responded and said we would make the change; will be reconfirmed with editorial changes made
         2. TP 103: 1 Tech Query – Action taken: revised “The size and number of weights are to be adjusted to produce…….” Some wordsmithing needed to be done, edits needed to Figure 1, editorial; will be reconfirmed with editorial changes made
      iii. 6.8.17 – Reconfirmation Report for standards:
         1. TP 103-13 (2015) is a 1yr extension instead of 2 because 2018 will be six years. Proposal to move forward as a full standard instead of provisional? FL indicated recommended changes are coming to the standard; motion to extend the standard for one year; motion: VA, second: TN; next year, we will vote again on either deleting the standard or moving forward as a full standard (2018 is the last year it can be a TP standard) – it’s important to get the recommended changes in the standard before then; Katheryn Malusky/AASHTO indicated that NTPEP already has a group working on the changes, Tim Ruelke/FL volunteered to update the group during the mid-year webinar as to the status of the changes; a Tech Section ballot can be sent at any time that includes the changes
            a. Would need to coordinate with NTPEP: http://www.nttep.org/Pages/DWS.aspx; Jonathan Siriani is the AASHTO liaison for NTPEP’s DWS Tech Committee, Karen Byram of FL DOT is chair, Natalie Roskam of NC DOT is vice chair
      iv. M 180 – Proposed Revisions – there was a presentation by Wheeling Nisshin at the 2016 SOM addressing potential changes to M 180. Proposed changes are attached as attachments C and D attachment C. Discuss Support / Objections and if the Tech Section should proceed or recommend further changes.
Revisions are to include ZAM coating and new ASTM standards that pertain to that coating; Art Bertol/Wheeling Nisshin discussed the revisions; other materials and coatings will remain in the standard; VA – motion to move to Tech Section ballot, second: TN; motion by MN to approve as Tech Section ballot, second: TN (Danny Lane); voice vote based on quorum: motion by MN to move to full SOM ballot, second: VA, motion passes

v. Other Items?

D. TS Ballots

i. M 180 Corrugated Sheet metal Beams for Highway Guardrail, Revision forwarded to AASHTO in 2016. 2016 TS4d The issue concerns wording of “spot” in the spot test? Clarified that and what a beam actual is. Was this moved forward in 2016? This was brought up last year, and Ron received an email that the changes hadn’t been made; just need to make sure revisions show up when full ballot comes out; contact Dennis Dvorak/FHWA with questions. Art Bertol stated that the above changes were incorporated into the changes submitted and discussed in C iv above eliminating the issue.

E. Task Force Reports

i. M 333/TP 103- Task Force lead by Darren Hazlett (TX), assisted by Henry Lacinak (AASHTO) and Danny Lane (TN). Task force to look into developing a national standard : 2016 decided to “Proceed towards NCHRP Research” and “Do Nothing”. Also talk about getting into NTPEP. Are there any action items with this for 2017 and is this related to bullet above (bullet - IV:C:ii:2 ) Danny Lane/TN indicated there aren’t any action items; Darren is retiring, discussed who would replace him on the Task Force – Karen Byram can take over; this Task Force can be closed.

F. Research Proposals:

i. NCHRP 20-/ Task 374 Guidelines for Selecting Sign Sheeting Materials for AASHTO M 268 (H Lacinak)– this was on the 2016 agenda and was only briefly reviewed. Status of new information? VA indicated this was related to providing guidance to the states about how to use materials specifications; should have an update either at the mid-year webinar or next year; waiting to make the contract official.

ii. Tensioned Cable Guardrail Specification 46-14 Final Report (T Ruelke): Submitted Statement on 7.7.17 (attachment B) was recommended by TS in 2016. FL/Tim Ruelke gave an update; specification for materials used in cable barriers systems; TN/Danny Lane indicated we definitely need this; MN indicated $200,000 is too much for a synthesis (needs to be $100,000); discussion regarding MASH testing; change this to being endorsed by this Tech Section; Ron/WV made a motion to move this forward as a 20-07, TN - second.

V. New Business
A. Research Proposals None
B. AMRL - AASHTO re:source/CCRL – None
C. NCHRP Issues - None
D. Correspondence, calls, meetings - None
E. Presentation by Industry/Academia - None
F. Proposed New Standards - None
G. Proposed New Task Forces - None
H. Standards Requiring Reconfirmation – AASHTO will handle this
I. SOM Ballot Items (including any ASTM changes/equivalencies) – None

VI. Open Discussion
FL/Tim Ruelke discussed defining toll lanes and getting drivers to behave properly; working with TTI to do research on flexible lane delineators; delineators should be able to withstand abuse; Katheryn Malusky/NTPEP indicated that delineators will be handled by TTI and Danny Lane/TN will still be doing low-impact barrel testing; the revised NTPEP work plan will be balloted this fall; Tim asked if there would be a companion AASHTO standard – Katheryn indicated that evaluations are being conducted in accordance with state specifications (which may eventually become AASHTO standards)

NTPEP update given by Ryan Fragapane – he will forward notes to Ron Stanevich for the record

VII. Adjourn 11:44 a.m.
### TS 4d 2017 Annual Meeting Summary

**Meeting Date:** 8/8/2017

**Items approved by the TS for TS/Subcommittee/Concurrent Ballot**

<table>
<thead>
<tr>
<th>Standard Designation</th>
<th>Summary of Proposed Changes</th>
<th>TS Only, Subcommittee Only or Concurrent? (TS / S / C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T 257</td>
<td>reconfirmed, with editorial changes</td>
<td>TS</td>
</tr>
<tr>
<td>TP 103</td>
<td>reconfirmed, with editorial changes</td>
<td>TS</td>
</tr>
<tr>
<td>M 180</td>
<td>revisions to include ZAM coating and applicable ASTM standards that apply to that coating</td>
<td>S</td>
</tr>
</tbody>
</table>

**New Task Forces Formed:** None

<table>
<thead>
<tr>
<th>Task Force Name</th>
<th>Summary of Task</th>
</tr>
</thead>
</table>

**Research Liaison:** Kurt Turgeon/MN (new)

**Other Action Items:**
- Tim Ruelke/FL has been appointed as the new Vice Chair of TS 4d
- Tim Ruelke/FL will give an update on the status of changes to TP 103 at the 4d mid-year
- Make sure revisions to M 180 are added before the Subcommittee ballot comes out
- Close Task Force for M 333/TP 103
- Move research proposal for Tensioned Cable Guardrail Specification 46-14 forward as
This document presents the standard specification for AASHTO Designation: M 180-12 with proposed changes to the specification to include Zinc-Aluminum-Magnesium Alloy-Coating. Changes are presented in “blue” type. Those sections changed are placed in boxes, starting with “original language” then followed by “proposed changes”.

Standard Specification for

Corrugated Sheet Steel
Beams for Highway Guardrail

AASHTO Designation: M 180-12
Standard Specification for

Corrugated Sheet Steel
Beams for Highway Guardrail

AASHTO Designation: M 180-12

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. REFERENCED DOCUMENTS

2.1. AASHTO Standards:

- 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
- 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
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
- A924/A924M, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- 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

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 **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. Six 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.
- **Type V**—Zinc, 6% Aluminum, 3% Magnesium alloy coated, 245 g/m² (0.80 oz/ft²) minimum single-spot.
- **Type VI**—Zinc, 6% Aluminum, 3% Magnesium alloy coated, 305 g/m² (1.00 oz/ft²) minimum single-spot.

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 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 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 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 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

**Original**

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.

**Proposed**

6.1. *Base Metal* – The beam, transition, end, and buffer sections shall consist of sheet produced from 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.

*(Note: Removed “made of open hearth”)*

**Original**

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.”

**Proposed**

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

*Zinc-Aluminum-Magnesium Alloy* for Types V & VI shall contain 5-13% aluminum, 2-4% magnesium, and up to 1% total additional alloying elements (except iron) and the balance zinc as prescribed in ASTM A1046/A1046M Type 1.

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.
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 (5/8-in.) Post or Splice Bolt and Nut
Notes:
1. The bolt shall have M16 x 2 threads as defined in ANSI B1.13M 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 8.3.5 bolts.
2. Nuts shall have ANSI B1.13M M16 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 18.2.4.1M Style 1 for zinc-coated hex nuts, and ANSI B18.2.4.6M heavy-hex corrosion-resistant nuts shall conform to the requirements of ASTM A563M for Class 853. Zinc-coated nuts shall be tapped oversized as specified in ASTM A563M, except that a diemnetral allowance of 510 mm shall be used instead of 420 mm.
3. 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 2**—16-mm Post or Splice Metric Bolt and Nut

### 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 (1-ft) sections of beams and shall be of the same class and type specified for the full-length beams.
6.4. **Washers and Backup Plates:**

6.4.1. Washers shall be rectangular as shown in Figure 3. Washers for Types I, II, III, V, and VI 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 (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 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 (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 (50,000 psi);
- Tensile strength, minimum 483 MPa (70,000 psi); and
- Elongation, in 50 mm (2 in.), minimum, 12 percent.

8.1.2. **End and Buffer Sections:**

- Yield point, minimum, 227 MPa (33,000 psi); and
- Tensile strength, minimum 310 MPa (45,000 psi).
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 (0.003 in.) for Type I beam and 0.15 mm (0.006 in.) for Type II beam.

**Table 1 -- Coating Thickness Correction**

<table>
<thead>
<tr>
<th>Type</th>
<th>Single-Spot</th>
<th>Triple-Spot</th>
<th>Correction*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>g/m²</td>
<td>oz/ft²</td>
<td>g/m²</td>
</tr>
<tr>
<td>I</td>
<td>550</td>
<td>1.80</td>
<td>610</td>
</tr>
<tr>
<td>II</td>
<td>1100</td>
<td>3.60</td>
<td>1220</td>
</tr>
<tr>
<td>V</td>
<td>245</td>
<td>0.80</td>
<td>275</td>
</tr>
<tr>
<td>VI</td>
<td>305</td>
<td>1.00</td>
<td>350</td>
</tr>
</tbody>
</table>

*Galvanized coating mass : thickness (7.14 g/m² = 1.00 μm) (1.00 oz/ft² = 1.68 mils)

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

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 111M/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>
<thead>
<tr>
<th>Table 2 -- Weight of Coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of Coating</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Min Check Limit</td>
</tr>
<tr>
<td>Single-Spot Test</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Min Check Limit</td>
</tr>
<tr>
<td>Triple-Spot Test</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
</tr>
</tbody>
</table>
Figure 4—Thrie Beam

Notes:
1. All dimensions are subject to manufacturer's tolerances except where allowable tolerances are shown.
2. All dimensions shown in milimeter 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.

© 2015 by the American Association of State Highway and Transportation Officials.
All rights reserved. Duplication is a violation of applicable law.
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 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 ASTM B695, Class 50, Type I.

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.
9.4. **Type V and VI Beams:**

9.4.1. The beams shall be alloy-coated before fabrication and shall be coated in accordance with ASTM A1046/A1046M. 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.

9.4.2. The mass of coating shall conform to the requirements prescribed in Table 3 for the types specified. The mass of coating is the total amount of coating on both sides of a sheet or beam, expressed as grams per square meter (ounces per square foot) of the sheet or beam.

<table>
<thead>
<tr>
<th>Table 3 -- Weight of Coating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight of Coating</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Min Check</td>
</tr>
<tr>
<td>Limit</td>
</tr>
<tr>
<td>Single-Spot Test</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Type</td>
</tr>
<tr>
<td>V</td>
</tr>
<tr>
<td>VI</td>
</tr>
</tbody>
</table>

9.4.3. The sheets or beams shall be of prime finish, that is, free from injurious defects such as peeling, lamination, and uncoated spots. Uncoated, bare edges resulting from transverse shearing, longitudinal slitting and punching of holes are permissible and expected for Type V & VI beams.

9.4.4. 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-aluminum-magnesium alloy 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 pairing or whittling, and it shall not be possible to peel any portion of the coating so as to expose the base metal.

9.4.5. 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.

9.5. **Bolts and Nuts:**

9.5.1. 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.
9.6. **Washers:**

9.6.1. Washers shall be hot-dip zinc-coated in accordance with the requirements of M 232M/M 232.

9.7. **Galvanizing Repair:**

9.7.1. 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**

<table>
<thead>
<tr>
<th>Type</th>
<th>Thickness</th>
<th>Class A Tolerance</th>
<th>Thickness</th>
<th>Class B Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mm</td>
<td>Under Specified</td>
<td>mm</td>
<td>Under Specified</td>
</tr>
<tr>
<td></td>
<td>in.</td>
<td>Thickness, No Limit for</td>
<td>in.</td>
<td>Thickness, No Limit for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Over Thickness</td>
<td></td>
<td>Over Thickness</td>
</tr>
<tr>
<td>I</td>
<td>2.74</td>
<td>0.23</td>
<td>3.51</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>0.108</td>
<td>0.009</td>
<td>0.138</td>
<td>0.010</td>
</tr>
<tr>
<td>II</td>
<td>2.82</td>
<td>0.23</td>
<td>3.58</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>0.111</td>
<td>0.009</td>
<td>0.141</td>
<td>0.010</td>
</tr>
<tr>
<td>III</td>
<td>2.67</td>
<td>0.23</td>
<td>3.43</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>0.105</td>
<td>0.009</td>
<td>0.135</td>
<td>0.010</td>
</tr>
<tr>
<td>IV</td>
<td>2.67</td>
<td>0.23</td>
<td>3.43</td>
<td>0.25</td>
</tr>
<tr>
<td></td>
<td>0.105</td>
<td>0.009</td>
<td>0.135</td>
<td>0.010</td>
</tr>
</tbody>
</table>
### Table 4 -- Beam or Sheet Thickness

<table>
<thead>
<tr>
<th>Type</th>
<th>Class A</th>
<th>Class B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Thickness</td>
<td>Under Specified Thickness, No Limit for Thickness</td>
</tr>
<tr>
<td></td>
<td>Thickness</td>
<td>Over Thickness</td>
</tr>
<tr>
<td></td>
<td>mm</td>
<td>in.</td>
</tr>
<tr>
<td>I</td>
<td>2.74</td>
<td>0.1080</td>
</tr>
<tr>
<td>II</td>
<td>2.82</td>
<td>0.1110</td>
</tr>
<tr>
<td>III</td>
<td>2.67</td>
<td>0.1050</td>
</tr>
<tr>
<td>IV</td>
<td>2.67</td>
<td>0.1050</td>
</tr>
<tr>
<td>V</td>
<td>2.71</td>
<td>0.1066</td>
</tr>
<tr>
<td>VI</td>
<td>2.72</td>
<td>0.1070</td>
</tr>
</tbody>
</table>

**Note:** See Table 1 for coating correction values related to Types I, II, V, and VI.
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 (29 1/2 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 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,
- 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 (1 1/4 in.) and a minimum height of 19 mm (3/4 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.

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.