

## SECTION 1103—TRAFFIC SIGNING AND MARKING

**1103.01 GENERAL REQUIREMENTS**—Certify material, as specified in [Section 106.03\(b\)3](#).

### **1103.02 EXTRUDED ALUMINUM CHANNEL SIGNS (FOR POST MOUNTED SIGNS, TYPES A AND E AND STRUCTURE MOUNTED)**—

**(a) Extruded Aluminum Channels.** As shown on the [Standard Drawings](#).

Use channels conforming to [ASTM B 221/B 221M](#), Alloy 6063-T6, from a manufacturer listed in [Bulletin 15](#).

Use continuous-channel sections equal to the sign width. The channel section is nominal. The Contractor may use an alternate extruded channel section of equal or greater section moduli with dimensions suitable to utilize the mounting hardware with written permission.

**(b) Coating Treatment.** Use a chemical conversion coating, such as Alodine No. 1200, Alodine No. 1200S, or Bonderite No. 781.

Apply the coating to the channel surfaces to ensure a good bond between the reflective sheeting material and the surface. Coat according to Military Specification, MIL-C-5541E, “Chemical Conversion Coatings on Aluminum and Aluminum Alloys.” Do not handle with bare hands between the chemical conversion coating process and the application of the reflective sheeting. Handle by special devices or by hand wearing clean PVC gloves.

**(c) Reflective Sheeting.** Use precolored Type III or Type IV sheeting, conforming to the Department's specification for Retroreflective Sheeting Materials and Process Inks for Traffic Control, from a manufacturer listed in [Bulletin 15](#).

Apply the sheeting to the face and a 10 mm (3/8-inch) width along both edges of the channel sections, using a procedure specified by the sheeting material manufacturer. Apply free of bubbles or wrinkles greater than 75 mm (3 inches) in length and with total sheeting shrinkage of not more than 3.2 mm (1/8 inch). A maximum of one splice may be made in the sheeting for any channel section. Make the splice perpendicular to the longitudinal centerline of the channel, with the edges of adjacent pieces butted together throughout the entire seam length, without any overlap or separation. If covered sections are stacked before sign fabrication, then use microfoam between sign faces and store sections in a vertical position.

**(d) Legend and Border.** Use direct-applied cutout Type IX reflective sheeting material for letters, numerals, accessories, borders, and symbols.

**(e) Sign Fabrication.** Apply the reflective sheeting, then firmly bolt channels together with the webs in the same plane, to form a smooth and uniform surface. Adjust channel ends for correct position so the edges are free from projections.

Securely fasten assembled sign panels to a rigid framework, before application of legend and before shipment. Lay out the legend and border on the sign face as indicated on the sign fabrication drawings.

Apply cutout Type IX legend and border to sign face according to manufacturer's instructions.

Fabricate signs in a single unit. If necessary, ship large signs sectionalized in panels. When shipping sectionalized signs, slit any legend and border, which overlaps the panels.

**(f) Sign Identification.** Fabricate the plaques of aluminum, plastic, or fiberglass of sufficient thickness to provide the necessary stiffness and to resist vandalism, or stencil directly on the sign panel with weather-resistant paint. Indicate sign number and the month and year of erection in 25 mm (1-inch) high characters of a contrasting color to the background, and affix to the rear of the sign in the lower righthand corner when viewed from the back. If rivets are used to attach plaques, use 3.2 mm (1/8-inch) aluminum rivets inserted from the sign face.

**1103.03 FLAT SHEET ALUMINUM SIGNS WITH STIFFENERS (FOR POST MOUNTED SIGNS, TYPES A, D, AND E; AND STRUCTURE MOUNTED SIGNS)—**

**(a) Flat Sheet Aluminum.** Use aluminum as specified in [Section 1103.04\(a\)](#) with a minimum thickness of 2.03 mm (0.080 inch).

Fabricate panels from a single aluminum sheet or from a number of pieces, making every effort to minimize the total length of joints. Locate joints so the legend does not straddle two or more aluminum sheets, whenever possible. Use sheets with a minimum width of 1200 mm (48 inches), wherever possible. Use continuous sheets for the full width of signs less than 3.6 m (12 feet) wide or for the full height of signs less than 3.6 m (12 feet) high. Use sheets free of buckles, warps, or dents. Remove burrs.

**(b) Coating Treatment and Reflective Sheeting.** [Sections 1103.02\(b\)](#) and [\(c\)](#), except as follows:

Apply the sheeting only to the face of the sign. A maximum of one splice in the reflective sheeting will be allowed on an aluminum sheet.

**(c) Legend and Border.** [Section 1103.02\(d\)](#)

**(d) Extruded Aluminum Stiffeners, and Splice Bars.** As shown on the [Standard Drawings](#) and as follows: Manufacture channels from aluminum, conforming to [ASTM B 209/B 209M](#), Alloy 6061-T6.

Use large stiffener sections in 4.9 m (16-foot) lengths and medium stiffener sections in 3.6 m (12-foot) lengths. An alternate cross section of equal or greater section modulus than that indicated may be used with written permission.

**(e) Sign Fabrication.** Stiffener sections may end at a maximum of 75 mm (3 inches) from each sign edge. If the sign is more than 150 mm (6 inches) wider than the length of a full-length stiffener section, then splice two sections together, using 4.8 mm (3/16-inch) rivets, as shown on the [Standard Drawings](#), to form a longer composite section. Position the splice so it is not on or within 380 mm (15 inches) of a sign post or within the center half of the span between sign posts. Stagger splices on adjacent sign stiffeners as much as possible. The aluminum sheeting may extend above the top stiffener or below the bottom stiffener for a maximum distance equal to one-third of the spacing between the stiffeners. If using an exit panel, use a stiffener on both the primary sign top and on the exit panel bottom.

Use 4.8 mm (3/16-inch) aluminum rivets at a maximum spacing of 150 mm (6 inches) and end rivets within 25 mm (1 inch) of the end of the stiffener. Hold the aluminum sheet firmly against the stiffener section while holes are drilled and rivets are expanded.

If the aluminum sheets are placed with the long dimension vertical or if a single large section stiffener or a single flanged medium section stiffener is used to join two panels together, then it may be necessary to have the flat sheet aluminum clamped to the stiffener section while the holes are drilled. Then, disassemble the sign for shipping. If disassembled, then remove burrs around the drilled holes to facilitate handling and to ensure a tight connection.

If exit panels cannot be supported by two sign posts, brace the panel with one or more auxiliary supports. Bolt the supports to a minimum of three stiffeners on the primary sign by use of clips.

If a single stiffener section is not used to join two adjacent panels together use butting plates, as shown on the [Standard Drawings](#). Place butting plates at the left and right edges of the sign and at intervals not greater than 900 mm (36 inches) throughout the length of horizontal joints between the posts. Use either twist-in bolts or standard-connection bolts and plastic inserts to fasten the butting plates.

For joints between aluminum sheets, without a stiffener on the joint, fasten lightweight aluminum sheets with 3.2 mm (1/8-inch) aluminum rivets to the sign back.

Use twist-in toggle and buckle straps, or post clips, on stiffener sections at each post.

Lay out the legend and border on the sign face according to the sign fabrication drawings.

Apply cutout Type III or Type IV legend and border to sign face according to manufacturer's instructions.

Fabricate signs in a single unit. If necessary, ship large signs sectionalized in panels Slit any legend and border, which overlaps the panel, when shipping sectionalized signs.

**(f) Sign Identification.** [Section 1103.02\(f\)](#)

### 1103.04 FLAT SHEET SIGNS (FOR POST MOUNTED SIGNS, TYPES B, C, AND F; AND DISTANCE MARKER(S))—

(a) **Blanks.** Use aluminum blanks. For signs furnished under [Section 901](#), use plywood, aluminum, acrylonitrile butadiene styrene (ABS), aluminum/plastic laminate, corrugated polypropylene, or polyethylene blanks.

Physical and chemical properties of plywood and aluminum blanks are to conform to Publication 306M.

(b) **Coating Treatment.** Prepare sign faces with appropriate coating conforming to Publication 306M.

(c) **Reflective Sheeting.** Use sheeting from a manufacturer listed in [Bulletin 15](#).

**1. General.** Apply the sheeting to the sign face using a procedure according to the sheeting manufacturer, free of bubbles or wrinkles greater than 75 mm (3 inches) in length, and with total sheeting shrinkage of not more than 3.2 mm (1/8 inch).

On signs larger than 1200 mm (48 inches) on the shorter side, sheeting may be spliced with the edges of adjacent pieces butted together throughout the entire seam length without any overlap or separation.

Use Type III or Type IV sheeting for all signs.

(d) **Ink.** As recommended by the manufacturer of the reflective sheeting.

(e) **Electronic Cuttable (EC) Film.** Use film from a sheeting manufacturer listed in [Bulletin 15](#). Apply the sheeting to the sign face using a procedure according to the sheeting manufacturer, free of bubbles or wrinkles greater than 25 mm (1 inch) in length.

(f) **Legend and Border.** Apply legend and border of the color, size, and dimensions shown in Publication 212, Publication 213, and the MUTCD or as indicated. Use silk screens with a mesh of 12XX or finer for reverse screening. Use stencils with sharp clear-cut edges, uniform curvature, and straight lines. Silk screen in a manner resulting in uniform color and tone, with sharply-defined edges and without blemishes on the sign background. Air dry or bake signs after silk screening to achieve a smooth hard finish. Blisters appearing during the drying process will be cause for rejection. If direct-applied legend is indicated for any directional or destination sign, use Type III or Type IV reflective sheeting. Slip-sheet and pack signs to ensure delivery in an undamaged condition.

### 1103.05 DELINEATION DEVICES—Not used.

### 1103.07 STEEL S OR W BEAM POSTS AND BREAKAWAY SYSTEM (FOR POST MOUNTED SIGNS, TYPE A)—

(a) **Steel S or W Beam Posts.** As shown on the [Standard Drawings](#).

(b) **Breakaway System.** As shown on the [Standard Drawings](#) and as follows:

**1. Couplings.** Alloy steel AMS 6378D with:

- Minimum tensile yield stress of 896 MPa (130,000 psi).
- Ultimate tensile strength of 1034 MPa (150,000 psi).
- Minimum Rockwell C hardness of 32.
- Capable of withstanding a tensile breaking load of 182.4 kN (41,000 pounds).

**2. Hinge Plates.** Alloy steel AISI 4130, 4340, or an equivalent material with a minimum tensile yield stress of 482 MPa (70,000 pounds per square inch), an ultimate tensile stress range of 620 MPa (90,000 pounds per square inch) to 745 MPa (108,000 pounds per square inch), and a tensile breaking load, in kilonewtons (pounds), as follows:

Model SBHB1B	51 min. (11,450 min.)
Model SBHB2B	73 min. (16,400 min.)

**3. Brackets.** Aluminum alloy [ASTM B 221/B 221M](#), Alloy 6061-T6 or equal, with a load-concentrating boss of stainless steel, [ASTM A 582/A 582M](#), Type 416, or equal.

**4. Bolts, Nuts, and Washers.**

**4.a Hinge Plates.** AISI 4130 Steel. Galvanized as specified in [Section 1105.02\(s\)](#), [ASTM A 153](#).

**4.b Brackets.** [ASTM B 209](#); Alloy 6061-T6.

**5. Anchor.** Type 304 stainless steel ferrule with 1053 steel rod and coil.

**6. Coupling Bolts.** AMS 6378D, galvanized as specified in [Section 1105.02\(s\)](#), [ASTM A 153/A 153M](#).

**(c) Fabrication.** Cut, drill or punch holes in parts or members, before galvanizing. Furnish a statement, before the beginning of galvanizing, showing the carbon content of the steel to be galvanized. Hot-dip galvanize posts and hardware after fabrication, as specified in [Section 1105.02\(s\)](#). Bolts, nuts, and washers to be galvanized according to [ASTM B 695](#) and B 696 (AASHTO M 298 and M 299) and conforming to the coating thickness, adherence, and quality requirements of [ASTM A 153/A 153M](#) (AASHTO M 232).

**1103.08 BREAKAWAY STEEL POSTS (FOR POST MOUNTED SIGNS, TYPE B AND DISTANCE MARKERS)—**

**(a) Steel Channel Bar Posts.** As shown on the [Standard Drawings](#) and as follows:

Roll posts from standard carbon steel rails, [ASTM A 499](#), with a minimum tensile strength of 620 MPa (90,000 pounds per square inch) and a minimum yield strength of 415 MPa (60,000 pounds per square inch) or new billet steel equivalent with a minimum tensile strength of 620 MPa (90,000 pounds per square inch) and a minimum yield strength of 415 MPa (60,000 pounds per square inch). Cast heat analysis of new billet as follows:

<u>Element</u>	<u>Composition (%)</u>
Carbon	0.67 to 0.82
Manganese	0.70 to 1.10
Phosphorus, max.	0.04
Sulphur, max.	0.05
Silicon	0.10 to 0.25

Roll bars to the required shape, dimensions, and mass (weight).

Drill or punch holes for mounting. Additional holes on 25.4 mm (1-inch) centers available for punching are allowed. After fabrication, paint green according to [ASTM G 154](#) using Federal Color No. 595.14062; electrostatically coat with a green polyester coating as specified in [Section 1103.08\(c\)](#); or hot-dip galvanize as specified in [Section 1105.02\(s\)](#) ([ASTM A 123/A 123M](#)).

**(b) Steel Square Posts.** As shown on the [Standard Drawings](#) and as follows:

**1. Material.** Roll formed and conforming to one of the following:

- Cold rolled steel in 3.4 mm (10 gage (0.135-inch)) or 2.7 mm (12 gage (0.105-inch)) with a minimum yield strength of 230 MPa (33,000 pounds per square inch) and a minimum tensile strength of 310 MPa (45,000 pounds per square inch), conforming to the chemical and mechanical requirements of [ASTM A 653/A 653M](#) and [ASTM A 924/A 924M](#), Grade 230 (Grade A).
- Hot rolled carbon sheet steel in 2.7 mm (12 gage (0.105 inch)) or 1.9 mm (14 gage (0.083-inch)) with a minimum yield strength of 415 MPa (60,000 pounds per square inch) and a minimum tensile strength of 515 MPa (75,000 pounds per square inch), conforming to the chemical requirements of [ASTM A 1011/A 1011M](#), Grade 55.
- Cold rolled steel in 1.9 mm (14 gage (0.075-inch)) with a minimum yield strength of 415 MPa (60,000 pounds per square inch) and a minimum tensile strength of 480 MPa (70,000 pounds per square inch), conforming to the chemical requirements of [ASTM A 1008/A 1008M](#).

## 2. Fabrication.

- Corner weld and scarf as necessary to allow sections to telescope within each other.
- Space 11.1 mm (7/16-inch) diameter cut holes or knockout holes on 25.4 mm (1-inch) centers, on the centerline of all four sides, in true alignment, and opposite to each other.

## 3. Protective Coating. Apply after fabrication using one of the following methods:

**3.a Method 1.** Galvanize or coat the inside and outside as specified in [Section 1105.02\(s\)](#) (AASHTO M 111). Either of two alternate coating systems may be used as follows:

- **Outside.** Apply a hot-dipped coating of zinc, according to [ASTM B 6](#), at a minimum rate of  $0.305 \text{ kg/m}^2 \pm 0.030 \text{ kg/m}^2$  (1.0 ounce per square foot  $\pm$  0.1 ounce per square foot) of actual surface area; a chromate conversion coating at a rate  $46.5 \text{ mg/m}^2 \pm 23.25 \text{ mg/m}^2$  (30 micrograms per square inch  $\pm$  15 micrograms per square inch) of actual surface area; and a thermoplastic, electrostatically applied acrylic or polymer coating,  $0.013 \text{ mm} \pm 0.005 \text{ mm}$  (0.5 mil  $\pm$  0.2 mil) in thickness, and
- **Inside.** Apply a zinc based coating,  $0.013 \pm 0.005 \text{ mm}$  (0.5  $\pm$  0.2 mil) in thickness, at a rate of  $0.092 \text{ kg/m}^2 \pm 0.0153 \text{ kg/m}^2$  (0.3 ounce per square foot  $\pm$  0.05 ounce per square foot) with a minimum of 80% zinc powder by mass (weight).

**3.b Method 2.** Apply a triple coating of zinc, conforming to AASHTO M 120, having a mass (weight) of  $0.183 \text{ kg/m}^2 \pm 0.046 \text{ kg/m}^2$  (0.60 ounce per square foot  $\pm$  0.15 ounce per square foot), to the outside of posts after fabrication. Apply a chromate conversion coating of  $23.25 \text{ mg/m}^2 \pm 7.75 \text{ mg/m}^2$  (15 micrograms per square inch  $\pm$  5 micrograms per square inch) and a clear organic exterior coating of  $0.005 \text{ mm} \pm 0.003 \text{ mm}$  (0.2 mil  $\pm$  0.1 mil) following the zinc application. Provide a double, in-line application of a full zinc-based organic coating of  $0.030 \text{ mm} \pm 0.015 \text{ mm}$  (1.2 mils  $\pm$  0.6 mils) for the inside surface, tested according to [ASTM B 117](#).

**3.c Method 3.** Galvanize inside and outside according to [ASTM A 653/A 653M](#) and [ASTM A 924/A 924M](#), coating designation Z275 (G90), by hot-dip method before fabrication. Provide zinc-coating to corner welds after scarifying operations.

**(c) Polyester Post Coating.**

**1. Powder Composition.** As follows, or of sufficiently similar composition to meet the specified testing requirements:

- |  |           |
|--|-----------|
| • Polyester Resin (molecular weight equivalent 2,000-5,000)                    | 40%-75%   |
| • Blocked-Isocyanate Curing Agent<br>(molecular weight equivalent 1,000-3,000) | 10%-25%   |
| • Flow Control Agent (acrylo-terpolymers)                                      | 0.1%-2.0% |
| • Exterior-Durable Grade Pigment and Extender                                  | 25%-50%   |
| • Organic Volatile Content   | 3% Max.   |

**2. Pretreatment.** Blast clean steel posts to near white with blast profile not greater than 0.051 mm (2 mils). Apply coating immediately after cleaning, as an electrostatically charged dry powder sprayed onto the grounded post, using an electrostatic spray gun.

**3. Color.** Green, unless otherwise specified.

**4. Physical Tests.** Test coating as follows:

- **Impact Test.** According to [ASTM D 2794](#), showing no cracks or breaks when an impact of 11.3 N·m (100 inch-pounds) is applied.
- **Salt Spray.** No rust, blisters, or undercutting of uncoated or scribed areas apparent, when tested for 500 hours, according to [ASTM B 117](#).
- **Film Thickness.** Thickness measured on a flat surface of the post, according to [ASTM D 1186](#), 0.051 mm (0.002 inch) minimum.
- **Weatherometer.** No more than 15% gloss loss, when tested for 1,000 hours in a carbon arc weatherometer, according to [ASTM G 152](#), Type EH.
- **Humidity.** No blistering of the coating nor gloss loss greater than 5%, when tested according to [ASTM D 2247](#).

**1103.09 TREATED WOOD AND COMPOSITE POSTS (FOR POST MOUNTED SIGNS, TYPES C AND E)—****(a) Treated Wood Posts (for Post Mounted Signs, Types C and E).**

**1. Posts.** S4S No. 1 Dense or No. 1 Dense SR Southern Yellow Pine or No. 1 Douglas Fir-Larch, seasoned to a maximum of 19% moisture.

Grade and grade mark each post, before treatment, with an official grade stamp or inspection agency mark, certified by the Board of Review, American Lumber Standards Committee. Cut and drill before preservative treatment.

**2. Treatment.** Treat with Ammoniacal Copper Arsenite (ACA) or Chromated Copper Arsenate (CCA) Type A, B, or C meeting AWPA Standard P5. Use a minimum preservative retention of 6.4 kg/m<sup>3</sup> (0.40 pound per cubic foot) by assay (oxide basis). Treat and quality mark according to AWPA C2. Inspect according to AWPA Standards M1 and M2.

Include a treatment certificate with each shipment.

**(b) Composite Posts (for Post Mounted Signs, Type E).**

**1. Posts.** Unsaturated polyester resin reinforced with E-glass and lightweight aggregate concrete not greater than 1762 kg/m<sup>3</sup> (110 pounds per cubic foot) to form a rigid structural support member. Tensile modulus of tube to be not less than 1.7 x 10<sup>4</sup> MPa (2,500 kips per square inch). Posts to be equal to or greater in strength to Schedule 40 steel of the same diameter ([ASTM A 53/A 53M](#)).

**2. Weathering.** Post shall have less than 10% loss of strength after 3,600 hours of accelerated weathering exposure to moisture and lamps required in [ASTM G 152](#), [G 155](#) and [G 154](#).

**3. Color.** Specified post color will be permanent throughout the FRP tube with not less than 38 µm (1.5 mil) dry film thickness. After 3,600 hours exposure according to [ASTM G 152](#), [G 155](#), and [G 154](#), posts will exhibit 90% adhesion, [ASTM D 4541](#) and a maximum color change of 25, Delta -E.

**1103.10 DELINEATOR POSTS**—Not used.

**1103.11 MISCELLANEOUS MATERIALS**—

**(a) Bolts and Nuts for Extruded Panel Sign Post-Clips.** Galvanized steel as specified in [Section 1105.02\(s\)](#); [ASTM A 307](#) or [A 325/A 325M](#).

**(b) Washers.**

**1. Aluminum.** Conforming to [ASTM B 209/B 209M](#), Alclad 2024-T4

**2. Nylon.** 3.2 mm (1/8 inch) thick by 25 mm (1-inch) minimum outside diameter. Maximum allowable applied torque 54 N·m (480 inch-pounds).

**(c) Lock-Nuts and Lock-Washers for Extruded Panel Sign Post-Clips.** Galvanized as specified in [Section 1105.02\(s\)](#); [ASTM A 307](#) or [A 325/A 325M](#).

**(d) Post-Clips.** For extruded panel signs, aluminum, conforming to [ASTM B 108](#), Alloy 356-T6. For flat sheet aluminum signs with stiffeners, stainless steel, Type 304, 1.9 mm (14 gage).

**(e) Auxiliary Supports for Exit Panels.** Aluminum conforming to [ASTM B 211/B 211M](#), Alloy 6061-T6. 76 mm x 76 mm x 4.8 mm (3 inches by 3 inches by 3/16-inch) angle, 2 m (6 1/2 feet) long or long enough to attach to three stiffeners on the main sign.

**(f) Lag Screws.** M8 x 1.25 (5/16-inch) round head, galvanized steel as specified in [Section 1105.02\(s\)](#); [ASTM A 307](#).

**(g) Rivets.** Aluminum, self-plugging or hollow-core, as follows:

- 4.8 mm (3/16-inch) for mounting reflective units and distance plaques—Alloy 5056 with 7178 mandrels.
- 4.8 mm (3/16-inch) for mounting flat aluminum sheets to stiffeners sections— Alloy 5056 with carbon steel mandrels.

Rivet size specified is the minimum shank diameter. Use rivets with sufficient grip range to attach to background sign material, stiffeners, or posts. Use a 5.40 mm (No. 10) drill for 5 mm (3/16-inch) rivets for attachment of stiffeners and splice bars.

**(h) Bolts, Nuts, and Washers for Flat Sheet Aluminum Signs with Stiffeners.** Stainless steel, Type 304 bolts. Use M8 x 1.25 x 25 (5/16-inch by 1 inch long) for butting plates and M8 x 1.25 x 50 (5/16-inch by 2 inches long) for post-clips. Use standard connection bolts or twist-in bolts.

**(i) Twist-in Toggle and Buckle Straps.** Stainless steel, Type 201, and 19 mm (0.75 inch) wide and 0.76 mm (0.03 inch) thick, with rounded edges. Spot welded, twist-in type toggle on end of strap. Spot welded, antirotational buckle on other end of strap. Toggles and buckles shall be stainless steel, Type 304, and 1.6 mm (1/16 inch) thick.

**(j) Butting Plates.** Fabricate from stainless steel, Type 304.

**(k) Anchors.** [Section 1105.02\(c\)2](#). From a manufacturer listed in [Bulletin 15](#).

**(m) Anti-Theft Sign Hardware.**

#### 1. System A.

- **Bolts.** [Section 1105.02\(c\)1](#) and as follows:  
Provide M8 x 1.25 x 65 (5/16 inch by 2 1/2-inch) steel carriage bolts with minimum 17.5 mm (11/16-inch) diameter round head, square neck, and threads to within 25 mm (1 inch) of head.  
Furnish bolts having a mechanically deposited cadmium coating, [ASTM B 696](#), or zinc, Type I coating as specified in [Section 1105.02\(s\)](#).
- **Nuts.** Square, pyramidal-shaped nuts with all four sides sloping at an angle of 41 degrees; M8 x 1.25 (5/16-18 UNC threads); C-1010 cold-rolled steel, case hardened to Rockwell hardness of 55 to 60.  
Furnish nuts having a 0.05 mm to 0.13 mm (0.002 inch to 0.005 inch) thick, mechanically deposited, zinc, Type II yellow chromate coating as specified in [Section 1105.02\(s\)](#) ([ASTM B 695](#)), tested according to [ASTM B 201](#).

#### 2. System B.

- **Bolts.** Section 1103.11(o) and as follows:  
Provide M8 x 1.25 x 65 (5/16-inch by 2 1/2-inch) and M8 x 1.25 x 80 (5/16-inch by 3-inch) bolts with minimum 14.3 mm (9/16-inch) diameter one-way heads and threads to within 25 mm (1 inch) of head.
- **Nuts.** Section 1103.11(p) and as follows:  
Provide nuts, Alloy 2011-T3, double-chamfered hexagon with self-locking conical shape 14.3 mm (9/16-inch) - 9.5 mm (3/8-inch) by 5 mm (3/16-inch) unit under the nut with M8 x 1.25 (5/16-18 UNC) threads. Hexagon portion should break away from self-locking unit with 4.5 N·m (5/16-18 UNC) to 9 N·m (40 inch-pounds to 80 inch-pounds) of torque.
- **Washers.** Nylon 3.2 mm (1/8 inch) thick by 25 mm (1-inch) minimum outside diameter with 54 N·m (480 inch-pounds) maximum allowable applied torque.

**(n) Banding.** Stainless steel, Type 201, 19 mm (0.750 inch) wide by 0.76 mm (0.030 inch) thick, with rounded edges for handling ease and safety. Buckles and other necessary hardware shall be of stainless steel, Type 304.

**(o) Aluminum Bolts.** [ASTM B 211/B 211M](#). Alloy 2024-T4, thread fit, ANSI Class 6g, and threads shall be within two threads of the head or a minimum of 45 mm (1 3/4 inches).

**(p) Aluminum Nuts.** [ASTM B 211/B 211M](#). Alloy 2024-T6, thread fit, ANSI Class 6H (ANSI Class 2B, 18 UNC threads).

**1103.12 SIGN AND DISTANCE MARKER SUPPORTS—**

(a) **General.** Hot-dip galvanize steel, except stainless steel, after fabrication, as specified in [Section 1105.02\(s\)](#). Drill or punch holes and cut before galvanizing.

(b) **Brackets for Post Mounted Signs, Types C, D, and F.** [ASTM A 283](#).

(c) **Bars for Post Mounted Signs, Types C, D, and E.** AASHTO M 270/M 270M ([ASTM A 709/A 709M](#)) Grade 250 (Grade 36).

(d) **Shims for Post Mounted Sign, Types C and E.** AASHTO M 270/M 270M ([ASTM A 709/A 709M](#)) Grade 250 (Grade 36).

(e) **Steel Pipe Supports for Post Mounted Signs, Types D and E.** [ASTM A 53/A 53M](#).

(f) **Shapes and Plates for Post Mounted Signs, Type D.** AASHTO M 270/M 270M ([ASTM A 709/A 709M](#)) Grade 250 (Grade 36).

(g) **Angles (Aluminum) for Post Mounted Signs, Type E, and Structure Mounted Signs.** [ASTM B 308/B 308M](#). Alloy 6061-T6.

(h) **Shim Bars and Plates for Post Mounted Signs, Type E.** AASHTO M 270/M 270M ([ASTM A 709/A 709M](#)) Grade 250 (Grade 36).

(i) **Brackets, Bars, Clamps, Strips, and Gussett Plates (for Erecting Distance Markers on Bridge Railing).** Stainless Steel, [ASTM A 167](#).

**1103.13 DELINEATOR BRACKETS—**Not used.**1103.14 REFLECTIVE GLASS BEADS—**

(a) **General.** Furnish reflective glass beads conforming to AASHTO M 247, except as follows:

1. **Gradation.** Satisfies the following gradation for type indicated:

Sieve Size	Percent Beads Passing			
	Type A	Type B	Type C	Type D
2.0 mm (10)	-	100	-	-
1.7 mm (12)	-	95 to 100	100	-
1.4 mm (14)	-	80 to 95	95 to 100	-
1.18 mm (16)	100	10 to 40	80 to 95	100
1.0 mm (18)	-	0 to 5	10 to 40	-
850 μm (20)	-	0 to 2	0 to 5	95 to 100
710 μm (25)	-	-	0 to 2	65 to 90
600 μm (30)	75 to 95	-	-	-
500 μm (35)	-	-	-	10 to 45
300 μm (50)	15 to 35	-	-	0 to 10
150 μm (100)	0 to 2	-	-	0 to 5

2. **Rounds.** Provide glass beads with a minimum of 75% true spheres overall, a minimum of 70 % true spheres per sieve, and not more than 3% angulars overall.

**3. Coating.** Supply Types A, B, and D glass beads with coatings to enhance moisture resistance, embedment, and adherence with the binder. Supply Type C with coatings to enhance embedment and adherence.