

Section 4186. Signing Materials

4186.01 DESCRIPTION.

- A.** Ensure the following:
 - 1. Only new and unused materials are used.
 - 2. Materials are approved before incorporating into the work.
 - 3. Samples taken as directed by the Engineer. As a convenience to the Contractor, samples may be taken at the point of production when arrangements are made with the Office of Materials.
 - 4. Sufficient time is allowed for sampling and testing.
 - 5. Access to the producing plant is available for the purpose of sampling.
- B.** In lieu of sampling and testing, the Engineer may require certifications of any material or tests specified for the material.

4186.02 SIGN PANELS.

Fabricate sign panels from sheet aluminum, galvanized steel, or when specified, plywood or flexible roll-up material.

A. Sheet Aluminum.

- 1. Meet the following requirements:
 - a. Aluminum for Type A signs complies with ASTM B 209, Alloy 5052-H38.
 - b. If the aluminum thickness is not specified in the contract documents, then the thickness is 0.080 inches (2 mm) for signs with the longest side of 36 inches (900 mm) or less, and 0.125 inches (3 mm) for signs with the longest side greater than 36 inches (900 mm). These thicknesses are subject to similar tolerances as specified in ASTM B 209 for a sheet having a width equal to the greatest dimension of the sign.
- 2. Before application of sheeting, degrease and etch the aluminum surface according to the sheeting manufacturer's recommendations. A conversion coating may be applied to the aluminum according to the sheeting manufacturer's recommendations. Remove all white rust present on the aluminum prior to application of the sheeting according to the sheeting manufacturer's recommendations.

B. Galvanized Steel.

Meet the following requirements:

- 1. Galvanized steel for Type A signs complies with ASTM A 653/A 653M, light commercial coating.
- 2. Use phosphatized galvanizing.

3. For Type A signs with the longest side 30 inches (750 mm) or less, sheet thickness is 0.0785 inch (2 mm) with a minus tolerance of 20%. For all other Type A signs, sheet thickness is 0.1233 inch (3.123 mm) with a minus tolerance of 20%.

C. Plywood.

Furnish softwood plywood complying with the latest edition of the National Institute of Standards and Technology Voluntary Product Standard PS 1 for Structural Plywood. Use plywood that is 1/2 inch (12.5 mm) thick and is either medium density overlay (MDO) or high density overlay (HDO). The panel grades are:

1. Exterior HDO-Industrial B-B.

- a. Overlaid both sides with a two step lay up, sanded prior to overlay to reduce wood grain and repair show-through, and the overlay suitable for sign manufacture and compatible with the reflective sheeting adhesive. No marks, blemishes, or damage of any kind on the overlay.
- b. Panel faced veneers of a certified hardwood, tested and certified according to Section 5.8.7 of PS 1 by an International Accreditation Service (IAS) recognized inspection/testing agency or Douglas fir from Group 1 classification of species. Inner plies of Douglas fir. Grade C plugged or better.

2. Exterior MDO-General B-B.

- a. Overlaid both sides with a two step lay up, sanded prior to overlay to reduce wood grain and repair show-through, and the overlay suitable for sign manufacture and compatible with the reflective sheeting adhesive. No marks, blemishes, or damage of any kind on the overlay.
- b. Panel faced veneers from a Group 1 classification of species or equivalent, tested and certified according to Section 5.8.7 of PS 1 by an IAS recognized inspection/testing agency. Inner plies from either Group 1 or Group 2 classification of species. Grade C or better.

D. Structural Panels Used in Type B Signs.

Meet the following requirements:

1. Extruded aluminum highway sign panels are in 6 inch and 12 inch (150 mm and 300 mm) widths.
2. Each section is manufactured according to the details and dimensions shown in the contract documents.
3. Aluminum extrusions comply with ASTM B 221, Alloy 6063-T6.

E. Edge Trim Molding.

Meet the following requirements:

1. For Type B signs, edge trim molding is manufactured of aluminum, the same as used in the sign, according to details and dimensions shown in the contract documents.
2. Aluminum complies with ASTM B 221, Alloy 6063-T6.
3. Aluminum molding has a mill finish.

F. Flexible Roll-up Sign Faces.

Meet the requirements of ASTM D 4956 for Type VI sheeting with Class 5 backing, except as modified in this specification.

4186.03 RETRO REFLECTIVE SHEETING.

A. General.

1. Meet the requirements of ASTM D 4956, including supplementary requirements, except when modified in the contract documents or this specification. Comply with [Materials I.M. 486.03](#) for inspection and acceptance of reflective sheeting.
2. Retro Reflective sheeting is to be uniform in color and reflectivity. In a single sign, or traffic control device, variations in color or reflectivity noticeable at a distance of 50 feet (15 m) or more, under daytime or nighttime lighting conditions, is cause for rejection of the sign.
3. Retro Reflective sheeting is classified as shown in Table 4186.03-1.

Table 4186.03-1: Retro Reflective Sheeting Classification

Type I	A medium retroreflective sheeting referred to as "engineering grade". This sheeting is typically enclosed lens glass bead material.
Type II	A medium high intensity retroreflective sheeting sometimes referred to as "super engineering grade". This sheeting is typically enclosed lens glass bead material.
Type III	A high intensity retroreflective sheeting. This sheeting is typically an encapsulated glass bead retroreflective material.
Type IV	A high intensity retroreflective sheeting. This sheeting is typically an unmetalized microprismatic retroreflective element material.
Type VI (Iowa)	A flexible, very high intensity retroreflective sheeting for use on roll-up signs. This sheeting is typically a microprismatic retroreflective material.
Type VII (Iowa)	A prismatic, very high intensity retroreflective sheeting. This sheeting is typically a microprismatic retroreflective material.

4. For Type VI (Iowa) and Type VII (Iowa) sheeting, meet the requirements of [Materials I.M. 486.03](#).

B. Utilization of Reflective Sheeting.

Use Type III or IV sheeting for all signs with white background, unless specified otherwise.

1. Permanent Signs and Devices.

- a. Meet the following requirements:
 - 1) Type III or IV sheeting is used for all signs with yellow, green, red, blue or brown background, unless otherwise specified.
 - 2) The legend on white and yellow signs is fabricated using black nonreflective sheeting that is applied directly, or by silk screening with black opaque ink.
 - 3) The legend on green signs is fabricated using white Type III or IV sheeting that is applied directly.
 - 4) The legend on red signs is fabricated using transparent red ink that is reverse silk screened on white Type III or IV sheeting, or is fabricated using white Type III or IV sheeting that is applied directly on a red Type III or IV sheeting background.
 - 5) The legend on blue and brown signs is fabricated using transparent ink that is reverse silk screened on white Type III or IV sheeting, or white Type III or IV sheeting that is applied directly.
- b. Use Type III or IV sheeting for permanent road closure barricades.

2. Work Zone Signs and Devices.

a. Interstate and Primary Highways.

Meet the following requirements:

- 1) Type VII (Iowa) sheeting is used for all rigid signs with orange backgrounds. The legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink.
- 2) Type VI (Iowa) sheeting is used for all flexible roll-up signs with orange backgrounds. The legend is fabricated by silk screening with black opaque ink.
- 3) Type VII (Iowa) sheeting is used for STOP/SLOW paddles. The black legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink on orange Type VII (Iowa) sheeting. The white legend is fabricated using transparent red ink that is reverse silk screened on white Type VII (Iowa) sheeting.
- 4) Type VII (Iowa) non-fluorescent sheeting is used for barricades, vertical panels, and all other work zone traffic control devices that use premanufactured barricade sheeting.
- 5) Type VII (Iowa) fluorescent orange and Type III or IV white sheeting is used for drums, 42 inch (1050 mm) channelizers, tubular markers, and all other work zone traffic control devices that use horizontal sheeting.
- 6) For reboundable traffic control devices, Type III or IV or Type VII (Iowa) sheeting designed for this application is used.

b. Other Highways.

- 1) Meet the following requirements:

- a) Type III or IV sheeting is used for all rigid post mounted signs with orange backgrounds. Unless specified otherwise, Type I or II sheeting is used for all skid mounted signs with orange backgrounds. The legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink.
 - b) Type I or II sheeting is used for STOP/SLOW paddles. The black legend is fabricated using black nonreflective sheeting that is applied directly or by silk screening with black opaque ink. The white legend is fabricated using transparent red ink that is reverse silk screened on white retroreflective sheeting.
 - c) Type III or IV sheeting is used for barricades and vertical panels.
 - d) Type III or IV sheeting designed for reboundable devices is used for reboundable drums, tubular markers, and other reboundable markers.
- 2) At the Contractor's option, work zone signs and devices using retroreflective sheeting according to [Article 4186.03, B, 2, a](#), above may be used on all other highways.

C. Durability of Reflective Sheeting.

Subject reflective sheeting to the following tests, and at the end of the testing period, ensure it meets the requirements for artificial weathering specified in ASTM D 4956 Section 7.4 and 7.5 and shows no evidence of mildewing or similar disfigurement:

- 1. **White, yellow, green, red, blue and brown reflective sheeting used for permanent signing and traffic control devices:** 3 year outdoor Iowa exposure at 45 degrees facing south.
- 2. **Orange and White reflective sheeting used for temporary traffic control signing and traffic control devices:** 1 year outdoor Iowa exposure at 45 degrees facing south.

4186.04 NONREFLECTIVE SHEETING.

Meet the following requirements:

- Adhesive and physical properties are the same as for reflective sheeting found in ASTM D 4956.
- Color properties are the same as for Type III reflective sheeting found in ASTM D 4956.

4186.05 INKS, CLEARS, AND THINNERS.

Use according to the sheeting manufacturer's recommendations.

4186.06 SIGN FABRICATION.

A. General.

Meet the following requirements:

- 1. All sign blanks and panels are fabricated in a uniform and high quality manner.

2. All fabrication, including shearing, cutting, and hole punching or drilling, is completed before degreasing metal surface and applying reflective sheeting.
3. Sign blanks and panels are to size and shape and are free of buckles, warp, dents, cockles, burrs, and defects resulting from fabrication.
4. Type B signs are assembled using a maximum number of 12 inch (300 mm) wide structural panels, corresponding to the dimensions shown in the contract documents to keep the number of sign joints to a minimum. If a 6 inch (150 mm) panel is required, it is used in the top panel of the completed sign.
5. Finished signs, both Type A and B, are smooth and flat and are free from blisters, wrinkles, cracks, tears, and delaminations
6. All letters are clean cut and sharp.

B. Application of Sheeting.

1. Meet the following requirements:
 - a. Sheeting, reflective and nonreflective, is applied mechanically with the equipment and in a manner specified by the sheeting manufacturer or by a method which will produce an equivalent result.
 - b. On extruded aluminum or formed steel sign panels, the sheeting is lapped over the longitudinal edges of each panel a minimum distance of 1/4 inch (6 mm).
 - c. Sheeting is bonded to the panels using an accessory tool the sheeting manufacturer recommends or by a tool which will produce an equal result.
2. Whenever a sign face consists of two or more pieces or panels of reflective sheeting, they must be carefully matched for color at the time of sign fabrication to provide uniform appearance and brilliance, both day and night. Signs with background color of adjacent sheets or panels not properly matched will be rejected.
3. At splices, overlap pressure sensitive adhesive sheeting no less than 3/16 inch (5 mm). Sheeting with heat activated adhesive may be spliced with overlap no less than 3/16 inch (5 mm), or butted with a gap not to exceed 1/32 inch (1 mm). Use only butt splices on screen processed signs with transparent color.

C. Letters, Numerals, Symbols, and Borders.

Meet the following requirements:

1. Letters, numerals, symbols, and borders comply with the contract documents.

2. The border strip on the left and right edges of each sign is set in far enough from the edge to accommodate installation of the required trim molding without reducing the border width.

D. Other Details.

Meet the following requirements:

1. All gaps on the edges of plywood signs are filled with a waterproof putty.
2. Signs are slip sheeted and packed to ensure they are not exposed to moisture and they arrive at their destination in an undamaged condition.

4186.07 SIGN IDENTIFICATION.

- A. Mark the back of all finished signs with an identification sticker at the bottom edge of the sign that is visible when the sign is erected. Use a piece of nonreflective sheeting approximately 3 inches by 4 inches (75 mm by 100 mm) with the following information: the contractor's name, type of sheeting, and name of sheeting manufacturer. For Type A signs, include the erection date on the sticker.
- B. For Type B signs, in addition to the above sticker, place the following information on the back side in 1 inch (25 mm) letters: the sign number, and the erection date. The 1 inch (25 mm) letters may be painted or stenciled on with black exterior grade paint, or printed on a sticker.

4186.08 FINISHED SIGN INSPECTION.

Visually inspect finished signs upon receipt for correct message, and conformity to the contract documents. Replace non-complying signs at no additional cost to the Contracting Authority.

4186.09 FASTENING ACCESSORIES.

Ensure the dimensions and tolerances for all bolts, nuts, and washers comply with ANSI standards for the size required, unless stated otherwise. Ensure the threads of all fastening accessories meet the requirements of ANSI B1.1, National Coarse Thread Series. Meet the following requirements:

A. Type A Signs.

1. Bolts.

The length required depends upon the type of post supplied by the Contractor (wood, steel, or aluminum). Use the minor thread diameter in determining stress area.

- a. Use bolts 3/8 inch (9.5 mm) in diameter with a hexagonal head.
- b. Thread fit is to conform to ANSI Class 2A.

2. Nuts.

- a. Use finished, finished thick, regular, or heavy hexagonal, self locking nuts for 3/8 inch (9.5 mm) bolts, but use nuts all of the same type.
- b. Axial tensile strength at room temperature is to be no less than 4,730 pounds (21 kN).

3. Self Locking Nuts.

- a. Use nuts approved by the Engineer.
- b. Thread fit is to be as recommended by the manufacturer.

4. Washers.

- a. Use washers made of a quality of material approved by the Engineer.
- b. Washers are to be 3/8 inch (9.5 mm) I.D. by 1 3/8 inch (35mm) O.D. by 0.125 inch (3mm).
- c. A thickness tolerance of ± 0.006 inch (0.15 mm) is allowed.
- d. Neoprene washers are to be 3/8 inch (9.5mm) I.D. by 15/16 inch (24mm) O.D. by 1/8 inch (3 mm) thickness. (Neoprene washers are required when treated wood posts are used). Durometer hardness is to be 60 to 70, with a tolerance of ± 5 .

5. Other Details.

- a. Other details, including post clips on I-beam posts, etc., are shown in the contract documents.
- b. Hardware may be furnished in stainless steel or galvanized steel as approved by the Engineer. Ensure galvanizing meets requirements of ASTM F 2329, or ASTM B 633, Class Fe/Zn 25, Type II or Type IV.

B. Type B Signs.

Ensure the fittings described in the paragraphs below, when combined with the aluminum sections and posts, form a complete, assembled sign unit that will meet the specified strength requirements. Though aluminum hardware is specified, equivalent hardware may be furnished in stainless steel or galvanized steel as approved by the Department. Galvanizing is to meet the requirements of ASTM F 2329, or ASTM B 633, Fe/Zn 25.

1. Bolts.

Use the minor thread diameter in determining stress area.

- a. Use post clip bolts and panel bolts made from aluminum wire or rod meeting the requirements of ASTM B 211, Alloy 2024-T4.
 - **Post clip bolts:** 3/8 inch (9.5 mm) in diameter and 1 3/4 inches (45 mm) in length, square or rectangular head, manufactured according to the dimensions and details shown in the contract documents.
 - **Panel bolts:** 3/8 inch (9.5 mm) in diameter and 3/4 inch (19mm) in length with hexagonal head.
- b. Thread fit is to conform with ANSI, Class 2A.

2. Nuts.

For Type B signs, use nuts manufactured from any aluminum alloy listed in ASTM B 211 or from stainless steel and meeting the following requirements:

a. Post clip nuts:

- Finished, finished thick, regular, or heavy hexagonal, self locking nuts for 3/8 inch (9.5 mm) bolts, but all nuts to be of the same type.

- Able to withstand a proof load, at room temperature, of 4,730 pounds (21 kN).
- b. **Self locking nuts:** comply with [Article 4186.09, A, 3.](#)
- c. **Panel bolt nuts:**
 - Finished hexagonal nuts for 3/8 inch (9.5 mm) bolts. Able to stand a proof load of 4,200 pounds (18.7 kN).
 - Thread fit is to conform with ANSI, Class 2B.

3. Washers.

- a. Use washers made of a quality of material approved by the Engineer.
- b. Post clip washers and panel bolt washers are to be flat 7/16 inch (11 mm) I.D. by 1 inch (25 mm) O.D. by 0.078 inch (2 mm).
- c. A thickness tolerance of ± 0.006 inch (0.15 mm) is allowed.

4. Post Clips.

- a. Use aluminum castings manufactured according to the contract documents.
- b. Ensure clips are able to withstand the load requirements of the bolt specified.

5. Edge Trim Molding.

Meet the following requirements:

- a. Molding is attached to the signs by means of self tapping, 300 series, stainless steel, machine screws, Size 8-32.
- b. Pan head, binding head, or truss head screen is used.
- c. A screw is installed 1/2 inch (13 mm) from the end of each section of molding. Intermediate screws are installed no more than 12 inches (300 mm) apart.

C. Delineators, Milepost Markers, and 6 Inch by 6 Inch (150 mm by 150 mm) Route Markers.

1. Fasten delineators to the post with a blind, pull through, aluminum rivet and washer. Use a 3/16 inch (5 mm) diameter rivet with a suitable grip range. Use washers:
 - Made of a quality of material approved by the Engineer.
 - With dimensions of 0.193 inch (4.9 mm) I.D. by 3/4 inch (19 mm) O.D. by 0.091 inch (2.3 mm) with a thickness tolerance of ± 0.006 inch (0.15 mm).
2. Fasten milepost markers and 6 inch by 6 inch (150 mm by 150 mm) route markers to the post as shown in the contract documents.

4186.10 SIGN POSTS.

Furnish sign posts of the following types for the sign or signs specified:

A. Wood Posts for Type A or B Signs.

Furnish the size and type shown in the contract documents. Ensure posts meet the requirements of [Section 4164.](#)

B. Steel Breakaway Posts for Type A and B Signs.

1. Furnish the size and type shown in the contract documents. Ensure the following:
 - a. The steel meets the requirements of ASTM A 36/A 36M, unless otherwise specified.
 - b. Fabrication is according to Section 2408.
 - c. Posts are galvanized after fabrication, except as noted.
 - d. Galvanization is by the hot dip process, complying with ASTM A 123, Grade 85, and posts are cleaned and pickled before such application.
2. Use high strength bolts, nuts, and washers meeting requirements of Article 4153.06, B as fasteners for breakaway sign posts.
3. Furnish washers meeting the requirements of ANSI B18.22.1 for the bolts specified. Ensure washers are fabricated of steel capable of withstanding the specified minimum load of the bolt for which they will be used. The Engineer may approve washers with dimensions other than those specified.
4. Use heavy hexagonal, semi-finished nuts and jam nuts on the anchor bolts. Furnish nuts meeting the requirements of ANSI B18.2.2. Nuts may be tapped oversize only enough to produce finger free fit. Regular hexagonal jam nuts may be used if the Engineer approves.
5. Furnish bolts (including the entire length of the anchor bolts), nuts, and washers that are galvanized according to ASTM F 2329 or B 695 Class 50, Type I coating.
6. Ensure the following:
 - a. Holes in the fuse plates and splice plates are fabricated by drilling.
 - b. Notches in the base plates and fuse plates are provided so that no metal projects beyond any face of the plate and the edges of the notches are smooth and true.
 - c. All bearing surfaces of base plate and fuse plate assembly are smooth and free of beads or runs.
7. For the fuse plate assembly, cut the post by sawing or flame cutting. The cut may be made before or after galvanizing of the post. If the cut is made after galvanizing, repair the damaged area by painting or smoldering.
8. Before fabrication, submit shop drawings for the steel breakaway sign posts according to [Article 1105.03](#) for review.

C. Posts for Delineators, Milepost Markers, and 6 Inch by 6 Inch (150 mm by 150 mm) Route Markers.

Furnish the type and length designated in the contract documents. Use Type 1 posts for permanent roadside delineators. Use Type 1, Type 2, or Type 3 posts for temporary delineators.

1. Type 1 Posts.

Posts may be furnished pointed for driving. Meet the following requirements:

- a. Steel posts are galvanized after fabrication. The coating is applied by the hot dip process at a rate of not less than 2.0 ounces per square foot (610 g/m^2) of actual surface as provided in ASTM A 123.
- b. Nominal weight of the posts is 2.00 pounds (3 kg) or more per foot (meter), before punching, although a variation of 3% under the specified weight (mass) is permitted.
- c. Posts are U-shaped with flat flanges at the front or open end of the "U". The faces of the flanges are flat and in the same plane.
- d. The back of the posts are flat or ribbed or otherwise provide for suitable sign or delineator bearing to a width of at least 1 1/8 inches (28 mm) parallel to the front flanges.
- e. The front of the post has a width of 3 inches to 3 1/2 inches (75 mm to 90 mm).
- f. The overall depth of the section is 1 13/32 inches to 1 17/32 inches (35 mm to 40 mm).
- g. The cross section of the posts is symmetrical about the center axis perpendicular to the front and back, and the thickness of metal is reasonably uniform. The Engineer may allow minor deviations.
- h. Posts are punched on center line with holes 7/16 inch (11 mm) in diameter on 1 inch (25 mm) centers. Posts are punched the entire length of the post. The top hole is 1 inch (25 mm) from the top of the post. Spacing and alignment of holes is within 1/16 inch (2 mm) of correct center line and distance. Punching is done so that no cracks radiate from the holes.

2. Type 2 Posts.

Meet the following requirements:

- a. Steel posts galvanized after fabrication. The coating is applied by the hot dip process at a rate of not less than 1.0 ounce per square foot (305 g/m^2) of actual surface as provided in ASTM A 123.
- b. The nominal weight of the posts is 1.12 pounds (1.67 kg) or more per foot (meter), before punching, although a variation of 3% under the specified weight (mass) will be permitted.
- c. Posts are U-shaped with flat flanges at the front or open end of the "U". The faces of the flanges are flat and in the same plane.
- d. The back of the posts are flat or ribbed or otherwise provide for suitable sign or delineator bearing to a width of at least 11/16 inch (18 mm) parallel to the front flanges.
- e. The front of the post has a minimum width of 2 inches (50 mm).
- f. The overall depth of the section is at a minimum of 7/8 inch (22 mm).
- g. The cross section of the posts is symmetrical about the center axis perpendicular to the front and back, and the thickness of metal is reasonably uniform. The Engineer may allow minor deviations.
- h. Posts are punched according to [Article 4186.10, C, 1, h.](#)

3. Type 3 Posts.

Meet requirements of [Article 4186.10, C, 2](#), except posts may be painted in lieu of galvanizing. If painted, ensure they are painted with a prime coat and with a final coat of aluminum or green paint. Ensure posts are thoroughly dry before being bundled for shipment.

D. Perforated Square Steel Tube (PSST) Posts and Anchors

Use PSST posts and anchors on the approved list in [Materials I.M. 486.10](#) and meet the following. When not specified elsewhere in the contract documents, the post and anchor system shall meet the minimum manufacturer's size requirements for 90 mph (145 km/hr) wind load criteria and be approved by the Engineer.

1. PSST Posts.

- a. Provide PSST posts of the dimensions and gauge required by the contract documents.
- b. Posts shall be designated "crashworthy" as defined by NCHRP Report 350 Category 2, Level 3 or by AASHTO *Manual for Assessing Safety Hardware* (MASH) for post systems evaluated after January 1, 2011 and be FHWA accepted.
- c. Galvanized posts shall conform ASTM A 653, SS, Grade 50, Designation G-90 or greater.
- d. Cross section of post shall be a square tube roll formed and corner welded. Corner weld shall be zinc coated after scarfing operation.
- e. Pre-punch 7/16 inch (11 mm) holes on 1 inch (25 mm) centers on all sides, vertically aligned and centered horizontally.
- f. Furnished post shall be straight and have a smooth uniform finish. It must be possible to freely insert post into anchors and telescope consecutive sizes with a minimum amount of play.
- g. If post is to be field cut, cut ends shall be coated with zinc rich paint as required per specification.

2. PSST Post Anchors.

- a. Break-away, soil installation.
42 inch (1065 mm) minimum length, 7 gauge (4.76 mm) heavy duty winged anchor.
- b. Break-away, concrete installation.
Posts installed in a concrete island, use a 48 inch (1220 mm) minimum length, 7 gauge (4.76 mm) heavy duty anchor. Core an 8 inch (200 mm) diameter hole through pavement at least 8 inches (200 mm) deep. After placing anchor, fill hole with concrete mix approved by the Engineer and level off top of concrete.
- c. Triangular Slip Base Assembly.
 - 1) Ensure design is in accordance with the AASHTO Standards and Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, current edition and meets or exceeds NCHRP Report 350 or the AASHTO MASH criteria for any assembly system evaluated after January 1, 2011 and be FHWA accepted.
 - 2) Triangular Slip Base Assembly consists of four parts: one-piece anchor, top half slip base, hardware, and concrete foundation.

- a) One-piece anchor shall meet the following requirements:
 - Anchor shall have a triangular slip plate (1 inch (25 mm) thick) welded directly to anchor leg.
 - Anchoring portion shall be 3 inches (75 mm) square 7 gauge (4.76 mm) material and 42 inches (1065 mm) long.
 - Galvanize by hot dip process, complying with ASTM A 123, grade 85.
- b) Top-half slip base shall meet the following requirements:
 - Cast unit from Ductile Iron meeting ASTM A 536 Class 65-45-12.
 - Top half slip base shall have a triangular dimension to match 8 inch (200 mm) standard triangular slip plate, and shall receive 2.5 inch (63 mm) square sign support.
- c) Hardware shall meet requirements of [Article 4186.09](#).
- d) Concrete Footings: Apply [Section 2403](#).

4186.11 DELINEATORS.

A. Furnish delineators meeting the following requirements:

1. Reflectors that are circular, hermetically sealed, and prismatic with a sealed optical system.
2. Permanent roadside delineators are to include an aluminum housing of 0.020 inch (0.508 mm), ASTM B 209, Alloy 5052.
3. Temporary delineators are to include either an aluminum or a plastic housing.
4. Delineators with aluminum housing are to have an aluminum grommet expanded within the mounting hole.
5. Delineators with plastic housing are to have a molded one piece reinforced plastic sleeve extending the thickness of the delineator.
6. A 3/16 inch (5 mm) diameter central mounting hole capable of withstanding the pressure of fastening without cracking or damaging the reflective surface is required.
7. A clear and transparent face of methyl methacrylate compound meeting requirements of ASTM D 788, Grade B, with a reflective lens area of approximately 7 square inches (4500 mm²), and a backing fused to the lens under heat and pressure around the entire perimeter of the lens and the central mounting hole. Backing is to be aluminum foil or a white, opaque compound of the type specified for the face. The foil backing will be acceptable only when the delineator has an aluminum backing.
8. A colorless or yellow reflector, as specified.

9. A lens consisting of a smooth front surface, free from projections or indentations affecting reflectance other than a central mounting hole and identification, with a rear surface bearing a prismatic configuration so that it will effect a total internal reflection of light. Manufacturer's trademark molded legibly into the face of the lens.
- B.** Ensure the optical performance of each delineator reflector when tested according to Materials Test Method No. Iowa 905 is equal to or exceeds the minimum values listed in Table 4186.11-1:

Table 4186.11-1: Minimum Optical Performance

Observation Angle Degrees	Entrance Angle Degrees	Specific Intensity Candle Power Per Foot- Candle (Candela Per Lux)	
		White	Yellow
0.1	0	120 (11.0)	75 (7.0)
0.1	20	50 (4.6)	30 (2.8)
Select five test specimens for the specific intensity test. If all five specimens exceed the minimum values, the reflectance will be considered acceptable. If one of the five specimens fails to meet the minimum values, select an additional ten specimens selected for testing. These additional specimens must meet the minimum values. Reject the lot if two or more of the original five specimens, or one or more of the additional ten specimens fail to meet the minimum values.			

- C.** Test delineator reflectors for proper sealing against dust and water according to Materials Test Method No. Iowa 907, with no more than 2% of the specimens tested showing sealing test failure.
- D.** Test delineators for durability according to Materials Test Method No. Iowa 906.
- E.** Ensure the average loss in specific intensity is no greater than 10% of the average of the three specimens prior to the test. Ensure no more than one specimen is below the minimum values specified for unheated specimens.

4186.12 BARRIER MARKERS.

- A.** Furnish markers meeting the following requirements:
 1. Suitably shaped marker body designed for attachment to a flat surface.
 2. Reflective surface that presents at least 7 square inches (4500 mm²) when viewed on a line parallel to the roadway center line.
 3. Reflective surface of a flat acrylic plastic wide angle retroreflective lens of methyl methacrylate plastic meeting FSS LP-380C Type 1, Class C that is hermetically sealed or microprism sheeting mounted on a flat thermoplastic or PVC plastic body which is at least 70 mils (1.8 mm) thick.

4. Reflective surface exhibiting a minimum specific reflectance intensity listed in Table 4186.12-1:

Table 4186.12-1: Minimum Specific Reflectance Intensity

Observation Angle Degrees	Entrance Angle Degrees	Specific Intensity Candle Power Per Foot- Candle (Candela Per Lux)	
		White	Yellow
0.1	0	120 (11.0)	75 (7.0)
0.1	20	50 (4.6)	30 (2.8)

- B. Approved markers are listed in [Materials I.M. 486.08](#).