

**SECTION 1088
DELINEATORS**

1088-1 REFLECTIVE UNIT REQUIREMENTS FOR DELINEATORS

(A) Definition

Refer to ASTM D4956.

Define “entrance angle” as the angle at the reflector between direction of light incident on it and direction of reflector axis.

Define “observation angle” and “specific intensity” in accordance with Subarticle 1086-3(C)(3)(a).

(B) Reflective Elements

(1) Prismatic Plastic Type

(a) General

Use an acrylic plastic prismatic reflector hermetically sealed to an acrylic plastic back. The reflector shall consist of a clear and transparent face, herein referred to as a lens, with an acrylic plastic back fused to the lens under heat pressure around the entire perimeter of the lens. Where a central mounting hole is required, permanently seal the unit against dust, water and water vapor.

The lens shall consist of a smooth front surface free from projections or indentations except a central mounting hole and identification markings. Mold the manufacturer’s trademark legibly into the face of the lens.

(b) Specific Intensity

Refer to ASTM D4956.

The specific intensity of each prismatic plastic type reflector shall meet Table 1088-1 measurements made with reflectors spinning. Failure to meet the specific intensity minimum will constitute failure of the lot.

**TABLE 1088-1
OPTICAL PROPERTIES OF PRISMATIC
PLASTIC TYPE REFLECTORS**

Observation Angle (Degrees)	Entrance Angle (Degrees)	Minimum Specific Intensity (Candlepower per Footcandle)		
		<i>Crystal</i>	<i>Yellow</i>	<i>Red</i>
0.1°	0°	119	71	29
0.1°	15°	119	28	--
0.1°	20°	47	28	11
0.1°	35°	50	30	--

Locate the prismatic plastic type reflector to be tested at a distance of 100 feet from a single light source having an effective diameter of 2 inches operate the light source at approximately normal efficiency. Measure the return light from the reflector by a photoelectric photometer having a minimum sensitivity of 1 x 10 footcandles per mm scale division. The photometer shall have a receiver aperture of 0.5 inch diameter, shielded to eliminate stray light. The distance from light source center to aperture center shall be 2.1 inches for 0.1 degree observation angle. During testing, spin the reflectors to average the orientation effect.

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1 If a test distance other than 100 feet is used, modify the source and aperture
2 dimensions, and the distance between source and aperture, in the same
3 proportion as the test distance.

4 (c) Durability

5 (i) Seal Test

6 Use the following test to determine if a reflector is adequately sealed
7 against dust and water:

8 Submerge 50 samples in water at room temperature. Subject the submerged
9 samples to a vacuum of 5 inches gauge for 5 minutes. Restore atmospheric
10 pressure and leave the samples submerged for 5 minutes, then examine the
11 samples for water intake. Evidence of any water is a failure. Failure of
12 more than 2% of the number tested will be cause for rejection.

13 (ii) Heat Resistance Test

14 Test three reflectors for 4 hours in a circulating air oven at 175°+5°F. Place
15 the test specimens in a horizontal position on a grid or perforated shelf,
16 permitting free air circulation. At the conclusion of the test, remove the
17 samples from the oven and permit them to cool in air to room temperature.
18 The samples, after exposure to heat, shall show no change in shape and
19 general appearance when compared with unexposed control standards. Any
20 failures will be cause for rejection.

21 (2) High Performance Sheeting Grade

22 The reflective sheeting shall be Grade C retroreflective sheeting that conforms to
23 Article 1092-2.

24 **1088-2 GUARDRAIL AND BARRIER DELINEATORS**

25 **(A) Brackets and Casings for Delineators**

26 Make brackets for guardrail and barrier delineators out of 12 gauge galvanized steel,
27 0.063 inch thick aluminum alloy, or .080 inch thick polycarbonate. Use molded plastic
28 type guardrail and barrier delineators that consist of a plastic casing and a reflective
29 element.

30 **(B) Reflective Element Requirements**

31 The reflective element shall meet Article 1088-1. In addition, guardrail delineators and
32 side mounted barrier delineators shall have a minimum reflective area of 7 sq.in. Top
33 mounted barrier delineators shall have a minimum reflective area of 28 sq.in.

34 **(C) Material Certification**

35 Furnish a Type 2 material certification in accordance with Article 106-3 for all guardrail
36 and barrier (permanent) delineators and a Type 7 material certification for all guardrail
37 and barrier delineators (temporary) before use.

38 **(D) Approval**

39 All materials are subject to the approval of the Engineer.

40 **1088-3 GUARDRAIL END DELINEATION**

41 **(A) General**

42 Use guardrail end delineation that is adhesive coated yellow reflective sheeting applied
43 with a pressure sensitive adhesive backing.

(B) Reflective Sheeting Requirements

Use Grade C yellow retroreflective sheeting which conforms to Article 1092-2 for all guardrail end delineation. In addition, guardrail end delineation shall have a minimum reflective area of 2 sf for curved end sections or cover the entire portion of square end sections. See *Roadway Standard Drawings*.

(C) Material Certification

Furnish a Type 2 material certification in accordance with Article 106-3 for all guardrail end delineation before use.

(D) Approval

All materials are subject to the approval of the Engineer.

1088-4 OBJECT MARKERS**(A) General**

Use 7 feet galvanized steel U-shaped channel posts as supports for delineators that are fabricated from steel conforming to ASTM A36 or ASTM A409. Use 7 feet posts, which weigh at least 1.12 lbs/lf after fabrication and application of protective finish. Punch or drill all posts with 3/8 inch diameter holes on the centerline, spaced on 1 inch centers, starting 1 inch from the top and extending at least 24 inches down the posts. Make sure that the holes are clean and the posts are free of burrs. Hot dip galvanize the posts after fabrication for the full length and total area in accordance with ASTM A123.

(B) Reflectors

Use 3 inches diameter prismatic plastic reflectors on object markers that meet Subarticle 1088-1(B)(1).

(C) Reflective Sheeting Requirements

Use Grade C retroreflective sheeting on object markers that meet Article 1092-2.

(D) Panel Requirements

Use panels that meet Article 1092-1.

(E) Fasteners

Use fasteners that meet Article 1092-1.

(F) Material Certification

Furnish a Type 5 material certification in accordance with Article 106-3 for sheeting, a Type 2 material certification for delineators and a Type 1 material certification for U-channel posts before use.

(G) Approval

All materials are subject to the approval of the Engineer.

1088-5 TUBULAR MARKERS**(A) General**

Provide tubular markers that are made of ultraviolet stabilized plastic impact resistant material and have been evaluated by NTPEP. Provide orange, yellow or white tubular markers as shown in the plans.

Provide tubular markers that are flexible or have a flexible joint at the base, such that it will return to its original shape and position if struck by a 5,000 lb vehicle at a velocity of 55 mph. When struck the tubular markers shall not permanently distort to a degree that would prevent reuse.

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1 Use tubular markers that are circular in shape and have a minimum height of 36 inches
2 with a broadened base. Use tubular markers that have a minimum height of 42 inches on
3 roadways with posted speed limits greater than 50 mph.

4 Design tubular markers that have white retroreflective collars or as shown in the contract.

5 Where retroreflective collars are required, provide Grade C retroreflective sheeting or
6 better that meets Article 1092-2. Use retroreflective sheeting bands with a minimum
7 width of 4 inches with 6 inches between the bands. Apply a continuous strip of sheeting
8 completely around the tubular marker to ensure 360° retroreflectivity.

9 **(B) Material Certification**

10 Furnish a Type 3 material certification in accordance with Article 106-3 for all new
11 tubular markers and retroreflective collars and a Type 7 material certification for all used
12 tubular markers and retroreflective collars before use.

13 **(C) Approval**

14 All materials are subject to the approval of the Engineer.

15 **1088-6 FLEXIBLE DELINEATOR**

16 **(A) General**

17 Provide flexible delineators evaluated by NTPEP.

18 **(B) Retroreflective Sheeting**

19 Use retroreflective sheeting that is a minimum area of 16 sq.in., with a minimum width
20 of 3 inches. The reflective sheeting shall be Grade C retroreflective sheeting or better
21 and shall conform to Article 1092-2.

22 Use retroreflective sheeting which is yellow, red or crystal, as shown in the plans. Attach
23 the retroreflective sheeting on the front and back of the delineator post as required by the
24 contract.

25 **(C) Post**

26 Design a delineator post that is flexible and made of recycled material. Provide
27 a delineator post that is resistant to impact, ultraviolet light, ozone, hydrocarbons and
28 stiffening with age.

29 Provide a post that is not seriously affected by exhaust fumes, asphalt or road oils, dirt,
30 vegetation, soil, deicing salts or any other types of air contamination or materials likely to
31 be encountered. Upon weathering, the post shall not exhibit serious discoloration,
32 checking or cracking, peeling or blistering, swelling, shrinking or distortion, or any other
33 detrimental effects. Weathering shall not cause appreciable strength or flexibility loss.

34 Design a post with a smooth surface that is free from irregularities or defects. The
35 surface of the post shall not soil excessively. If soiling does occur, it shall be easily
36 cleaned using detergent and water, or solvent.

37 Use posts that have a convex shaped cross-section. The cord distance for the cross-
38 section shall be from 3.5 inches to 4.5 inches in length.

39 Design a post such that it can maintain straightness throughout its entire life. Straight is
40 defined as no point along its length any more than 1 inch away from a perfectly straight
41 edge placed longitudinally along any side of the post.

42 Provide a post in which both sides of the top of the post accepts, and holds securely,
43 retroreflectorized sheeting.

44 Design posts that are gray in color.

(D) Base Support

Provide a base support that is hot rolled rail steel or new billet steel meeting Article 1088-5, the physical requirements of ASTM A499 and the chemical requirements of ASTM A1.

Use a base support that is a uniform flanged U-channel post with a nominal weight of 3 lb./ft. before holes are punched. Use base support posts that are 18 inches in length and have sufficient number of 3/8 inch diameter holes on 1 inch centers to facilitate attachment of the flexible post.

(E) Anchoring

Design a delineator post for a permanent installation to resist overturning, twisting and displacement from wind and impact forces.

(F) Temperature

Design flexible delineators that do not bend, warp or distort and remain straight, when stored or installed at temperatures up to + 120°F. Design all components of the flexible delineator, post and reflective sheeting to remain stable and remain fully functional within a temperature range of - 20°F to + 120°F.

(G) Impact Resistance, Wind Resistance

Design flexible delineators that meet the impact and wind resistance of the current evaluation criteria of the NTPEP.

(H) Product Identification

Provide flexible delineator post that are permanently identified, on the rear side, with the manufacturer's name and the month and year of fabrication in order to provide a tracking method for ongoing outdoor evaluation, and specification quality control. The letters shall be at least 1/4 inch in height and permanently affixed to the rear of the marker.

(I) Material Certification

Furnish a Type 2 and Type 3 material certification in accordance with Article 106-3 for all flexible delineators before use.

(J) Approval

All materials are subject to the approval of the Engineer.

SECTION 1089 TRAFFIC CONTROL

1089-1 WORK ZONE SIGNS**(A) General**

Use Grade B fluorescent orange retroreflective sheeting on rigid work zone sign substrates. All sheeting shall conform to Article 1092-2. Cover the entire sign face of the sign substrate with Department approved sheeting. No bubbles or wrinkles will be permitted in the material.

(1) Work Zones Signs (Stationary)

Use approved composite or aluminum substrate for sign backing. Signs and sign supports shall meet NCHRP 350 crash requirements for breakaway devices.

(2) Work Zones Signs (Barricade Mounted)

Use approved composite or roll-up signs for barricade mounted sign substrates. No other type of sign substrate is allowed on barricades. Approved composite barricade