

Section 1088

- 1 (b) Yellow
- 2 Daylight reflectance at 2° Standard observer and CIE illuminant
- 3 Using XYZ scale D65/10° - 45% minimum =Y
- 4 ASTM E1349
- 5 (2) Bond Strength
- 6 The bond strength shall be 200 psi or greater in accordance with ASTM D4796.
- 7 (3) Cracking Resistance at Low Temperatures
- 8 After applying a 4", 125 mil draw-down to concrete blocks and cooling to 15 ± 3°F,
- 9 the material shall show no cracks at an observation distance of 12".
- 10 (4) Specific Gravity
- 11 The specific gravity shall be 1.95-2.20 in accordance with ASTM D792.
- 12 (5) Softening Point
- 13 The softening point shall be 215 ± 15°F in accordance with ASTM D36.
- 14 (6) Drying Time
- 15 When applied at a thickness of 125 mils, the material shall set to bear traffic in no
- 16 more than 2 minutes when air and substrate temperature is 50°F ± 3°F (and no more
- 17 than 10 minutes when the air and substrate temperature is 90°F ± 3°F when applied
- 18 at temperature of 412.5 ± 12.5°F in accordance with AASHTO T 250.
- 19 (7) Alkyd Binder Determination
- 20 The thermoplastic material shall immediately dissolve in diacetone alcohol. Slow
- 21 dissolution is evidence of the presence of hydrocarbon binder components.
- 22 (8) Indentation Resistance
- 23 The Shore Type A2 Durometer with a 4.41 lb load applied shall be between 40 and
- 24 75 units after 15 seconds at 115°F in accordance with ASTM D2240.

1087-8 MATERIAL CERTIFICATION

26 Furnish the following pavement marking material certifications in accordance with
27 Article 106-3:

Glass Beads	Type 3 Material Certification and Type 4 Material Certification
Paint	Type 3 Material Certification
Removable Tape	Type 3 Material Certification
Thermoplastic	Type 3 Material Certification and Type 4 Material Certification
Cold Applied Plastic	Type 2 Material Certification and Type 3 Material Certification
Polyurea	Type 3 Material Certification

**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.

1 Define "observation angle" and "specific intensity" in accordance with
2 Subarticle 1086-3(C)(3)(a).

3 **(B) Reflective Elements**

4 (1) Prismatic Plastic Type

5 (a) General

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

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

14 (b) Specific Intensity

15 Refer to ASTM D4956.

16 The specific intensity of each prismatic plastic type reflector shall meet
17 Table 1088-1 measurements made with reflectors spinning. Failure to meet the
18 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	--

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

28 If a test distance other than 100 ft is used, modify the source and aperture
29 dimensions, and the distance between source and aperture, in the same
30 proportion as the test distance.

31 (c) Durability

32 (i) Seal Test

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

35 Submerge 50 samples in water at room temperature. Subject the submerged
36 samples to a vacuum of 5" gauge for 5 minutes. Restore atmospheric
37 pressure and leave the samples submerged for 5 minutes, then examine the

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1 samples for water intake. Evidence of any water is a failure. Failure of
2 more than 2% of the number tested will be cause for rejection.

3 (ii) Heat Resistance Test

4 Test 3 reflectors for 4 hours in a circulating air oven at 175°+5°F. Place the
5 test specimens in a horizontal position on a grid or perforated shelf,
6 permitting free air circulation. At the conclusion of the test, remove the
7 samples from the oven and permit them to cool in air to room temperature.
8 The samples, after exposure to heat, shall show no change in shape and
9 general appearance when compared with unexposed control standards. Any
10 failures will be cause for rejection.

11 (2) High Performance Sheeting Grade

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

14 1088-2 GUARDRAIL AND BARRIER DELINEATORS

15 (A) Brackets and Casings for Delineators

16 Make brackets for guardrail and barrier delineators out of 12 gauge galvanized steel,
17 0.063" thick aluminum alloy, or .080" thick polycarbonate. Use molded plastic type
18 guardrail and barrier delineators that consist of a plastic casing and a reflective element.

19 (B) Reflective Element Requirements

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

23 (C) Material Certification

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

27 (D) Approval

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

29 1088-3 GUARDRAIL END DELINEATION

30 (A) General

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

33 (B) Reflective Sheeting Requirements

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

38 (C) Material Certification

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

41 (D) Approval

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

1 1088-4 OBJECT MARKERS**2 (A) General**

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

10 (B) Reflectors

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

13 (C) Reflective Sheeting Requirements

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

15 (D) Panel Requirements

16 Use panels that meet Article 1092-1.

17 (E) Fasteners

18 Use fasteners that meet Article 1092-1.

19 (F) Material Certification

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

23 (G) Approval

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

25 1088-5 TUBULAR MARKERS**26 (A) General**

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

30 Provide tubular markers that are flexible or have a flexible joint at the base, such that it
31 will return to its original shape and position if struck by a 5,000 lb vehicle at a velocity of
32 55 mph. When struck the tubular markers shall not permanently distort to a degree that
33 would prevent reuse.

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

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

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

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1 (B) Material Certification

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

5 (C) Approval

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

7 1088-6 FLEXIBLE DELINEATOR

8 (A) General

9 Provide flexible delineators evaluated by NTPEP.

10 (B) Retroreflective Sheeting

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

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

17 (C) Post

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

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

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

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

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

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

36 Design posts that are gray in color.

37 (D) Base Support

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

41 Use a base support that is a uniform flanged U-channel post with a nominal weight of
42 3 lb/ft before holes are punched. Use base support posts that are 18" in length and have
43 sufficient number of 3/8" diameter holes on 1" centers to facilitate attachment of the
44 flexible post.

1 (E) Anchoring

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

4 (F) Temperature

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

9 (G) Impact Resistance, Wind Resistance

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

12 (H) Product Identification

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

17 (I) Material Certification

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

20 (J) Approval

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

22 **SECTION 1089**
23 **TRAFFIC CONTROL**

24 1089-1 WORK ZONE SIGNS**25 (A) General**

26 Grade B fluorescent orange sheeting shall be used on rigid work zone sign substrates.
27 The sheeting shall conform to Article 1092-2. Cover the entire sign face of the sign
28 substrate with Department approved Grade B fluorescent orange reflective sheeting. No
29 bubbles or wrinkles will be permitted in the material.

30 Roll-up sign retroreflective requirements shall conform to Article 1092-2.

31 (1) Work Zones Signs (Stationary)

32 Use Grade B fluorescent orange retroreflective sheeting that meets the reflective
33 requirements in Article 1092-2. Use approved composite or aluminum substrate for
34 sign backing. Signs and sign supports shall meet NCHRP 350 requirements for
35 breakaway devices.

36 (2) Work Zones Signs (Barricade Mounted)

37 Use approved composite or roll-up signs for barricade mounted sign substrates. No
38 other type of sign substrate is allowed on portable sign stands. Approved composite
39 barricade mounted warning signs (black on orange) shall be Grade B sheeting that
40 meets the retroreflective requirements of Article 1092-2. Sign and barricade
41 assembly shall meet NCHRP 350 for Work Zone Category II devices.