# SECTION 993
# HIGHWAY DELINEATORS
# (INCLUDING POSTS AND ATTACHMENTS)

**993-1 Type A Delineators.**

**993-1.1 Reflectors:** The reflectors for these alternate delineators shall be of acrylic plastic and shall be a minimum of 3 inches in diameter. They shall be mounted in a heavy-duty housing with a back plate.

The reflector shall consist of a clear and transparent plastic lens, which shall be colorless or amber as specified, and a plastic back of the same material, fused to the lens under heat and pressure around the entire perimeter, in such manner as to form a homogeneous unit, permanently sealed against dust, water, and water vapor.

The lens shall consist of a smooth front surface, free from projections or indentations (other than for identification or orientation) and a rear surface bearing a prismatic configuration such that it will effect total internal reflection of light.

The acrylic plastic shall be of a type meeting the requirements of Federal Specification L-P-380, Type I, Class 3, and, in order that the Department can readily check the suitability of the raw material used, the manufacturer shall stipulate the raw material and the particular molding compound to be furnished.

The reflector element shall meet the test requirements specified below.

**993-1.2 Durability Tests For Type A Reflectors:**

(a) Seal Test: The following test will be used to determine if a reflector is adequately sealed against dust and water.

Submerge 50 samples in water bath at room temperature. Subject the submerged samples to a vacuum of 5 inches gauge for five minutes. Restore atmospheric pressure and leave samples submerged for five minutes, then remove and examine the samples for water intake. Failure of more than two of the 50 samples tested shall be cause for tentative rejection of the LOT.

In the event of such tentative failure of more than two of the 50 samples tested, a re-sample of the 100 reflector shall be checked-tested. If not more than four of these 100 samples fail then the LOT will be considered as acceptable.

(b) Corrosion Test: The reflector assembly shall withstand the combined corrosion test set forth in ASTM B 117.

**993-1.3 Optical Requirements:**

**993-1.3.1 Definitions:** The term, “Entrance Angle”, designates the angle at the reflector between the direction of light incident on it and the direction of the reflector axis.

The term, “Observation Angle”, designates the angle at the reflector between the observer’s line of sight and the direction of light incident on the reflector.

The term, “Specific Intensity”, designates the candle-power returned by a reflector at the specific observation angle, for each foot-candle of illuminance at the reflector.

**993-1.3.2 Specific Intensity:** The specific intensity of every reflex reflector intended for use in the delineators shall be at least equal to the minimum values shown below. Failure to meet the required specific intensity shall constitute failure of the reflector being tested. Failure of more than two reflectors out of 50 subjected to test shall constitute failure of the entire LOT.

| Observation Angle | Entrance Angle | Specific Intensity candle-power/foot-candle | |
|---|---|---|---|
| | | Crystal | Yellow |
| 0.1 degree | 0 degree | 40 | 24 |
| 0.1 degree | 20 degree | 16 | 10 |

**993-1.3.3 Optical Testing Procedure:** The reflex reflector to be tested shall be spun so as to have an average orientation effect, and shall be placed at a distance of 100 feet from a single light source having an effective diameter of 2 inches. The light source shall be operated at approximately normal efficiency. The return light from the reflector shall be measured by means of a photo-electric photometer having a minimum sensitivity of 1 by $10^{-7}$ foot-candles per mm scale division. The photometer shall have a receiving aperture of 1/2 inch diameter, shielded to prevent the entry of stray light. The distance from light source center to aperture center shall be 2.1 inches for the 0.1 degree observation angle.

If a test distance other than the stipulated 100 feet is used, the source and the aperture dimensions, and the distance between source and aperture shall be modified directly as the test distance.

**993-1.4 Delineator Element:** The delineator element shall consist of a reflector element mounted in a housing fabricated of aluminum alloy No. 3003-H 14 (or other alloy approved as equal for the purpose), or of heavy thickness, cold-rolled, hot-dip, galvanized steel, and having a thickness of 0.064 inch.

After all fabrication has been completed, the aluminum housing shall be treated with Alodine 1200, Iridite 14-2, Bonderite 721, or equal product, in accordance with the recommendations of the manufacturer of the particular treatment used.

**993-1.5 Assembly:** The attachment of the delineator to the housing and of the housing to the post shall be by such method that no mounting hole is required in the delineator; also, that the delineator can be easily removed from the post with proper tools but that such removal is not possible without the use of such tools.

The mounting holes shall be sized to receive 1/4 inch carriage bolts, or other 1/4 inch bolts, and shall be spaced to fit holes on the posts spaced at 1 inch centers.

**993-2 Type C Delineators.**

**993-2.1 Reflective Sheeting:** The reflective sheeting for these alternate delineators shall meet the requirements of Section 994, sheeting Types III, IV, V and VII. The delineators shall be 4 by 4 inch or 4 by 8 inch with the reflective sheeting permanently adhered to 0.040 inch sheet aluminum of 6061-T6 (ASTM B 209) prepared in accordance with recommendations of the sheeting manufacturer.

**993-2.2 Assembly:** The attachment of the delineator directly to the post shall be by two holes on the face of the delineator.

The mounting holes shall be 1/4 inch square holes to receive 1/4 inch carriage bolts, or other 1/4 inch bolts and shall be spaced to fit holes on the post spaced at 1 inch centers.

**993-3 Delineator Posts and Accessories.**

The delineator posts shall be of steel or aluminum as shown in the plans and of the alloys called for. They shall have the necessary holes for attachment of the delineator housing.

The assembly shall be furnished with the necessary bolts, nuts and washers for attaching to the posts.

**993-4 Insulating Materials.**

Neoprene, for the separating of aluminum parts and steel parts, shall contain at least 60%, by volume, of pure neoprene. Other approved material may be used, subject to the requirement that the material shall meet the approval of the Engineer as to pliability and ability to withstand wear caused by stretching or distortion.

If other material or method is proposed for use as insulation, it shall be indicated along with any details necessary.

Additional materials specifications are shown in the plans.

**993-5 Reflector Units for Guardrail and Concrete Barrier Wall.**

**993-5.1 General:** Reflector units for use on guardrail and concrete barrier wall installations shall consist of a hermetically sealed acrylic plastic prismatic reflex reflector or retroreflective sheeting permanently adhered to 0.040 inch thick sheet aluminum of 6061-T6 (ASTM B 209) prepared in accordance with recommendations of the sheeting manufacturer.

**993-5.2 Reflector Element:**

**993-5.2.1 Acrylic Plastic:** These reflectors shall be of acrylic plastic meeting the requirements of Federal Specification L-P-380, Type I, Class 3. The manufacturer shall stipulate the raw material used in the compound in order that the Department may readily check the suitability of the raw material.

The reflector shall consist of a clear transparent, or translucent amber plastic face, herein referred to as the lens, with a heat sealable plastic coated metallic foil back fused to the lens under heat and pressure around the entire perimeters of the lens to form a unit permanently sealed against dust, water and water vapor.

The reflector lens shall consist of a smooth front surface, free from projections or indentations and the necessary identification markings, and a rear surface having a prismatic configuration such that it will affect total internal reflection of light.

When the reflectors are tested as specified in 993-1.3 for Type A Delineators, the specific intensity of the colorless reflectors shall not be less than 119 at 0 degree entrance angle and not less than 47 at 20 degree entrance angle, and the specific intensity of the amber reflectors shall be not less than 71 at 0 degree entrance angle and not less than 28 at 20 degree entrance angle.

**993-5.2.2 Retroreflective Sheeting**: Retroreflective sheeting for these reflector units shall be Type III, IV, V, or VII meeting the requirements of Section 994. The sheeting shall be yellow or white, depending on the locations of use for each. The minimum reflective surface area of the marker shall be 9 $inch^2$. The adhesive backing for these markers shall be Class I.

**993-5.3 Installation:** Markers shall be installed at locations identified in the plans and in accordance with the Design Standards, Index Nos. 400 and 410.

**993-6 Product Acceptance on the Project.**

Acceptance will be made in accordance with the requirements of Section 705. Manufacturers seeking evaluation of their product must submit an application in accordance with Section 6.