



## **APEX Model 828 and 828AR**

### **Prismatic Retroreflective Pavement Marker and Prismatic Retroreflective Abrasion Resistant Marker**

#### **GENERAL DESCRIPTION**

Apex Model 828 and 828AR markers consist of one or two PMMA prismatic cube corner lens and a thermoplastic ABS body. The abrasion resistant Model 828AR has a thin layer of untempered glass bonded to the Model 828 reflective surface.

#### **DETAILED SPECIFICATIONS**

##### **1. DESIGN AND FABRICATION**

- a. Nominal Dimensional Details

Overall Dimensions	11.5cm x 8.0 cm x 1.7 cm (4½" x 3¼" x 5/8")
Slope of Reflecting Face	32 degrees to base
Effective Reflective Area	14.5 square centimeters (2.25 square inches)
- b. Material

The lens is molded of methyl methacrylate conforming to ASTM D788 Grade 8. The body is molded of acrylonitrile butadiene styrene thermoplastic polymer. Minimum of 10% of the content by weight is composed of postconsumer recycled-content.
- c. Surface

Thin untempered glass is bonded to the prismatic retroreflective faces to provide an extremely hard and durable abrasion resistant surface. The area covered by the glass is not less than 13.6 square centimeters (2.1 square inches). The outer surface of the shell is smooth except for purposes of identification.

The base of the marker is free from gloss and substances that may reduce its bond to adhesive.

#### **OPTICAL REQUIREMENTS**

##### **1. DEFINITIONS**

Horizontal entrance angle shall mean the angle in the horizontal plane between the direction of incident light and the normal to the leading edge of the marker.

Observation angle shall mean the angled at the reflector between the illumination axis and the observation axis.

Coefficient of Luminous Intensity (CIL) shall mean the ratio of the luminous intensity of the retroreflector in the direction of observation to the illuminance at the retroreflector on a plane perpendicular to the direction of the incident light. For markers, CIL is expressed in millicandelas per incident lux (mcd/lx). The equivalent English term is Specific Intensity (SI) expressed in candles per foot candle (cd/ftc).

## 2. OPTICAL PERFORMANCE

20 markers from each lot of 10,000 or less are selected at random for coefficient of luminous intensity check. Specific intensity is measured at a 30.5 m (100 feet) test distance, spacing between source center and receptor center is 5.33 cm (2.1 inches), receptor diameter and source diameter are each 2.54 cm (1.0 inch). Other test distances at 15.2 m (50 feet) and above may be used provided that the angular aperture requirements are met. (See ASTM E809, Measuring Photometric Characteristics of Photoreflectors.) 90% of tested markers must meet or exceed the requirements on the following table or the lot is rejected.

Observation Angle (degrees)	Horizontal Entrance Angles (degrees)	Coefficient of Luminous Intensity (mcd/lux)	Specific Intensity (cd/ft <sup>2</sup> )
0.2	0	White: 279 Yellow: 167 Red: 70 Green: 93 Blue: 26	White: 3.0 Yellow: 2.0 Red: 0.75 Green: 1.0 Blue: 0.28
0.2	±20	White: 112 Yellow: 67 Red: 28 Green: 37 Blue: 10	White: 1.5 Yellow: 1.0 Red: 0.3 Green: 0.4 Blue: 0.11

## 3. ABRASION RESISTANCE (Model 828AR Only)

For abrasion resistant markers (Apex Model 828AR), the glass face passes the following test: sand drop test as per ASTM D4280-12. (Note: in any two color units where the red lens is not covered with glass, the red lens is not abraded.)

## COLOR

Color conforms to the color requirements of ASTM D4280. The test method is provided in ASTM 4280 should it be required.

## PHYSICAL PROPERTIES

### 1. COMPRESSIVE STRENGTH REQUIREMENTS

Marker conditioned to 23dg +/- 2dg C (73 dg +/- 3.6dg F) for four hours shall be placed on a 13 mm (0.5 inch) thick flat steel plate. With a 9.5 mm (0.37 inch) Shore 60A elastomeric pad and a 13 mm (0.5 inch) thick flat steel plate placed on top of the marker, load is applied at a rate of 2.5 mm (0.1 inch) per minute. The marker shall support a minimum load of 2727kg (6000 lbs) without breakage or significant deformation.

### 2. FLEXURAL STRENGTH REQUIREMENTS

Marker conditioned to 23dg +/- 2dg C (73 dg +/- 3.6dg F) for four hours shall be placed on 12.7 by 25.4 mm (0.5 by 1.0 inch) steel bars and approximately 3 mm (0.12 inch) thick Shore 70A elastomeric pads. A Shore 70A elastomeric pad approximately 25 mm (1 inch) thick is placed on top of the marker, and a third 12.7 by 25.4 mm (0.5 by 1.0 inch) steel bars apply load to the top of the marker at a rate of 5.0 mm (0.2 inch) per minute. The marker shall support a minimum load of 909 kg (2000 lbs) without breakage.

### 3. RESISTANCE TO LENS CRACKING (Model 828AR Only)

Sampling: A random sample of markers to provide 10 lenses for each test (20 total) shall be selected from each lot.

Impact Testing: Condition the markers in a convection oven at 54dg C (130dg F) for one hour. Set the marker on a steel fixture designed to hold the reflecting face horizontal and set the fixture in a solid surface such as a concrete floor. While at the elevated temperature, impact the reflective face by allowing a 190 gm (0.42 lb.) dart fitted with a 0.64 cm (0.25 in) radius spherical head to drop 45.7 cm (18 in.) perpendicularly onto the center of the reflective surface. Cracks in the impact area shall be generally concentric in appearance. There shall be no more than two radial cracks longer than 0.64 cm (0.25 in.). There shall be no radial cracks extending to the edge of the glass.

Temperature Cycling: Subject samples to 3 cycles of 60dg C (140dg F) for four hours followed by -7dg C (20dg F) for four hours. There shall be no cracking or delamination following temperature cycling.

Tolerances: In either the impact or temperature cycling test, if 90% (9 lenses) of the test samples meet the above requirements, the lot shall be acceptable. Failure of 3 lenses of the sample shall be cause for rejection of the lot. Failure of 2 lenses shall necessitate a resample of 10 additional lenses. Failure of more than 1 lens of the resample shall be cause for rejection of the lot.

### 4. BOND STRENGTH TEST

Sand blast end of 5.1 cm (2 in.) diameter by 5.7 cm (2.25 in.) long steel test plugs with a threaded hole in the other end. Condition test plugs, pavement markers, and specified adhesive at 23dg +/- 2dg C (73dg +/- 3.6 dg F) for at least 4 hours before testing. Mix the specified adhesive until the mixture shows no streaks. Place adhesive on the center of the bottom surface of the markers and spread a layer of adhesive on the sandblasted surface of the test plug. Press plug firmly in the center of the marker with a twisting motion. With a squared end tool remove any adhesive which extrudes from under the plug. After 24 hours cure at 23dg +/- 2dg C (73dg +/- 3.6 dg F) measure bond strength using a tensile testing machine adjusted to travel at 0.5 cm (0.2 in.) per minute. Test fixture shall be designed to provide uniform load distribution. Bond strength less than 35.1 kg/cm<sup>2</sup> (500 psi) shall be considered a failure.