APEX Model 921 and 921AR

Prismatic Retroreflective Pavement Marker and Prismatic Retroreflective Abrasion Resistant Marker

GENERAL DESCRIPTION

Markers consist of an ABS plastic shell filled with a tightly adherent potting compound. The shell contains one or two glass covered prismatic retroreflective faces as required to reflect light from a single or opposite directions.

DETAILED SPECIFICATIONS

1. DESIGN AND FABRICATION
   a. Dimensional Details

Overall Dimensions	10.16 cm x 10.16 cm x 1.78 cm (4 in x 4 in x 0.75 in)
Slope of Reflecting Face	32 degrees to base
Area of Each Reflecting Face	21.0 square centimeters (3.25 square inches)

   b. Material
   The shell is molded of methyl methacrylate conforming to ASTM D788 Grade 8.

   c. Surface
   Thin untempered glass is bonded to the prismatic retroreflective faces to provide an extremely hard durable abrasion resistant surface. The area covered by the glass is not less than 19.35 square centimeters (3.00 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/ft c).

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)
0.2	0	White: 279 Yellow: 167 Red: 70 Green: 93 Blue: 23	White: 3.0 Yellow: 1.8 Red: 0.75 Green: 1.0 Blue: 0.28
0.2	20	White: 112 Yellow: 67 Red: 28 Green: 37 Blue: 10	White: 1.2 Yellow: 0.7 Red: 0.3 Green: 0.4 Blue: 0.11

3. ABRASION RESISTANCE (Model 921 AR Only)

   For abrasion resistant markers (Apex Model 921 AR), the glass face passes the following test: a 2.5 +/- 0.1 cm (1.0 +/- 0.2 in) diameter pad of No. 3 coarse steel wool conforming to Federal Specification FF-W-1825A is placed on a random sample of retroreflective faces. A load of 22.7 +/- 0.2 kg (50 +/- 0.5 lbs.) is applied and the surface is rubbed 100 times. Upon second photometer testing, using the same procedure described in item #2 above, the marker 75% or more of its original value or the lot is rejected. (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. FLEXURAL STRENGTH REQUIREMENTS

   Marketer conditioned to 23dg +/- 2dg C (73 dg -/+ 3.6dg F) shall support a load of 909 kg (2000 lbs.).

2. RESISTANCE TO LENS CRACKING

   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 delemination 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.

3. 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^2 (500 psi) shall be considered a failure.