

700 MATERIAL DETAILS

Materials shall conform to the stated requirements and/or the requirements of the referenced specifications including modifications as noted.

Copies of all Supplemental Specifications referenced in this section are on file with the City of Columbus Transportation Division.

721 - RAISED PAVEMENT MARKERS

The raised pavement marker (hereafter referred to as RPM/RPMs) shall consist of two components, one component is a casting; the other component is a prismatic retro-reflector. Both components of the RPM shall be as manufactured by the Amerace Corporation, Niles, Illinois, or an approved functional equivalent. The castings shall be Stimsonite Model 96, two-way plowable RPM castings and the prismatic retro-reflectors shall be stimsonite model 944 reflectors.

721.01 Prismatic Retro-Reflector. The Stimsonite Model 944 prismatic retro-reflector shall consist of an acrylic plastic shell filled with tightly adherent potting compound. The shell shall contain one or two prismatic retro-reflective faces to reflect incident light longitudinally along the pavement from a single or opposite directions. The reflector shall be in the shape of a shallow frustum of a pyramid. The reflector shall be constructed as follows:

1. Dimensions 4 inches (102 mm) by 2 inches (50 mm) by 1/2 inch (13 mm) (nominal) Slope of reflecting surface shall be 30°. Area of each reflecting surface shall be 1.87 sq. in. (1206 mm²) minimum. The outer surface of the shell shall be smooth except for purposes of identification.
2. The shell shall be molded of methyl methacrylate conforming to Federal Specification L-L-380C, Type 1, Class 3. Filler shall be a potting compound selected for strength, resilience and adhesion adequate to pass the necessary physical requirements. The surface of each lens other than red lenses shall be protected with a hard abrasion-resistant coating sufficient to pass the Steel Wool Abrasion Procedure and subsequent Reflective Intensity Requirement.

The Contractor shall furnish to the Engineer, Certified Test Data that the prismatic retro-reflectors meet the following requirements:

A. **Brightness Requirements.**

- (1) **Definitions.**

Horizontal entrance angle shall mean the angle in the horizontal plane between the direction of entrance light and the normal to the leading edge of the reflector. Divergence angle shall mean the angle at the reflector between observer's line of sight and the direction of the light entrance on the reflector.

Reflective brilliance shall mean candlepower of the returned light at the chosen divergence angle for each foot candle of illumination at the reflector on a plane perpendicular to the entrance light.

(2) **Optical Performance.**

(a) **Steel Wool Abrasion Procedure.**

Form a 1 inch (25 mm) diameter flat pad using #3 coarse steel wool per Federal Specification FF-W-1825. Place the steel wool pad on the reflector lens. Apply a load of 50 pounds (23 kg) and rub entire lens surface 100 times.

(b) **Reflective Brilliance.**

After abrading the lens surface, using the foregoing steel wool abrasion procedure, the reflective brilliance of each crystal (white) reflecting surface at 0.2 degrees divergence angle shall be not less than the following when the entrance light is parallel to the base of the reflector.

**Horizontal Entrance Angle Reflective Brilliance
Candlepower/ft. C**

0 degrees	3.0
20 degrees	1.2

For yellow reflectors, the reflective brilliance shall be 60 percent of the value for crystal (white).

For red reflectors, the reflective brilliance shall be 25 percent of the value for crystal (white).

(c) **Optical Testing Procedure.**

A minimum sample of 30 reflectors of each color shall be tested. The reflector to be tested shall be located with the center of the reflecting face at a distance of 5 feet (1.5 m) from a uniformly bright

light source having effective diameter of 0.28 inches (7 mm).

The photocell width shall be an annular ring .37 inches (9.4 mm) I.D. - .47 inches (12 mm) O.D. It shall be shielded to eliminate stray light. The distance from light source center to the photocell center shall be 0.21 inches (5.3 mm). If a test distance of other than 5 feet (1.5 m) is used, the source and receiver dimensions and the distance between source and receiver shall be modified in proportion to the test distance.

Failure of more than 4 percent of the reflecting faces shall be unacceptable.

B. Seal Test Requirements.

A sample of 50 units shall be submerged in water at room temperature and subjected to a vacuum of 5 inches (127 mm) gage for five minutes. After restoring atmospheric pressure the units shall be left submerged for an additional five minutes. When examined for water intake, failure of more than one unit shall be cause for rejection of the shipment.

C. Heat Resistance Test Requirements.

Three reflectors shall be tested for four hours in a circulating air oven at 175° F (79° C) ± 5° F (±3° C). The test specimens shall be placed in a horizontal position on a grid of perforated shelf permitting free air circulation. At the conclusion of the test the samples shall be removed from the oven and permitted to cool in air to room temperature. The samples after exposure to heat shall show no significant change in shape and general appearance when compared with corresponding unexposed control standards. Failure of one unit shall be cause for rejection of the shipment.

D. Strength Testing Procedure and Requirements.

A random sample of three reflectors shall be selected for test purposes.

Center the reflector base down over the open end of a hollow metal cylinder 1 inch (25 mm) high, 3 inches (76 mm) I.D., 3.5 inches (89 mm) O.D. apply a load to the top of the reflector through a 1 inch (25 mm) diameter by 1 inch (25 mm) high metal plug centered on top of the reflector. Rate of loading shall be 0.2 inches (5 mm) per minute.

Failure shall constitute either breakage or significant deformation of the reflector at any load less than 2,000 pounds (909 kg).

E. Impact and Temperature Cycling Tests.

Note: On two color units, the red lens should not be subjected to impact test.

1. Sampling.

A random sample of reflectors to provide 20 lenses for each test (40 total) shall be selected from each lot.

2. Impact Testing.

Position the reflectors in a convection oven at 130° F (54° C) for one hour. While at the elevated temperature, impact the reflective face by allowing 1.42 pound (0.6 kg) dart fitted with a 0.25 inch (6.4 mm) radius spherical head to drop 18 inches (457 mm) 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 0.25 inches (6.4 mm). There shall be no radial cracks extending to the edge of the glass.

3. Temperature Cycling.

Subject samples to 3 cycles of 140° F (60 °C) for 4 hours followed by 20° F (-7° C) for 4 hours. There shall be no cracking or delamination following temperature cycling.

4. Tolerance.

In either the impact or temperature cycling test, if 90 percent (18 lenses) of the test samples meet the above requirements, the lot shall be acceptable. Failure of 4 lenses of the sample shall be cause for rejection of the lot. Failure of 3 lenses shall necessitate a resample of 20 lenses. Failure of more than 1 lens of the resample shall be cause for rejection of the lot.

721.02 RPM Casting. The Stimsonite Model 96 RPM casting shall be nodular iron conforming to Specification ASTM-A-536-80, Grade 72-45-05, hardened to 52-54 RHC, snowplowable in two opposing directions, designed to be equipped with a replaceable prismatic retro-reflector. The Stimsonite Model 96 RPM casting shall weigh approximately 5.5 lbs (2.49 kg).

721.03 Casting Adhesive. The casting adhesive used to bond the RPM to the pavement shall be a two-component standard set epoxy available from Poly-Carb, Inc. or

General Adhesives and Chemical Company or an approved functional equivalent, all made with the following formulation:

Component A	Parts By Weight
Epoxy Resin (Epon 828 or functional equivalent)	100.0
Titanium Dioxide	7.68
No. 13 Talc U	36.64

Component B	Parts By Weight
N-Aminoethyl Piperazine (Jefferson or functional equivalent)	25.10
Nonyl Phenol	50.03
Talc Fiberine (C-400, Sierra or equal)	69.28
Molacco Black	0.23

The bidder shall furnish to the Engineer, a Certification of Compliance containing the Certified Formulation and Certified Test Data for the casting adhesive to be obtained in the following manner:

- A. The Certified Formulation shall be, for each of the Component Parts, the actual part by weight, the name of the producer and brand name of the material, and the producer's code number.
- B. Certified Test Data for the properties of the Component Parts, Components A (Epoxy) and B (Hardener), and the Cured System shall be obtained in accordance with the Methods of Test of AASHTO M237-73. The respective properties of the Component Parts to be tested are noted in Sections 2.3.1 through 2.3.3 and 2.3.5 through 2.3.7. The properties of both Components A and B to be tested are noted in Section 3.1.
- C. The properties of the Cured System to be tested are listed in Table 7 of AASHTO M237-73.
- D. Certified Test Data for the Component Parts may be obtained by the respective manufacturers. Certified Test Data the Cured System shall be obtained by an independent test laboratory or the respective manufacturer.
- E. For sampling purposes a batch shall consist of a single charge of all Components into a mixing chamber.
- F. Certified Test Data will be required for each batch of material. The Contractor shall furnish the Engineer a 1 pint (0.5 L) sample of each

Component Part from each batch of casting adhesive to be used on the project and from any subsequent batches when required by the Engineer.

- G. If substitutions are made for the prescribed materials, Epoxy Resin (Epon 828 or functional equivalent), N-Aminoethyl Piperazine (Jefferson or functional equivalent), or Nonyl Phenol (Jefferson or functional equivalent) the Contractor shall submit the producer's technical literature along with the Certified Formulation.
- H. As per MIL-P-15173A, Type B, if substitution for the prescribed materials No. 13 Talc U or Talc Fiberine (C-400, Sierra or equal) occurs after production has begun, the Contractor shall furnish new Certification of Analysis with another Certified Formulation and Certified Test Data.

721.04 Reflector Adhesive. The reflector adhesive used by the Contractor to bond the prismatic retro-reflector to the casting shall be either; MACCO, LN-602 (Liquid Nails), a waterproof synthetic rubber and resin based adhesive, manufactured by SCM Glidden-Durkee, Division of SCM Corporation, MACCO Adhesive Group, Wickliffe, Ohio 44092; or Franklin Panel and Metal Framing Adhesive, a solvent mastic of rubber, resin, and reinforcing inert material dissolved or dispersed in flammable solvent, manufactured by Franklin Chemical Industries, Inc., General Offices, 2020 Bruck St., P.O. Box 07802, Columbus, Ohio 43207 or an approved equivalent.

OR

The adhesive shall be pressure-sensitive, 100 percent solids, 0.040 inch (1.0 mm) thick with closed cell release paper on the bottom.

The Bidder shall furnish to the Engineer a Certification of Compliance containing the certified formulation of the synthetic rubber and resin based reflector adhesive. The Certified Formulation shall be for each material the actual percent by weight.