



Standard Specification
for

White and Yellow Reflective Thermoplastic Striping Material
(Solid Form)

AASHTO DESIGNATION: M 249-79

1. SCOPE

1.1 This specification covers a reflectorized thermoplastic pavement striping material that is applied to the road surface in a molten state by mechanical means with surface application of glass beads at a rate specified by the purchaser. Upon cooling to normal pavement temperature, it produces an adherent reflectorized stripe of specified thickness and width capable of resisting deformation by traffic.

1.2 The values stated in SI units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

- 2.1 *AASHTO Standards:*
M 247 Glass Beads Used in Traffic Paints
T 250 Thermoplastic Traffic Line Material
- 2.2 *ASTM Standard:*
D 36 Test Method for Softening Point of Bitumen (ring-and-ball apparatus)
- 2.3 *Federal Standards:*
Federal Test Method Standards No. 141
Federal Test Standard No. 595

3. MATERIALS

3.1 The thermoplastic material shall be homogeneously composed of pigment, filler, resins and glass reflectorizing spheres.

3.1.1 The thermoplastic material shall be available in both white and yellow.

3.1.2 The vendor shall have the option of formulating the material according to his own specifications. However, the physical and chemical properties contained in this specification shall apply regardless of the type of formulation used. The material upon heating to application temperature shall not exude fumes which are toxic, or injurious to persons or property. The pigment beads and filler shall be well dispersed in the resin. The material shall be free from all skins, dirt, and foreign objects.

3.1.3 Glass Beads (Pre-Mix)—The beads shall be uncoated and conform to AASHTO M 247-Type I.

4. REQUIREMENTS

4.1 *Specific Gravity*—The specific gravity of the white and yellow thermoplastic traffic line material shall not exceed 2.15.

4.2 *Composition*—The pigment, beads, and filler shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt, and foreign objects and shall comply with requirements according to Table 1.

TABLE 1 Composition

Component	White	Yellow
Binder	18.0 min	18.0 min
Glass beads	30–40	30–40
Titanium dioxide	10.0 min	—
Calcium carbonate and inert fillers	42.0 max	See Note
Yellow pigments	—	—

NOTE—Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing all other requirements of this specification are met.

4.3 *Physical Characteristics:*

4.3.1 *Color*—The thermoplastic material after heating for 240 ± 5 minutes at $218 \pm 2^\circ\text{C}$ ($425 \pm 3^\circ\text{F}$) and cooled to $25 \pm 2^\circ\text{C}$ ($77 \pm 3^\circ\text{F}$) shall meet the following:

White: Daylight reflectance at 45 degrees—0 degrees—75-percent minimum.

Yellow: Daylight reflectance at 45 degrees—0 degrees—45 percent minimum.

(a) For highway use, the color shall match Federal Test Standard Number 595—Color 13538.

(b) For airport use, the color shall comply with the requirements established by the FAA. The chromaticity and luminance factors shall be within the limits in Table 2 when determined under standard conditions:

(a) angle of illumination, 45 degrees

(b) direction of view, perpendicular to surface

(c) illuminant, CIE standard illuminant D65.

TABLE 2 CIE Equations

Yellow	
Orange boundary	$y = 0.130 + 0.636x$
White boundary	$y = 0.910 - x$
Green boundary	$y = 1.35x - 0.093$
Luminance factor	$\beta = 0.27 \text{ (mm)}$
White	
Purple boundary	$y = x$
Blue boundary	$y = 0.610 - x$
Green boundary	$y = 0.040 + x$
Yellow boundary	$y = 0.710 - x$
Luminance factor	$\beta = 0.35 \text{ (mm)}$

NOTE—The chromaticities and luminance factors of ordinary colors and colors of retro-reflecting materials shall be determined under the following standard conditions:

- (a) angle of illumination: 45 degrees;
- (b) direction of view: perpendicular to surface; and
- (c) illuminant: CIE standard illuminant D65.

4.3.2 Drying Time—When applied at a temperature range of $211 \pm 7^\circ\text{C}$ ($412.5 \pm 12.5^\circ\text{F}$) and thickness of 3.2 to 4.8 mm ($1/8$ to $3/16$ in.) the material shall set to bear traffic in not more than 2 minutes when the air temperature is $10 \pm 2^\circ\text{C}$ ($50 \pm 3^\circ\text{F}$) and not more than 10 minutes when the air temperature is $32 \pm 2^\circ\text{C}$ ($90 \pm 3^\circ\text{F}$).

4.3.3 Cracking Resistance at Low Temperature—After heating the thermoplastic material for 240 ± 5 minutes at $218 \pm 2^\circ\text{C}$ ($425 \pm 3^\circ\text{F}$), applying to concrete blocks, and cooling $-9.4 \pm 1.7^\circ\text{C}$ ($15 \pm 3^\circ\text{F}$), the material shall show no cracks.

4.3.4 Impact Resistance—After heating the thermoplastic material for 240 ± 5 minutes at $218 \pm 2^\circ\text{C}$ ($425 \pm 3^\circ\text{F}$) and forming test specimens, the impact resistance shall be a minimum of 1.13J (10-in. lbs.).

4.3.5 Softening Point—After heating the thermoplastic material for 240 ± 5 minutes at $218 \pm 2^\circ\text{C}$ ($425 \pm 3^\circ\text{F}$) and testing in accordance with ASTM D 36 the materials shall have a softening point of $102.5 \pm 9.5^\circ\text{C}$ ($215 \pm 15^\circ\text{F}$).

4.3.6 Flowability—After heating the thermoplastic material for 240 ± 5 minutes at $218 \pm 2^\circ\text{C}$ ($425 \pm 3^\circ\text{F}$) and testing for flowability, the white thermoplastic shall have a maximum percent residue of 18 and the yellow thermoplastic shall have a maximum percent residue of 21.

4.3.7 Yellowness Index—The white thermoplastic material shall not exceed a yellowness index of 0.12.

4.3.8 Flowability—Extended Heating—After heating the thermoplastic material 8.0 ± 0.5 hours at $218 \pm 2^\circ\text{C}$ ($425 \pm 3^\circ\text{F}$), with stirring the last 6 hours, and tested for flowability, the thermoplastic shall have a maximum percent residue of 28.

4.4 Storage Life—The material shall meet the requirements of this specification for a period of 1 year. The thermoplastic must also melt uniformly with no evidence of skins or unmelted particles for this 1-year time period. Any material not meeting the above requirements shall be replaced by the manufacturer.

5. APPLICATION PROPERTIES

5.1 The thermoplastic material shall readily extrude at temperatures of $211 \pm 7^\circ\text{C}$ ($412.5 \pm 12.5^\circ\text{F}$) from approved equipment to produce a line 3.2 to 4.8 mm ($1/8$ to $3/16$ in.) thick which shall be continuous and uniform in shape having clear and sharp dimensions.

5.2 The material shall not exude fumes which are toxic, obnoxious, or injurious to persons or property when it is heated during applications.

5.3 The application of additional glass beads by drop-on methods shall be at a rate specified by the purchaser and agreed upon by the applicator.

6. PACKAGING AND MARKING

6.1 The thermoplastic material shall be packaged in suitable containers to which it will not adhere during shipment and storage. The blocks of cast thermoplastic material shall be approximately 300 by 915 by 51 mm (12 by 36 by 2

in.) and shall have a mass of approximately 23 kg (50 lbs). Each container label shall designate the color, manufacturer's name, batch number, and date of manufacture. Each batch manufactured shall have its own separate number. The label shall warn the user that the material shall be heated to $211 \pm 7^\circ\text{C}$ ($412.5 \pm 12.5^\circ\text{F}$) during application.

6.2 The contractor shall assume all cost resulting from the use of patented materials, equipment, devices or processes used on or incorporated in the work, agrees to indemnify and save harmless the purchaser and his duly authorized representatives from all suits at law, or action of every nature for or on account of the use of any patented materials, equipment, devices, or processes.

7. SAMPLING

7.1 The minimum size batch of thermoplastic traffic striping material sampled and tested shall not be less than 1360 kg (3000 lbs) unless the total order is less than this amount. Any manufacturer not familiar with the technique of making this material should consult the purchaser. A small trial batch should be made prior to making the thermoplastic traffic striping material in large quantities to make certain the finished product will comply with all the requirements of this specification.

8. TESTING

8.1 The material shall be tested in accordance with AASHTO T 250 or with the appropriate method in Federal Test Method Standard No. 141 or ASTM designation.