

TECHNICAL SPECIFICATIONS  
FOR  
RETROREFLECTIVE PREFORMED PAVEMENT MARKINGS

1. Description

This work shall consist of furnishing and installing retroreflective high performance and high durability preformed pavement markings. All preformed markings shall be installed in accordance with this provision and in conformance to the dimensions and lines shown on the Plans or established by the Engineer. All work shall be in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways, dated 1988, or as modified.

2. Materials

The preformed patterned markings shall consist of white or yellow films with clear and/or yellow-tinted microcrystalline ceramic beads incorporated to provide immediate and continuing retroreflection. These films shall be manufactured without the use of lead chromatic pigments or other similar, lead-containing chemicals. The films shall have a pressure sensitive adhesive pre-coated on the non-reflective side.

Preformed symbol and legend markings shall conform to the applicable shapes and sizes as outlined in the Manual on Uniform Traffic Control Devices for Streets and Highways, dated 1988, or as modified.

The material, when applied according to the manufacturer's instructions, shall provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. The film shall be weather resistant and, through normal traffic wear, shall show no fading, lifting or shrinkage which will significantly impair the intended usage of the marking and shall show no significant tearing, roll back, or other signs of poor adhesion.

(a) Classification

1) Type 1 - High Performance Patterned Centerline Markings

The markings shall be highly durable retroreflective pliant polymer materials designed for longitudinal centerline and word/symbol markings subject to high traffic volumes and severe wear conditions such as shear action from crossover or encroachment on typical longitudinal configurations.

2) Type 2 - Durable Longitudinal Edgeline Markings

The markings shall be durable, retroreflective, foil-based pavement marking film designed for preformed markings with free-rolling traffic for edge lines.

3) Type 3 - High Durability Channelizing and Transverse Markings

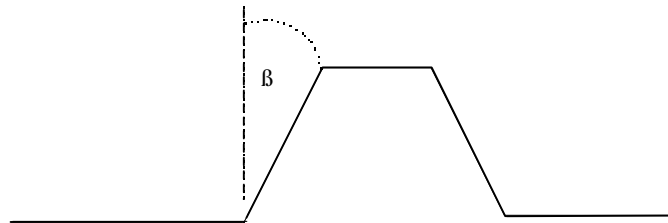
High durability retroreflective preformed pavement marking film shall be used as channelizing and transverse markings such as stop bars, cross walks, and gore markings subjected to high traffic volumes and severe wear conditions such as repeated shear action from crossover or encroachment.

(b) Requirements

1) Composition

Type 1 - High Performance Patterned Centerline Markings

The retroreflective pliant polymer pavement markings shall consist of a mixture of high-quality polymeric materials, pigments, and glass beads distributed throughout its base cross-sectional area, with a reflective layer of microcrystalline ceramic beads bonded to a durable polyurethane topcoat surface. The patterned surface shall have approximately  $50\% \pm 15\%$  of the surface area raised and presenting a near vertical face ( $\beta$  angle of  $0^\circ$  to  $60^\circ$ ) to traffic from any direction. (See diagram below.) The channels between the raised areas shall be substantially free of exposed beads or particles. The film shall have a pre-coated pressure sensitive adhesive.



Type 2 - Durable Longitudinal Edgeline Markings

The retroreflective pavement marking material shall consist of microcrystalline ceramic beads and glass beads with ceramic skid-resistant particles embedded in a top polyolefin wear surface with a thin, flexible, conformable backing. The film shall have a pre-coated pressure sensitive adhesive.

Type 3 - High Durability Channelizing and Transverse Markings

The preformed markings shall consist of white or yellow films with pigments selected to conform to standard highway colors. The preformed markings shall consist of a mixture of high quality polymeric materials, pigments, and glass beads distributed throughout its base cross-sectional area.

A retroreflective layer of glass beads and a layer of ceramic skid resistant particles shall be bonded to the top urethane wear surface. The urethane wear surface shall have a nominal thickness of 0.005 inches (0.13mm). The film shall have a pre-coated pressure sensitive adhesive.

2) Retroreflectance

The white and yellow markings shall have the following initial expected retroreflectance values as measured in accordance with the testing procedures of ASTM D4061. The photometric quantity to be measured shall be coefficient of retroreflected luminance (RL) and shall be expressed as millicandelas per square foot per foot-candle [(mcd x ft<sup>-2</sup>) x fc<sup>-1</sup>]. The metric equivalent shall be expressed as millicandelas per square meter per lux [(mcd x m<sup>-2</sup>) x lx<sup>-1</sup>].

Type 1 - High Performance Patterned Centerline Markings

	<u>WHITE</u>			<u>YELLOW</u>		
Entrance Angle	86.0°	86.5°	88.8°	86.0°	86.5°	88.8°
Observation Angle	0.2°	1.0°	1.05°	0.2°	1.0°	1.05°
Retroreflected Luminance R <sub>L</sub> [(mcd x ft <sup>-2</sup> ) x fc <sup>-1</sup> ]	1100	700	500	800	500	300

Type 2 - Durable Longitudinal Edgeline Markings

	<u>WHITE</u>			<u>YELLOW</u>		
Entrance Angle	86.0°	86.5°	88.8°	86.0°	86.5°	88.8°
Observation Angle	0.2°	1.0°	1.05°	0.2°	1.0°	1.05°
Retroreflected Luminance R <sub>L</sub> [(mcd x ft <sup>-2</sup> ) x fc <sup>-1</sup> ]	930	575	450	430	300	205

Type 3 - High Durability Channelizing and Transverse Markings

	<u>WHITE</u>			<u>YELLOW</u>		
Entrance Angle	86.0°	86.5°	88.8°	86.0°	86.5°	88.8°
Observation Angle	0.2°	1.0°	1.05°	0.2°	1.0°	1.05°
Retroreflected Luminance R <sub>L</sub> [(mcd x ft <sup>-2</sup> ) x fc <sup>-1</sup> ]	700	400	300	410	175	150

3) Beads

Type 1 - High Performance Patterned Centerline Markings

Index of Refraction - All microcrystalline ceramic beads bonded to the polyurethane-coated, patterned surface of the material shall have a minimum index of refraction of 1.70 when tested using the liquid oil immersion method.

The glass beads mixed into the pliant polymer shall have a minimum index of refraction of 1.50 when tested by the liquid oil immersion method.

Type 2 - Durable Longitudinal Edgeline Markings

Index of Refraction - All microcrystalline ceramic and glass beads bonded to the polyolefin-coated surface of the material shall have a minimum index of refraction of 1.70 when tested using the liquid oil immersion method.

Type 3 - High Durability Channelizing and Transverse Markings

Index of Refraction - All glass beads bonded to the polyurethane-coated surface of the material shall have a minimum index of refraction of 1.50 when tested using the liquid oil immersion method. The glass beads mixed into the pliant polymer shall have a minimum index of refraction of 1.50 when tested by the liquid oil immersion method.

4) Skid Resistance

Type 1 - High Performance Patterned Centerline Markings

The patterned surface of the retroreflective pliant polymer shall provide an initial average skid resistance value of 45 BPN as measured by the British Portable Skid Tester in accordance with ASTM E303 except values will be taken downweb and at a 45° angle from downweb. These two values will then be averaged to find the skid resistance of the patterned surface.

Type 2 - Durable Longitudinal Edgeline Markings

The surface of the durable retroreflective films shall provide an initial minimum average skid resistance value of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E303.

Type 3 - High Durability Channelizing and Transverse Markings

The surface of the highly durable retroreflective films shall provide an initial minimum average skid resistance value of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E303.

5) Patchability

The pavement marking materials shall be capable of use for patching worn areas of the same type in accordance with the manufacturer's instructions.

6) Thickness

Type 1 - High Performance Patterned Centerline Markings

The film, without adhesive, shall have a minimum caliper of 0.065 inches (1.651mm) at the thickest portion of the patterned cross-section and a minimum caliper of 0.020 inches (0.508mm) at the thinnest portion of the cross-section.

Type 2 - Durable Longitudinal Edgeline Markings

The film without adhesive shall have a minimum thickness of 0.012 inches (0.30mm).

Type 3 - High Durability Channelizing and Transverse Markings

The film without adhesive shall have a minimum thickness of 0.060 inches (1.52mm).

(c) General Performance Considerations

The film, when applied according to the recommendations of the manufacturer, shall provide a neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. The film shall be weather resistant and, through normal traffic wear, shall show no fading, lifting, or shrinkage which will significantly impair the intended usage of the marking and shall show no significant tearing, roll back, or other signs of poor adhesion.

3. Equipment

Following proper application, the markings shall be immediately ready for traffic. The bidder, when bidding, shall identify the proper equipment necessary for proper application and make recommendations for application that will assure effective product performance. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's instruction.

4. Warranty

(a) Type 1 - High Performance Patterned Centerline Markings

Warranty

The manufacturer warrants that pavement marking material sold for applications in the United States will remain effective for its intended use under normal traffic

conditions and meet the minimum retained coefficient of retroreflection value of 100 millicandelas per foot squared per foot-candle (measured at 1.0° observation and 86.5° entrance angles) subject to the following provisions:

Table 1

<u>Application</u>	<u>Warranty Period</u>
Longitudinal markings	4 years
Words and Symbols	2 years

If the markings are applied in accordance with all the manufacturer’s application recommendations and fail during the warranty period to retain the minimum reflectance values, fail to adhere to the roadway, or fail due to complete wear-through during the warranty period shown above (from the date of installation), the manufacturer's sole responsibility and purchaser's and user's exclusive remedy shall be:

The manufacturer will provide the replacement materials to restore the marking to its original effectiveness.

A visual night inspection must be made with a manufacturer’s representative and a customer representative present to identify areas of the installation which appear to be below the minimum retained reflectance values specified in Table 1. Areas which appear to be below the minimum retained reflectance value shall be identified as “zones of measurement.” To qualify for material replacement, a “zone” must be at least 360 feet in road length and consist of either edge lines, center lines, or lane lines, but not in combination, or a single word or symbol marking.

(b) Type 3 - High Durability Channelizing and Transverse Markings

Warranty

The manufacturer warrants that pavement marking material sold for applications in the United States will remain effective for road presence and non-wear through under normal traffic and meet the minimum retained skid resistance of 45 BPN (ASTM E-303), subject to the following provisions:

Table 2

<u>Application</u>	<u>Legends</u>	<u>Warranty Period</u>	
		<u>Symbols</u>	<u>Channelizing Markings</u>
New Asphalt Inlay	2 years	2 years	1 year
New Asphalt Inlay	<u>Stop Bars</u>	<u>Crosswalks</u>	<u>Gore Markings w/ ADT</u>
			<u>Lane of 6,000 or Less</u>
	1 year	2 years	1 year

If the pavement markings are applied in accordance with application procedures provided by the manufacturer (which will be furnished to the applier upon request), and fail to retain the minimum skid resistance value, fail to adhere to the roadway, or fail due to complete wear-through during the warranty period shown above (from the date of installation), the manufacturer's sole responsibility and purchaser's and user's exclusive remedy shall be:

The manufacturer will provide replacement materials to restore the marking to its original effectiveness.

5. Construction Requirements

The markings shall be applied in accordance with the manufacturer's installation instructions. Marking configurations shall be in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways, dated 1988, or as modified.

The manufacturer shall provide application equipment, manual or automatic as necessary for the job requirements. These applicators shall be capable of applying two lines simultaneously of the appropriate width and spacing as determined by the marking requirements. This equipment shall be provided to the agency or its contractor representative at no cost for whatever period or number of occasions necessary to complete the work schedule.

6. Method of Measurement

Linear pavement markings will be measured in linear feet (linear meters) complete-in-place for the width specified.

7. Basis of Payment

- (a) Retroreflective preformed pavement markings will be paid for at the Contract Unit Price, which shall be full compensation for preparing the pavement surface, for furnishing and placing all materials, and for all materials, labor, tools, equipment, and incidentals necessary to complete the work.

(b) Payment will be made under the following Bid Items as set forth in the Bid Schedule:

<u>Pay Item</u>	<u>Unit</u>
Preformed Pavement Marking, Linear (Type)	Lin. Ft.
Preformed Pavement Marking, Symbols/Legends	Ea.