

SPECIFICATION – NO. 3
HIGH DURABILITY PREFORMED PAVEMENT MARKINGS
(Including Stop Lines and Crosswalks)

1.0 DESCRIPTION

The work shall consist of furnishing and installing retroreflective preformed polymer pavement markings for lane, center line and edge line longitudinal striping, work messages, symbols and particularly, stop lines and crosswalks. The marking may be applied to hot or ambient temperature bituminous surfaces and to properly prepared concrete surfaces. Work shall be accomplished in accordance with this provision and in reasonably close conformance to the dimension and lines shown on the Plans or established by the Engineer.

2.0 MATERIALS AND COMPONENT REQUIREMENTS

2.1. GENERAL

High durability preformed markings shall consist of white or yellow films with a urethane topcoat and glass beads distributed throughout to provide immediate and continuing retroreflection. Ceramic particles shall be bonded to the top urethane layer to provide a skid resistance surface. The edges of the preformed tape rolls shall be clean-cut and true.

Preformed works, symbols, stop lines and crosswalks shall conform to shapes and sizes as outlined in the “Minnesota Manual on Uniform Traffic Control Devices,” dated 1991, or as modified.

All materials shall be of the highest quality as the markings will be subjected to severe wear conditions such as repeated shear actions from crossover or encroachment traffic or traffic turning stopping and starting.

2.2. REQUIREMENTS

2.2.1. Glass Beads – The size, quality and refractive index of the glass beads shall be such that the performance requirements for the markings shall be met. Bead adhesion shall be such that beads are not easily removed when the material surface is scratched with a thumbnail.

2.2.2. Glass Bead Retention – The film shall have glass bead retention qualities such that when a 2” x 6” (5.08cm x 15.24 cm) sample is bent over a ½” diameter mandrel, with the 2” dimension perpendicular to the mandrel axis, microscopic examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.

2.2.3. Initial Reflectance – Pavement markings shall have the following initial minimum reflectance values as measured in accordance with ASTM D 4061. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandelas per square foot per footcandle [mcd ft⁻² fc⁻¹]. The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance shall be 50 ft. (15m) and the sample size shall be a 2.0 x 2.5 ft. rectangle (0.61m x 0.76m).

		<u>White</u>			<u>Yellow</u>	
Entrance Angle	86.0	86.0	86.5	86.0	86.0	86.5
Observation Angle	0.2'	0.5'	1.0'	0.2'	0.5'	1.0'
Specific Luminance SL [mcd ft ⁻² fc ⁻¹].	700	500	400	500	350	300

2.2.4. Reflectivity Retention – To have a good, effective performance life, the glass beads must be strongly bonded and not be easily removed by traffic wear.

The following test shall be employed to measure reflectivity retention:

Taber Abraser Simulation Test

Using a Taber Abraser with an H-18 wheel and a 125 gram load, the sample shall be inspected at 200 cycles, under a microscope, to observe the extent and type of bead failure.

No more than 15% of the beads shall be lost due to pop-out and the predominant mode of failure shall be “wear down” of the beads.

2.2.5. Thickness – The film, without adhesive, shall be a minimum thickness of 0.60”(1.50mm).

2.2.6. Tensile Strength and Elongation –The film shall have a minimum tensile strength of 150 pounds per square inch of cross-section when measured in the direction of the length of roll and tested in accordance with ASTM D 638-76, except that a sample 6” x 1” (15.24cm x 2.54cm) shall be tested at a temperature between 70°F and 80°F using a jaw speed of 10 to 12 inches per minute. The sample shall not exceed an elongation of 50% at break when tested by this method.

2.2.7. Skid Resistance – The surface of the retroreflective film shall provide an initial average skid resistance value of 55 BPN when tested in accordance with ASTM E 303.

2.2.8. Patchability – The pavement marking film shall be capable of use for patching work areas of the same type of film in accordance with manufacturer’s instructions.

2.2.9. Color –The pavement markings shall consist of white and yellow films with pigments selected and blended to conform to standard highway colors. White material shall be no darker or yellower than chip 17778 of Federal Standard 595a. The color yellow shall be reasonable close to color chip 13538 of the Federal Standard No. 595a.

- 2.2.10. Adhesive – All pavement markings shall be pre-coated pressure sensitive adhesive to bond the tape to the surface of the roadway. The adhesive and other materials shall be compatible with a primer should it be necessary to precondition a pavement surface and is so ordered by the Engineer.
- 2.2.11. Primer – The manufacturer of the markings shall recommend an appropriate primer when the overlay procedure is specified or becomes a necessary installation procedure.
- 2.2.12. Shelf Life – The markings shall be suitable for use up to one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

3.0 PERFORMANCE REQUIREMENTS

- 3.1. Pavement marking tapes, symbols and legends placed on concrete and bituminous pavements, whether on hot or ambient surface temperatures, shall meet at least the following field performance requirements.
- 3.2. Adhesion – During the standard warranty granted by the manufacturer following the installation date of markings placed in accordance with the manufacturer's instruction and determined to be an inadequate traffic control device, supply materials shall be provided by the manufacturer for material actually missing from the surface due to loss of adhesion¹ or complete wear-through.
- 3.3. A minimum retroreflectance level is not offered on these markings.

4.0 CONSTRUCTION REQUIREMENTS

4.1. GENERAL

Marking tape shall be supplied in roll form without a protective liner, unless otherwise specified by the Engineer. Legend and symbols shall be supplied in accordance with the manufacturer's recommendations.

4.2. PRE-INSTALLATION

To assure a quality installation, the Contractor shall provide for the following materials control and services.

- 4.2.1. Certification of Materials Shipped – The manufacturer shall, by notarized letter, certify that the specified products in these provisions were shipped to the Contractor. The letter shall contain the following information:

¹ Overlay application placed after September 1 are not recommended and are exempt from the adhesion loss performance. Also, inlaid and overlaid materials are exempt if their removal is caused by snow plow equipment.

1. State Project Number/Highway Number/Location
2. Name of Prime Contractor
3. Mn/DOT Specification Number
4. Shipping Date
5. Product Names/Numbers/Quantities
6. Notary Seal

The notarized letter must be presented to the Engineer at least fifteen (15) calendar days prior to installing the materials on the project.

4.2.2. Training of a Striping Contractor – The Contractor shall secure and cause application training seminars to enhance the installation of the pavement markings. The training shall address surface preparation and all application requirements and techniques necessary for successful marking tape applications. Upon completion of the seminar for these personnel, the manufacturer of the marking tape shall provide written certification of approval to the Contractor in the following forms:

1. A certificate stating this approval and dated for one year. A copy of this certificate shall be on file with Mn/DOT.
2. Cards stating this approval and dated for one year will be given to each person approved and may be requested by state project personnel.

4.2.3. Equipment and Inlay Application Procedures – There are two types of application procedures, both of which may be required on a single project. The MANUAL and MECHANICAL application procedures are not detailed herein but may be obtained from the Office of Traffic Engineering (651) 284-3500.

4.3. INSTALLATION CONTROLS AND DETAILS

4.3.1. Marking tapes, legends and symbols shall be applied in accordance with the details shown in the Special Provisions, Plans, this Specification and control points established by the Engineer.

4.3.2. Work Restrictions – Application of marking materials during hours of darkness will only be allowed by approval of the Engineer. On pavement open to traffic, the work may be suspended by direction of the Engineer during peak traffic hours or at any other time traffic is being unduly hampered or delayed by the work in progress. Other restricting will be determined by provisions governing paving operations.

4.3.3. Alignment, Dimensions and Tolerances

- A. The Engineer will place necessary “spotting” at appropriate points to provide horizontal control for striping and determine necessary starting

and cut-off points. Skip line intervals will not be marked. Longitudinal joints and pavement edges shall serve as horizontal control when so directed.

- B. Unless otherwise indicated all pavement striping shall be 4 inches wide. Skip lines shall be applied in lengths of 10 feet separated by gaps of 40 feet. The 50-foot cycle length is to be rigorously controlled and shall be carried through form day to day.
- C. A tolerance of 1/8 under and 1/2 inch over the specified width will be allowed for striping provided the variance is gradual and does not detract from the general appearance. Skip line segments may vary up to 1/4 foot from the specified lengths provided the over and under variation are reasonable compensatory. Alignment deviations from the control guide shall not exceed 2 inches. Material shall not be applied over a longitudinal joint. Establishment of application tolerances shall not relieve the Contractor of his responsibility to comply as closely as practicable with the planned dimensions.

4.4. FINAL PRODUCT

The films, 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 shrinking which will significantly impair the intended usage of the marking throughout its useful life and shall show no significant tearing, roll-back or other signs of poor adhesion.

5.0 PAVEMENT MARKING BY OVERLAY PROCEDURE

The Special Provisions or Plans of the Contract will indicate markings that are to be placed using the overlay procedure. Also, the overlay procedure may be necessary when conditions or events occur that prevent the use of the specified inlay procedure.

5.1. OVERLAY PROCEDURE SPECIFIED

Payment for the accepted quantities of pavement markings installed at contract prices per unit of material shall be compensation in full for all costs incurred in furnishing and installing, including surface preparation, use of primers, and traffic control, the materials, all as recommended by the manufacturer and subject to the Engineer's approval.

5.2. INLAY PROCEDURE SPECIFIED NOT USED

- 5.2.1. Beyond Contractor's Control – When markings specified cannot be inlaid AND the Engineer determines that the Contractor had no control over the causation, the pavement

markings shall be installed by the overlay procedure. The Contractor shall install the markings per instruction from the manufacturer and as approved by the Engineer. Surface preparation, including traffic control, shall be paid for under Specification 1904 – EXTRA AND FORCE account work.

- 5.2.2. If the Engineer determines that the “causation” in Section 5.2.1 was within the Contractor’s control, the markings shall be installed by the overlay method, as ordered by the Engineer. Pay items (for inlaying) shall be used and are payment in full for all additional costs incurred, including traffic control.

6.0 ACCEPTANCE

Acceptance of completed work shall be based on daytime and nighttime reviews conducted by the Engineer. The Engineer may order rework based on the day and/or night reviews.