

SPECIFICATIONS – NO. 1
PATTERNED PREFORMED POLYMER PAVEMENT MARKING TAPE
WITH IMPROVED RETENTION OF REFLECTIVITY
FOR LINES AND SELECTED SYMBOLS AND LEGENDS

1.0 DESCRIPTION

The work shall consist of furnishing and installing longitudinal, highly durable retroreflective preformed pliant polymer patterned pavement marking tape with improved retroreflective retention, hereinafter referred to as patterned tape, on bituminous pavements in accordance with these provisions and in reasonable close conformance to the dimensions and lines shown on the Plans and/or as directed by the Engineer. Placement on hot bituminous surfaces by an inlay procedure is generally specified. However, overlay procedures may be required. Patterned tape may be applied to concrete surfaces immediately following appropriate preparation of the surface. Also, legends and symbols may be specified using inlay and/or overlay procedures.

2.0 MATERIALS AND REQUIRED PROPERTIES

2.1 GENERAL – Patterned tape, legends, and symbols shall be made of highly durable pliant polymer materials designed for markings subjected to high traffic volumes and severe wear conditions such as shear action associated with encroachment and crossover traffic on typical longitudinal pavement striping for center lines, lane and edge lines. STOP LINES and CROSSWALKS are generally not specified under this material.

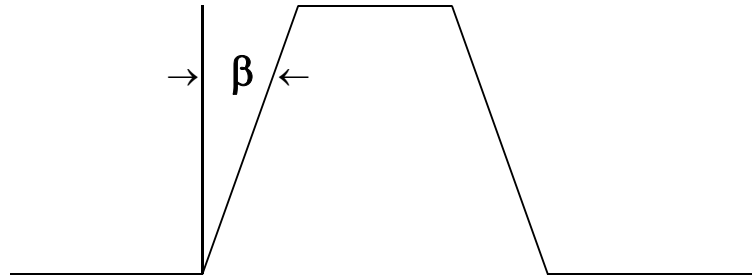
The pavement markings shall be capable of application to new, dense and open-graded asphaltic concrete wearing courses during the bituminous paving operation in accordance with the manufacturer's instructions. The preformed material shall conform to pavement contours by the action of traffic. If solvents and primers are needed to assure adhesion and effective product performance, the manufacturer shall identify them and instruct the Contractor in their application on bituminous and concrete surfaces.

To the extent feasible, the following specifications and requirements for patterned tape apply to all selected legends and symbols.

2.2 ADHESIVE – Patterned tape shall be capable of adhering to new bituminous wearing courses during the paving operation. A pre-coated pressure sensitive adhesive shall be provided to bond the tape to hot bituminous or properly prepared concrete surfaces. The adhesive and other materials shall be compatible with a primer should it be necessary to precondition a pavement surface.

2.3 SHELFLIFE – Patterned tape shall be suitable for use one year after the date of receipt when stored in accordance with the manufacturer’s recommendations.

2.4 COMPOSITION – Patterned tape shall consist of a mixture of high quality polymeric materials, pigments and glass beads distributed through out its base cross-sectional area. Ceramic beads shall be bonded to a durable, polyurethane topcoat surface. The patterned surface shall have 50% plus or minus 15% of the surface area raised and presenting a near vertical face (B angle of 0 degrees to 60 degrees) to traffic from any direction as illustrated below. The channels between the raised areas shall be substantially free of exposed beads or particles.



2.4 BEADS

2.5.1 Retroreflectance – The white and yellow patterned tapes shall have the following initial expected retroreflectance values as measured in accordance with the testing procedures of 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 per sf per fc). The metric equivalent shall be expressed as millicandelas per square meter per lux. The test distance shall be 50 feet (15m) and the sample size shall be a 2.0 foot x 2.5 foot rectangle (0.61m x 0.76m).

2.5.2 Initial Retroreflectance Values

	<u>WHITE</u>		<u>YELLOW</u>	
Entrance Angle in Degrees	86.0	86.5	86.0	86.5
Observation Angle in Degrees	0.2	1.0	0.2	1.0
Specific Luminance (SL)*	1100	700	800	500

* These retroreflectance values are based on dark room photometric reading per ASTM D 4061. The “Ecolux” retroreflectometer measures at this same approximate geometry, that is, 86.5 degrees entrance angle and 1.0 degree observation angle.

2.5.3 Ceramic and Glass Beads – All ceramic beads bonded to the polyurethane coated patterned surface shall have a minimum index of refraction of 1.70 when tested using the liquid oil immersion method. These instructions are available from Mn/DOT's Office of Materials and Research. Glass beads mixed into the pliant polymer shall have a minimum index of refraction of 1.5 when tested by the liquid oil immersion method.

2.5.4 The size and quality of all beads shall be such that the performance requirements for the retroreflective patterned tape shall be met.

2.6 ACID RESISTANCE – All beads shall show resistance to corrosion of their surface after exposure to a 1% solution (by weight) of sulfuric acid. The 1% acid solution shall be made by adding 5.7cc of concentrated acid into 1000cc of distilled water. CAUTION: Always add the concentrated acid into the water, no the reverse. The test shall be performed as follows:

Take a 1" x 2" sample, adhere it to the bottom of a glass tray and place just enough acid solution to completely immerse the sample. Cover the tray with a piece of glass to prevent evaporation and allow the sample to be exposed for 24 hours under these conditions. Then decant the acid solution (do not rinse, touch, or otherwise disturb the bead surfaces) and dry the sample while adhered to the glass gray in a 150 degree F (66 degree C) oven for approximately 15 minutes.

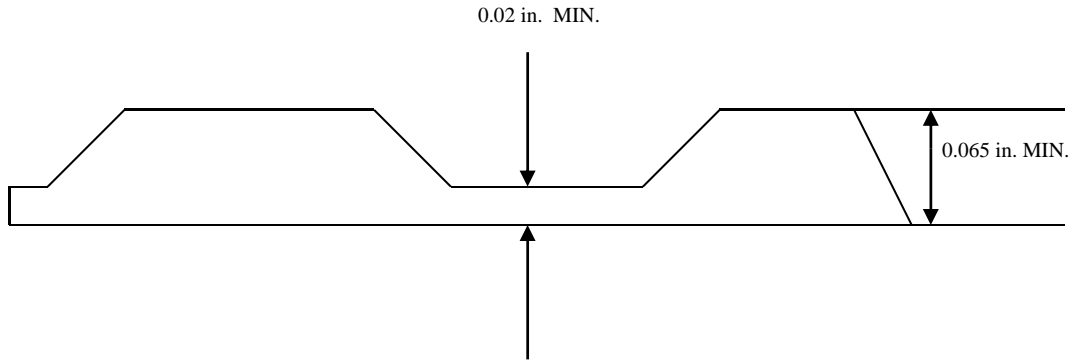
Microscopic examinations (20X) shall show no more than 15% of the beads having a formation of a very distinct opaque white (corroded) layer on their entire surface.

2.7 COLOR – The patterned tape shall consist of white and yellow films with pigments selected and blended to conform to standard highway colors per FHWA Color Chart 595a.

2.8 SKID RESISTANCE – The patterned surface of the retroreflective patterned tape shall provide an initial average skid resistance value of 45 BPN when tested according to ASTM E 303 except values will be taken at downweb and at 45 degree angle from downweb. These two values will then be averaged to find the skid resistance of the patterned surface.

2.9 PATCHABILITY – The patterned tape material shall be capable of use for patching worn areas of the same type of tape in accordance with the manufacturer's instructions.

2.10 THICKNESS – The pattern material 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 0.02 inches (0.508mm) at the thinnest portion of the cross-section.



3.0 PERFORMANCE REQUIREMENTS

3.1 Patterned tape, symbols and legends placed on concrete and bituminous pavement, whether on hot or ambient surface temperatures, shall meet 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 instructions and determined to be an inadequate traffic control device, replacement materials shall be provided by the manufacturer for material actually missing from the surface due to loss of adhesion* of complete wear-through.

* Overlay applications placed after September 15 are not recommended and are exempt from the adhesion loss performance. Also, inlaid and overlaid materials are exempt if their removal is caused by snowplow equipment.

3.3 MINIMUM RETROFLECTANCE VALUES – During the standard warranty period, pattern tape shall retain a minimum retroreflectance as follows:

	<u>WHITE</u>	<u>YELLOW</u>
Entrance Angle in Degrees	86.5	86.5
Observation Angle in Degrees	1.0	1.0
Average Value – SL*	100	100

* All retroreflectance measurements shall be made using an ECOLUX (trademark) brand retroreflectometer.

4.0 CONSTRUCTION REQUIREMENTS

4.1 GENERAL – Patterned 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.

The polymer markings, when applied according to the recommendations of the manufacturer, shall provide a neat, durable marking that will not flow or distort due to resistant and, through normal traffic wear, shall show no fading, lifting or shrinking which will significantly impair the intended usage of the marking through out its useful life and shall show no significant tearing, roll-back or other signs of poor adhesion.

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 patterned tape in these provisions was shipped to the Contractor. The letter shall contain the following information:

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

The notarized letter must be presented to the Engineer at least fifteen (15) calendar days prior to installing 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. This training shall address surface preparation and all application requirements and techniques necessary for successful pattern tape applications. Upon completion of the seminar for these personnel, the manufacturer of patterned 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 the 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. Since training of installers is a requirement of this Specification, the MANUAL and MECHANICAL application procedures are not detailed herein but may be obtained from the Office of Traffic Engineering (612) 582-1044.

4.3 INSTALLATION CONTROLS AND DETAILS

4.3.1 Patterned tape, legends and symbols shall be applied in accordance with the details shown in the Special Provision, Plans, this Specification and control points established by the Engineer. The Contractor shall provide sufficient pavement marking material, equipment and manpower to keep abreast of the paving operations, including placement of legends and symbols, to insure proper inlayment of the materials.

4.3.2 Work Restriction – Application of patterned materials during hours of darkness will only be allowed by approval of the Engineer. On pavement to 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.

1. The Engineer will place necessary “spotting” at appropriate points to provide horizontal control for striping, and determine necessary starting and cutoff points. Skip line intervals will not be marked. Longitudinal joints and pavement edges shall serve as horizontal control when so directed.
2. 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 from day to day.
3. A tolerance of 1/8 inch 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 variations 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 Contractor of responsibility to comply as closely as practicable with the planned dimensions.

5.0 OVERLAY AND INLAY 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 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, traffic control, and materials, all as recommended by the manufacturer and subject to the Engineer’s approval.

5.2 INLAY PROCEDURE SPECIFIED BUT 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 instructions 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 the 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.