

811.01

## **Section 811. PERMANENT PAVEMENT MARKINGS**

**811.01. Description.** This work consists of providing and applying retroreflective permanent pavement markings in accordance with the Michigan Manual on Uniform Traffic Control Devices. Provide markings, shapes, spacing, and dimensions that conform to the MDOT Pavement Marking Standard Plans.

**811.02. Materials.** Provide materials in accordance with the following:

Glass Beads .....	920
Waterborne Pavement Marking Material.....	920
Low Temperature Waterborne Pavement Marking Material .....	920
Regular Dry Pavement Marking Material .....	920
Cold Plastic Pavement Marking Material.....	920
Thermoplastic Pavement Marking Material .....	920
Sprayable Thermoplastic Pavement Marking Material.....	920
Polyurea Pavement Marking Material .....	920

Provide the Material Safety Data Sheets to the Engineer for required materials and supplies. Dispose of unused material and containers in accordance with the Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and 1994 PA 451, Part 111 Hazardous Waste Management.

Provide samples of permanent pavement marking materials on Department request.

### **811.03. Construction.**

**A. Equipment.** Apply longitudinal lines with certified self-propelled pavement marking equipment. The Engineer may approve other equipment for special markings or areas inaccessible to self-propelled pavement marking equipment.

Provide self-propelled equipment certified by the Department in accordance with the Equipment Certification Guidelines for Pavement Markings. Certification is effective for 2 years. Operate marking equipment at no greater than the certified speed. The Engineer will assume a striping, operating above the certified working speed, has operated at that speed for the entire day.

The Department may inspect the equipment at any time.

Use equipment capable of uniformly applying material to the required length and width.

Provide equipment for placing centerlines, capable of applying three, 4-inch minimum width lines on a two-lane road in one pass. If applying multiple centerlines, use three spray guns positioned 6 inches on center. For two lane freeways, apply the lane line from the left lane. For freeways with at least three lanes, apply the right lane line with the right edgeline.

Use an easily adjusted, dashing mechanism to retrace existing lane or centerline markings.

Use a self-propelled pavement marker capable of marking pavement in either direction on a roadway. Use a continuous skip cycle. Do not zero or return the cycle control unit to the beginning or start of a new cycle.

Provide a distance meter to measure the length of each line.

The Engineer may check the calibration of metering devices at any time. If the Engineer determines the equipment is unsatisfactory, use other methods approved by the Engineer.

Use equipment for placing hot-applied thermoplastic and sprayable thermoplastic material that can maintain the temperature recommended by the material manufacturer.

Allow time for the Engineer to inspect traffic control devices as shown in the pavement marking convoy typical. Correct traffic control devices not approved by the Engineer before continuing. If applying markings on a roadway closed to traffic, the traffic control devices specified in the pavement marking convoy typical are not required, unless otherwise directed by the Engineer.

**B. General.** The Department will not provide storage buildings or space for permanent pavement marking equipment or materials.

If specified on the plans, layout the permanent pavement markings. Otherwise, witness, log and lay out permanent pavement markings to replace in kind. When layout is complete, contact the Engineer to review the layout work before applying permanent pavement markings.

Before applying pavement markings, ensure the pavement surface is clean and dry. Air blast to remove material that prevents pavement markings from adhering to the pavement surface. Remove debris or dead animals from the line track.

For solid lines, apply 4 inch and 6 inch lines, no greater than ¼ inch wider than the required width. Apply solid lines with no gaps or spaces. Apply a double line as either two solid lines or one solid line and one broken line.

### 811.03

For new broken lines, apply 12½-foot long lines, no greater than 4 inches longer than the required length. Leave a 37½-foot gap between new broken lines. Continue this 50-foot cycle of broken line and gap, as shown on the plans. Apply new lines at the required location within a lateral tolerance of 1 inch.

When applying centerline and lane lines on new construction, retrace at least five existing adjacent skips to match the existing pavement marking cycle.

Retrace existing pavement markings using lines equal to the width and length of the original markings. For existing 4-inch, 6-inch, 8-inch, or 12-inch wide lines, retrace no greater than ¼ inch wider than the existing line. If existing lines exceed the nominal widths, ensure the total line widths, existing and retraced, do not exceed 5 inches, 7 inches, 9 inches, and 13 inches.

For existing 12½-foot broken lines, place the retraced line to a longitudinal tolerance of no greater than 4 inches longer than the existing line. If existing lines exceed 12½ feet long, ensure broken line lengths for existing and retraced lines do not exceed 13 feet.

Mix liquid materials during application. Do not thin materials. Uniformly apply pavement marking material at the rates shown in Table 811-1.

Table 811-1 Pavement Marking Material Application Rates per Mile (a, b)										
Binder Type	Thickness (mil)	Binder volume & Bead weight	Line Type							
			Broken				Solid			
			4 in	6 in	8 in	12 in	4 in	6 in	8 in	12 in
Waterborne	15	Binder (gal)	4	6	8	12	16	24	32	48
		Bead (lb)	32	48	64	96	128	192	256	384
Low Temperature Waterborne	15	Binder (gal)	4	6	8	12	16	24	32	48
		Bead (lb)	32	48	64	96	128	192	256	384
Regular Dry	15	Binder (gal)	4	6	8	12	16	24	32	48
		Bead (lb)	24	36	48	72	96	144	192	288
Thermoplastic	90	Binder (lb)	435	653	870	1,305	1,740	2,610	3,480	5,220
		Bead (lb)	50	75	100	150	200	300	400	600
Sprayable Thermoplastic	30 (c)	Binder (lb)	140	210	280	420	560	840	1,120	1,680
		Bead (lb)	50	75	100	150	200	300	400	600
Polyurea	20	Binder (gal)	6	8	11	17	22	33	44	66
		Bead (lb)	As directed by the manufacturer							
a. Binder yield indicates the amount to produce the required mil thickness without drop on beads. b. Bead yield indicates the amount of drop on beads required for the given binder. c. Apply drop on beads for a final thickness of 40 mil.										

### 811.03

The Engineer will determine the application rates by dividing the quantity of material used by the length of the line placed. The Engineer may check application rates at start up, and during work, without prior notice to the Contractor.

Load pavement marking materials on the pavement marking machine without interfering with, or delaying traffic. Operate striping equipment to prevent traffic from crossing the uncured markings. Prevent vehicles from being sprayed.

Position bead guns to direct beads into the line material and provide a uniform application of beads.

If applying markings in off-road areas open to traffic, including rest areas, roadside parks, or car pool lots, maintain traffic to prevent vehicles from crossing the uncured markings.

The Department does not require glass beads for waterborne pavement marking material if marking rest areas, roadside parks, and car pool lots.

Apply sharp, well-defined markings, free of uneven edges, overspray, or other visible defects, as determined by the Engineer. Ensure pavement marking lines are straight, or of uniform curvature. Pavement markings are subject to inspection by the Engineer in accordance with the Pavement Marking Inspection Guidelines. Remove pavement markings outside the required tolerances and re-apply in the correct locations. Re-apply unprotected pavement markings damaged by traffic and remove tracked lines at no additional cost to the Department.

**C. Removal.** If required, remove existing longitudinal pavement markings on old pavement or curing compound on new concrete in accordance with subsection 812.03.F.

If removing special markings, including legends, symbols, arrows, crosswalks, and stop bars, install the new markings within 5 working days.

If removing cold plastic markings, collect and dispose of removed material.

**D. Application, Temperature and Seasonal Restrictions.** Ensure the material application rates in Table 811-1, the temperature and seasonal application restrictions in Table 811-2, and the additional requirements detailed in this subsection for specific materials are met when applying any material, unless directed by the Engineer. Document moisture testing and provide results to the Engineer.

1. **Waterborne.** The Engineer will not decide the suitability of specific days for the application of waterborne paint. Re-apply lines washed away or otherwise damaged by rain at no additional cost to the Department.

The Contractor may place waterborne pavement markings immediately on new Hot Mix Asphalt (HMA) pavement.

2. **Low Temperature Waterborne.** If seasonal limitations prevent placement of waterborne paint, the Engineer may approve low temperature waterborne paint.

Wait at least 30 days after placing the pavement surface before applying low temperature waterborne pavement markings to new HMA wearing surface. The Engineer may waive the 30-day waiting period.

3. **Regular Dry Paint.** If seasonal limitations prevent the placement of waterborne paint, the Engineer may approve regular dry paint.

Wait at least 14 days after placing the pavement surface before applying regular dry pavement markings to new HMA wearing surface. The Engineer may waive the 14-day waiting period.

4. **Cold Plastic.** Prepare the pavement surface and apply the cold plastic tape in accordance with the manufacturer's specifications.

Remove curing compound from new concrete surfaces before applying cold plastic tape. For pavements with two or more layers of existing overlay cold plastic marking material or any other non-compatible materials, remove the existing marking material before installing the new cold plastic markings.

Install cold plastic tape legends, crosswalks, and stop bars, as shown on the standard plans, unless otherwise required in the plans.

- a. **With Contact Cement.** Apply contact cement recommended by the cold plastic marking manufacturer and approved by the Department. Mix contact cement during application. Do not thin the contact cement. Allow time for solvents to evaporate from the adhesive before applying the cold plastic marking. Apply the contact cement by a method recommended by the manufacturer and ensure it is beneath the entire marking.

Provide non-adhesive backed cold plastic for stop bars and crosswalks. Provide adhesive backed cold plastic for all other special markings.

Immediately after placement, roll transverse and special markings at least four times with a roller weighing at least 200 pounds. The Engineer will not require additional rolling for longitudinal applications if the equipment for installing the line is equipped with a roller.

- b. **Primerless – Without Surface Preparation Adhesive.** Ensure dry weather for at least 24 hours, and a dry pavement surface before applying the primerless cold plastic tape marking. Clean the pavement surface using an air compressor with at least 185 cfm air flow and 120 psi. On all pavement surfaces, prevent damage to transverse and longitudinal joint sealers.

Immediately after placement, roll transverse and special markings at least six times with a roller weighing at least 200 pounds. The Engineer will not require additional rolling for longitudinal applications if the equipment installing the line is equipped with a roller.

- c. **Primerless – With Surface Preparation Adhesive.** Use surface preparation adhesive on all primerless cold plastic tape as recommended by the manufacturer or as shown on the plans.

Ensure dry weather for at least 24 hours, and a dry pavement surface before applying the primerless cold plastic tape marking. Clean the pavement surface using an air compressor with at least 185 cfm air flow and 120 psi. On all pavement surfaces, prevent damage to transverse and longitudinal joint sealers.

Immediately after placement, roll transverse and special markings at least six times with a roller weighing at least 200 pounds. The Engineer will not require additional rolling for longitudinal applications if the equipment installing the line is equipped with a roller.

- 5. **Thermoplastic.** Ensure the pavement is free of excess surface and subsurface moisture that may affect bonding. The Engineer will not decide the suitability of specific days for the application of thermoplastic.

Heat and apply the thermoplastic material within the temperature range recommended by the manufacturer.

- 6. **Sprayable Thermoplastic.** Ensure the pavement is free of excess surface and subsurface moisture that may affect bonding. The Engineer will not decide the suitability of specific days for the application of thermoplastic.

Heat and apply the sprayable thermoplastic material within the temperature range recommended by the manufacturer.

7. **Polyurea.** Ensure the pavement is free of excess surface and subsurface moisture that may affect bonding. The Engineer will not decide the suitability of specific days for the application of thermoplastic.

Surface preparation requirements for special, and longitudinal polyurea pavement markings depend on surface conditions.

Prepare new HMA surfaces and HMA surfaces open to traffic for 10 days or less with no oil drips, residue, debris, or temporary or permanent markings, by cleaning the marking area with compressed air.

Prepare new PCC surfaces and PCC surfaces free of oil drips, residue, and debris, temporary, or permanent markings, by removing the curing compound from the area required for pavement markings.

Prepare existing HMA or PCC surfaces that do not have existing markings, but may have oil drip areas, debris, or both, by scarifying the marking area using non-milling grinding teeth or shot blasting. The Engineer will allow the use of water blasting to scarify the marking area on PCC surfaces.

Prepare existing HMA or PCC surfaces with existing non-polyurea markings by completely removing non-polyurea markings.

Prepare existing HMA or PCC surfaces with existing polyurea marking and that may have oil drip areas, debris, or both, by using the following methods:

- a. Clean the marking area with compressed air if markings are replaced every 2 years and no visible oil drip areas or visible chipping or spalling of the existing marking exist;
- b. Scarify the marking area using non-milling grinding teeth or shot blast if markings are replaced every 2 years and visible oil drip areas, chipping or spalling of the existing markings exist; or
- c. Completely remove existing pavement markings if markings are replaced every 4 years.



Table 811-2 Minimum Material Placement Temperature and Seasonal Restrictions (a)				
Material	Minimum Air Temperature (°F) (b)	Minimum Pavement Temperature (°F) (c)	Start Date	End Date
Waterborne	50	50	May 1	Oct. 15
Low Temperature Waterborne	35	35	Oct. 1	May 1
Regular Dry	25	25	Oct. 1	May 1
Cold Plastic Tape – with Contact Cement	60	60	May 1	Oct. 15
Cold Plastic Tape – Primerless – without Surface Preparation Adhesive	60	60	Jun. 1	Sept. 1
Cold Plastic Tape – Primerless – with Surface Preparation Adhesive	40	40	Apr. 15	Nov. 15
Thermoplastic	50	50	May 1	Oct. 15
Sprayable Thermoplastic	50	50	Apr. 15	Nov. 15
Polyurea	40	40	Apr. 15	Nov. 15
a. See text for more detailed information. b. Temperature must meet minimum and be rising. c. Pavement must be dry.				

E. **Second Application.** If the contract requires a second application of permanent pavement markings, complete two applications regardless of initial pavement marking conditions. Complete the second application from 14 days to 60 days after initial application in the same calendar year.

The Contractor may apply the second application before the required 14 days if previously approved by the Engineer.

F. **Call Back Painting.** The Engineer will provide a list of locations and limits for call back pavement marking painting, and will direct the order that the Contractor may paint the locations.

Begin call back painting work within seven days of the Engineer's notification.

G. **Shoulder Rumble Strip Marking (SRSM).** Apply markings 4 inches wide within the shoulder rumble strips as shown on the plans or directed by the Engineer. Ensure a gap of 8 inches to 10 inches between the edge line and the SRSM.

Apply solid lines for SRSM. If possible, apply the 6-inch edge line and the 4-inch SRSM in the same pass.

Retrace existing SRSM with lines of equal width. For existing 4-inch wide lines, retrace no greater than ¼ inch wider than the existing line. If the existing line exceeds a width of 4 inches, ensure the existing and retraced SRSM total line width is no greater than 5 inches wide. If possible, retrace the 6-inch edge line and the 4-inch SRSM in the same pass.

**H. Raised Pavement Marker (RPM) Removal.** Remove RPM with Department-approved equipment. During removal, do not disturb pavement more than 3 inches below the surface or more than 3 inches from the perimeter of the marker casting. The Engineer will stop marker removal if damage to the pavement exceeds these limits.

The Engineer will require patching, regardless of milling requirements, unless the Engineer determines damaged areas do not pose a hazard to traffic. Use leveling mix to patch concrete and HMA pavement that require HMA overlay.

Use a prepackaged, hydraulic, fast-set material for patching structural concrete, from the Qualified Products List for patching concrete pavement not requiring overlay. Patch concrete pavement, not requiring overlay in accordance with the patch material manufacturer's specifications.

Patch HMA pavement, not requiring overlay, with the epoxy adhesive used to attach raised pavement markers to the pavement.

Clean and dispose of debris from RPM removal and patching operations.

#### **811.04. Measurement and Payment.**

<b>Pay Item</b>	<b>Pay Unit</b>
Pavt Mrkg, Waterborne, __ inch, (color).....	Foot
Pavt Mrkg, Waterborne, 2nd Application __ inch, (color).....	Foot
Pavt Mrkg, Waterborne, for Rest Areas, Parks, & Lots, __ inch, (color) .....	Foot
Pavt Mrkg, Regular Dry, __ inch, (color) .....	Foot
Pavt Mrkg, Regular Dry, 2nd Application, __ inch, (color) .....	Foot
Pavt Mrkg, Thermopl, __ inch, (color) .....	Foot
Pavt Mrkg, Thermopl, __ inch, Crosswalk.....	Foot
Pavt Mrkg, Thermopl, __ inch, Stop Bar .....	Foot
Pavt Mrkg, Thermopl, __ inch, Cross Hatching, (color) .....	Foot
Pavt Mrkg, Sprayable Thermopl, __ inch, (color).....	Foot
Pavt Mrkg, Ovly Cold Plastic, __ inch, (color) .....	Foot
Pavt Mrkg, Ovly Cold Plastic, __ inch, Stop Bar .....	Foot
Pavt Mrkg, Ovly Cold Plastic, 12 inch, Crosshatching, (color) .....	Foot

811.04

Pavt Mrkg, Ovly Cold Plastic, ___ inch, Crosswalk.....	Foot
Pavt Mrkg, Ovly Cold Plastic, (legend).....	Each
Pavt Mrkg, Ovly Cold Plastic, (symbol) .....	Each
Pavt Mrkg, Polyurea, ___ inch, Crosswalk.....	Foot
Pavt Mrkg, Polyurea, ___ inch, Stop Bar .....	Foot
Pavt Mrkg, Polyurea, ___ inch, Cross Hatching.....	Foot
Pavt Mrkg, Polyurea, ___ inch, (color) .....	Foot
Pavt Mrkg, (material), 4 inch, SRSM, (color).....	Foot
Pavt Mrkg, (material), 4 inch, SRSM, 2nd Application, (color) .....	Foot
Rem Curing Compound, for Spec Mrkg .....	Square Foot
Rem Curing Compound, for Longit Mrkg ___ width .....	Foot
Rem Spec Mrkg .....	Square Foot
Call Back, Mobilization .....	Each
Call Back, Intermediate Transportation .....	Mile
Rem Raised Pavt Marker .....	Each
Witness, Log, Layout, Max. __, \$1,000.00 .....	Dollars

A. **General.** The Engineer will not measure the skips in dashed lines. The cost of traffic control and mobilization is included in the unit prices for other pavement marking placement pay items.

The cost of collecting and disposing of residue generated by the removal of cold plastic pavement markings and curing compound is included in the unit prices for other removal pay items.

The cost of glass beads is included in the unit prices for other pavement marking material.

The Department will not pay separately for the contact cement and adhesives for longitudinal lines, legends, symbols, arrows, crosswalks, or stop bars.

The Department will not pay for markings placed by equipment operated at speeds higher than the certified speed.

The Department will not assess liquidated damages if the 30-day waiting period for placing low temperature waterborne paint is in effect and the project is complete. The Department will not assess liquidated damages if the 14-day waiting period for regular dry paint is in effect and the project is complete.

The unit price for **Rem Curing Compound** includes the cost of preparing new PCC for marker application by removing the curing compound.

The Engineer will calculate pay adjustment as required by the contract when regular dry paint or low temperature waterborne paint are

substituted for waterborne paint due to seasonal limitations. The adjustment applies only to projects that have completion dates after October 1, or have approved extensions of time without liquidated damages beyond October 1. Contractors who are in liquidated damages after October 1 are not eligible for the price adjustment.

**B. Delayed Acceptance.** The Department will not pay for corrective action required for delayed acceptance, including removal and replacement of failed pavement markings.

The Department will delay final acceptance of completed pavement marking work for 60 days. During this 60-day delayed acceptance period, the Department will inspect the markings at its discretion. The Department will not accept pavement markings if less than 90 percent of the original marking remains, and will require the Contractor to replace the markings immediately. The Department will not consider pavement markings, damaged by snowplow operations, as failed.

Provide the Department with a maintenance bond equal to 90 percent of the value of the pavement marking work performed so the Department can accept the project for final payment before the end of the 60-day delayed acceptance period. Ensure the bond is in effect when the balance of the contract work is completed.

**C. Call Back.** The unit price for **Call Back, Mobilization** includes the cost of traveling to the first call back painting location.

The Engineer will measure **Call Back, Intermediate Transportation** based on the map distances. The unit price for **Call Back, Intermediate Transportation** includes the cost of traveling between intermediate locations.

**D. Pavement Marking Removal.** The Engineer will measure the full removal of special markings based on the Pavement Marking Standard Plans. The Department will pay for partial removal of special markings based on the dimensions of the actual removal area. If full removal of pavement markings is required, the unit prices for **Rem Spec Mrkg** or **Pavt Mrkg, Longit, 6 inch or Less Width, Rem**, and **Pavt Mrkg, Longit, Greater than 6 inch Width, Rem** include the cost of the removal in accordance with subsection 812.04.N.

If the Contractor removes multiple layers of pavement marking materials, the Department will not pay separately for material removed beyond the first layer.

**E. Material Deficiency.** The Engineer will compute the quantity of pavement marking material and glass beads applied per unit of

#### 811.04

measurement at the end of each work day. The Engineer may include an applied length of less than 10 miles in the next day's measurement. The Engineer will determine the material usage based on field measurements and the required application rate specified in Table 811-1.

The Department will reduce the unit price for pavement marking material for material shortages in direct proportion to the deficient material quantity, up to 6 percent. If the daily deficiency of pavement marking material, or beads, is greater than 6 percent, the Department will consider the day's work unsatisfactory and will direct the Contractor to reapply the day's markings to the thickness required by the contract, at no additional cost to the Department.