

Pavement Markings (1 of 3)

ROADSIDE

DESCRIPTION AND DEFINITION

A typical approach to marking a road involves placing a 4-inch-wide white line for the road edge and yellow line for the centerline.

Minnesota has been experimenting with the use of an enhanced, 6-inch-wide edge line in an effort to better delineate the road edge.

6-Inch Edge line

Advantages

- 50 percent wider lane line
- Low cost—approximately \$650 per mile
- Initial positive feedback from drivers
- Initial indication that 6-inch edge line results in a small crash reduction (5 to 10 percent)—not yet statistically significant

Disadvantages

- Higher cost than for 4-inch lines
- Still susceptible to snowplow damage
- No improvement in wet conditions
- No tactile effect

Embedded Wet Reflective Markings

A wet, reflective paint made of large glass beads is installed in a longitudinal trough that is approximately 0.04 inch deep. The larger beads provide improved visibility at night and during wet conditions, and the trough protects the beads from damage by snowplow blades. MnDOT considers this strategy experimental; limited installation has taken place, but approximately 250 miles have been approved for funding in 2012.

Advantages

- Improved visibility at night and during wet conditions
- No noise concerns
- Little/no snowplow damage expected

Disadvantages

- Relatively high cost (over typical painted edge line)
- Crash reduction as yet unknown
- No tactile effect

The STOP AHEAD pavement marking at intersections is intended to reduce crashes related to lack of driver awareness of stop-control at unsignalized intersections.

ROADWAY OPERATIONS

The installation of edge line and centerline pavement markings does not have an effect on the mobility of traffic on the roadway.

PROVEN, TRIED, INEFFECTIVE, OR EXPERIMENTAL

- NCHRP 500 series considers pavement markings a **TRIED** strategy.
- The only study in the FHWA Crash Reduction Clearinghouse that studied the effects of converting a 4-inch edge line to a 6-inch edge line found a 10 to 60 percent reduction in all rural crashes.
- MnDOT is evaluating the first round of installations of 6-inch edge lines. Preliminary results indicate crash reductions in the 5 to 10 percent range.
- STOP AHEAD pavement markings at intersections have a 15 percent reduction in crashes, a higher reduction than transverse rumble stripes.



Example of 6" Edgeline



Example of Embedded Wet Reflective Marking

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TYPICAL CHARACTERISTICS OF CANDIDATE LOCATIONS

The 2009 Minnesota Manual on Uniform Traffic Control Devices (MN MUTCD) provides the following guidance in the location of center and edge lines on roadways:

- Centerline markings shall be placed on all paved urban arterials and collectors with Average Daily Traffic (ADT) volume of 6,000 vehicles per day or greater
- Centerline markings should be placed on paved urban arterials and collectors with an ADT rate of 4,000 vehicles per day or greater
- Edge line markings shall be placed on paved streets or highways with ADT volume of 6,000 vehicles per day or greater
- Edge line marking should be placed on paved streets with ADT volume of 3,000 vehicles per day or greater

TYPICAL COSTS

Implementation Costs

- 6-inch edge line = \$650 per mile
- Embedded wet reflective paint = \$8,500 per mile

According to MnDOT’s Policy for Pavement Marking Operations, traffic volumes and resulting snow and ice operations have the greatest effect on performance of pavement markings. The following table provides a summary of the pavement marking life expectancy and typical costs for latex, epoxy, and preformed polymer tape.

Pavement Marking Life Expectancy and Typical Costs

	Latex Markings	Epoxy	Poly-Preform (tape)
Life Expectancy	1 to 2 years	3 to 4 years	4 to 7 years
4-inch marking – white (\$/ft)	\$0.06	\$0.18	\$3.20
4-inch marking – white skip (\$/ft)	\$1.00	\$0.45	\$3.20
24-inch marking, stop bars (\$/ft)	\$1.14	\$5.00	\$17.85
Arrows (each)	\$22.00	\$96.00	\$289.00
Messages (each)	\$101.00	\$196.00	N/A

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DESIGN FEATURES

The 2009 MN MUTCD provides examples of two-lane, two-way pavement marking applications for both passing permitted and marking for no-passing zones.

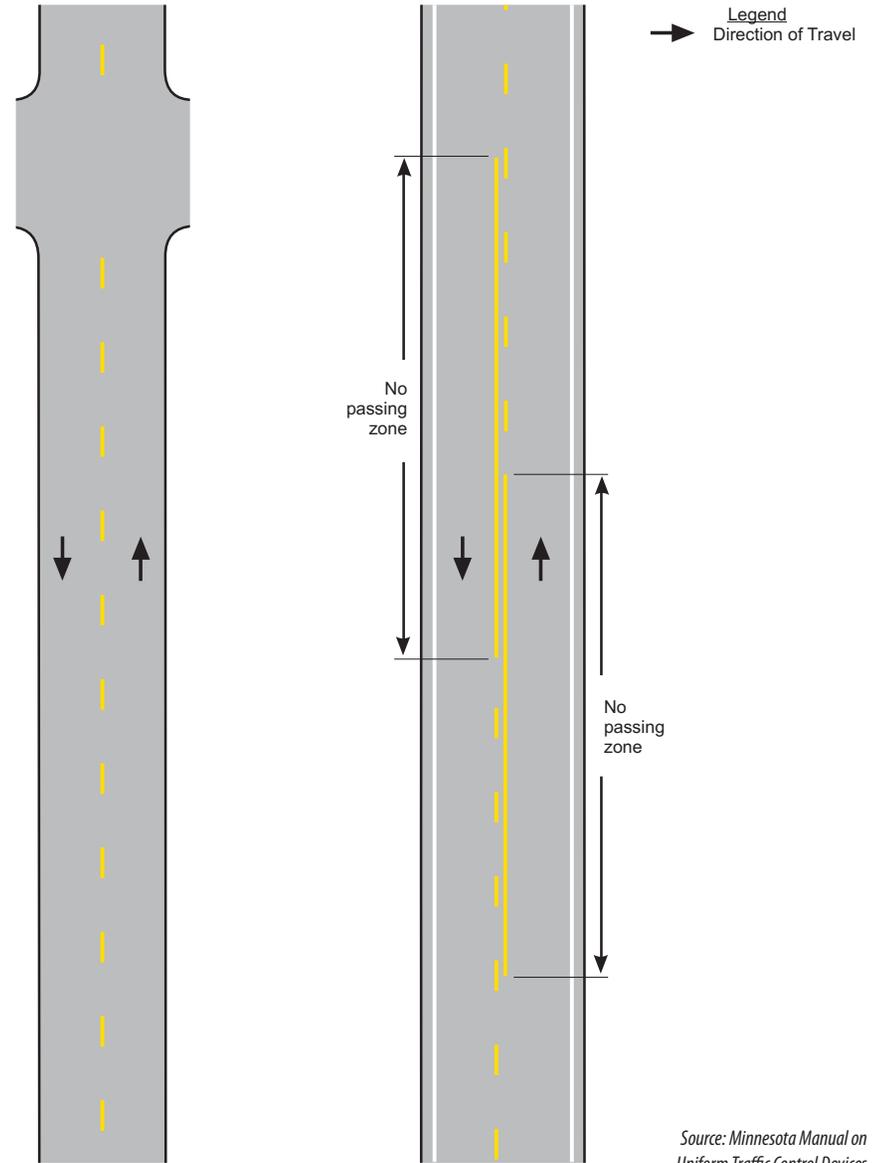
The designation of passing zones is unique; the regulatory device, not a sign, is the marking. As a result, if an agency chooses to install a centerline along a segment of road where it is not required (such as on residential or other urban streets) in an attempt to slow traffic, the lines must be appropriate for the passing conditions.

BEST PRACTICE

Maintain an inventory of pavement markings and develop a management approach for maintaining retroreflectivity of the markings that is consistent with available funding.

SOURCES

Minnesota Manual on Uniform Traffic Control Devices, 2009.
 MnDOT Policy for Pavement Marking Operations
 Safety Evaluation of STOP AHEAD Pavement Markings, FHWA-HRT-08-043, Gross, F and et. Al., December 2007.
 State of Practice for Minnesota Local Agency Pavement Marking Management, Minnesota Local Road Research Board, Report 201005TS, 2010.
 Minnesota Local Agency Pavement Marking Practices—Phase I, Minnesota Local Road Research Board, Report 201005, 2010
 Developing and Implementing Enhanced Pavement Marking Management Tools: Phase I—Mapping Tool, Minnesota Local Road Research Board, Report 200837ts, 2008.
 2008-37 Developing and Implementing Enhanced Pavement Marking Management Tools for the Minnesota Department of Transportation, Minnesota Local Road Research Board, Report 200837, 2008.
 Cost of Pavement Marking Materials, Minnesota Local Road Research Board, Report 200011, 2000.



a - Typical two-lane, two-way marking with passing permitted in both directions

b - Typical two-lane, two-way marking with no-passing zones

Source: Minnesota Manual on Uniform Traffic Control Devices



Pavement Markings Policy (1 of 2)

ROADSIDE

POLICY PURPOSE/INTRODUCTION

The purpose of this policy is to establish uniformity and consistency in the application, installation, and maintenance of pavement markings on **<Insert Agency>**'s roadway system.

The Commissioner of Transportation has adopted the MN MUTCD for use on all streets and highways of the State of Minnesota. The MN MUTCD contains guidelines relating to the design and application of traffic control devices—signs, markings, and signals—and is in substantial conformance with the national manual prepared by the Federal Highway Administration (FHWA).

The FHWA is in the process of developing minimum retroreflectivity criteria for pavement markings, similar to the recently adopted requirements for maintaining minimum levels of retroreflectivity for traffic signs. When the criteria are formally added to the MN MUTCD, **<Insert Agency>** will be responsible for maintaining pavement markings on the agency's system of highways such that the markings meet or exceed the minimum level criteria.

DEFINITIONS

Centerline—A 4-inch wide solid or skip line (10 feet of painted line followed by a 40-foot gap) that denotes the center of road and that the adjacent lane to the left carries traffic in the opposite direction. The solid line is the regulatory device that designates where passing is not allowed, and the skip line designates where passing is allowed.

Edge line—A 4- or 6-inch-wide line that denotes the edge of rural roads and separates lanes of traffic moving in the same direction on multi-lane highways.

Latex paint—A water-based paint that typically costs \$0.05 to \$1.00 per linear foot for a 4-inch line and has a life expectancy of 2 years on low-volume roads (under 1,500 vehicles per day) and 1 year on high-volume roads (more than 1,500 vehicles per day).

Epoxy—A multiple component liquid that is generally more durable than latex, costs \$0.20 to \$0.50 per linear foot for a 4-inch line, and has a life expectancy of 6 years on low-volume roads and 4 years on high-volume roads.

Edge line rumble strip—A 12- to 16-inch-wide grooved pattern, approximately ½ inch deep, constructed on the outside edge of the travelled lane or in the shoulder.

Edge line rumble stripE—An 8- to 12-inch-wide grooved pattern, approximately ½ inch deep, constructed on the outside edge of the traveled lane that contains the edge line pavement marking.

POLICY

<Insert Agency> will have a pavement marking program consisting of both construction and maintenance elements in order to provide reasonable levels of markings (presence and retroreflectivity) on all county and city roadways, consistent with adopted statewide performance measures, 365 days per year.

POLICY CRITERIA

It must be recognized that it is not possible to maintain pavement marking minimum retroreflectivity levels for all markings at all times. Winter operations and maintenance activities can damage and even obliterate markings such that pavement markings in the winter and spring may have little or no measurable retroreflectivity. In addition, during wet conditions the performance of conventional pavement markings is typically much less effective than during dry conditions. Also, pavement marking replacement periods are limited to seasonal cycles (dry pavements and pavement temperatures above 50 degrees Fahrenheit) making it impractical to perform pavement marking maintenance activities during winter months.

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The maintenance element of the pavement marking program consists of two parts—a visual assessment of in-place markings combined with a management approach to identify the segments of **<Insert Agency>**'s system that will be refurbished in any given year. The visual assessment will consist of **<Insert Agency>** staff conducting a nighttime inspection of all county and city highways and recording their determinations relative to whether or not the markings meet the adopted performance measures. The visual observations will supplement the management approach, which will track the service life of the markings on every **<Insert Agency>** highway. The annual program for refurbishing the pavement markings will then be developed based on addressing those facilities where the markings have been determined to no longer meet the adopted performance measures.

Edge and centerlines will be refurbished with latex paint and with the schedule based on the following expected frequency:

- **Low-volume highways**

- Centerlines: Every year
- Edge lines: Every other year

This frequency yields a refurbishing project that includes the centerline and one edge line (westbound) being done during one year and the same centerline and the other edge line (eastbound) being done the next year.

- **High-volume highways**

- Centerlines: Every year
- Edge lines: Every year

To address the issue of the performance of the pavement markings during wet conditions, **<Insert Agency>** will deploy edge line rumble stripEs along rural **<Insert Agency>** highways. Experience has demonstrated that installing the edge line pavement marking over the grooves of the rumble stripE provides improved visibility of the marking at night and during wet pavement conditions—the paint on the nearly vertical sides of the grooves in the pavement remains above the film of water during most rain events. In addition, the paint in the grooves is protected from damage by snowplows; as a result, the service life of the pavement marking is extended.

<Insert Agency> will not deploy pavement markings on residential streets. If markings are placed on residential streets, they will be consistent with required passing/no passing markings.

FINANCIAL CONSIDERATIONS

The construction element of the **<Insert Agency>**'s pavement marking program consists of using the epoxy material for all center and edge lines on new surfaces that are associated with construction and maintenance projects supported by state and federal funds. The additional state and federal funds on these projects allows **<Insert Agency>** to deploy the more durable and longer lasting epoxy markings at a reduced first cost and will also result in a long-term reduction in annual maintenance costs (because of the documented longer service life).