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Summary of the MUTCD Pavement Marking Retroreflectivity Standard

PAGE 1

Pavement markings are an accepted method to communicate both the intended travel path and roadway alignment for drivers during day and nighttime conditions. To ensure consistent application of pavement markings, their characteristics and warranting criteria are described in the Manual on Uniform Traffic Control Devices (MUTCD).

The new MUTCD Section 3A.03 requires agencies to use a method designed to maintain longitudinal pavement markings to a minimum level of retroreflectivity outlined in Table 3A-1. The Federal Highway Administration (FHWA) believes that this change will promote safety while providing sufficient flexibility for agencies to choose a maintenance method that best matches their specific conditions.

The new MUTCD Section does not imply that an agency must measure every pavement marking. Rather, the new MUTCD Section describes methods that agencies can use to maintain pavement marking retroreflectivity at or above the minimum levels. Agencies can choose one of these methods or combine them. However, agencies must adopt a method that produces results which correspond to the values in Table 3A-1. Agencies are allowed to develop other appropriate methods based on engineering studies, as long as there is still a tie to the values in Table 3A-1.

Within the new MUTCD Section there are subtle but important distinctions that categorize pavement markings into three general types:

- **Not required to be retroreflective**—These are pavement markings where ambient illumination assures adequate visibility or pavement markings that are needed only in the daytime (e.g. where access to a park may be daytime only). These pavement markings do not need to be maintained to minimum levels of retroreflectivity.
- **Required to be retroreflective, but not subject to minimum levels**—All markings other than those discussed in the first bullet must be retroreflective, but some of these markings are not subject to the new minimum retroreflectivity levels. Examples of exceptions provided by the new MUTCD language include crosswalk markings, other transverse markings, words, symbols, arrows, etc. Some longitudinal lines are exempt from the new minimum retroreflectivity levels under certain conditions, such as presence of continuous roadway lighting or raised retroreflective pavement markers.
- **Subject to minimum retroreflectivity levels**—These include the white and yellow longitudinal pavement markings that are required or recommended in the MUTCD, such as the center lines, edge lines, lane lines, and channelizing lines that the MUTCD says shall or should be used above certain volumes or for certain roadway conditions.

The new MUTCD Section recognizes that there may be some pavement markings that do not meet the minimum retroreflectivity levels at a particular point in time (such as during winter months in northern climates, along some isolated horizontal curves, near driveways, etc). As long as the agency with jurisdiction is maintaining pavement markings in accordance with Section 3A.03 of the MUTCD, the agency will be considered to be in compliance.

This document introduces the new MUTCD Section, references existing MUTCD language, and it also describes methods that can be used to maintain pavement marking retroreflectivity at or above the MUTCD's new minimum maintained retroreflectivity levels.

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The first revision to the 2009 MUTCD introduces a new section establishing a requirement to use a method designed to maintain minimum retroreflectivity levels for pavement markings. Agencies will have until [insert month and year - 4 years after Final Rule effective date] to establish and implement that pavement marking maintenance method. Agencies will have until [insert month and year - six years from the Final Rule effective date] to replace pavement markings that fail to meet the new regulations. The new MUTCD Section is shown on Page 2 and 3 of this document.

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PAGE 2

New MUTCD Minimum Pavement Marking Retroreflectivity Compliance Dates:

- Four years from date of Final Rule for implementation and continued use of a maintenance method that is designed to maintain pavement marking retroreflectivity at or above the established minimum levels.
- Six years from date of Final Rule for replacement of pavement markings that are identified using the maintenance method as failing to meet the established minimum levels.

New MUTCD Section 3A.03 Maintaining Minimum Retroreflectivity of Longitudinal Pavement Markings

Standard:

Public agencies or officials having jurisdiction shall use a method designed to maintain retroreflectivity of the following white and yellow longitudinal pavement markings, at or above the minimum levels in Table 3A-1:

1. **Center line markings on roads where they are required or recommended by Section 3B.01. This shall include any no-passing zone markings, longitudinal two-way left-turn lane markings, and yellow markings used to form flush medians on such roads.**
2. **Lane line markings on roads where they are required or recommended by Section 3B.04. This shall include any dotted lane lines, lane drop markings, and longitudinal preferential lane markings on such roads.**
3. **Edge line markings on roads where they are required or recommended by Section 3B.07. This shall include any channelizing lines delineating gores, divergences, or obstructions on such roads.**
4. **Any optional edge line markings that are used to qualify for the lower minimum retroreflectivity values in the "All other roads" row of Table 3A-1.**

Support:

Compliance with the above Standard is achieved by having a method in place and using the method to maintain the minimum levels established in Table 3A-1. Provided that a method is being used, an agency or official having jurisdiction would be in compliance with the above Standard even if there are pavement markings that do not meet the minimum retroreflectivity levels at a particular location or at a particular point in time.

There are many factors for agencies to consider in developing a method of maintaining minimum pavement marking retroreflectivity including, but not limited to, winter weather, environmental conditions and pavement resurfacing.

Guidance:

Except for those pavement markings specifically identified in the Option below, one or more of the following methods, as described in the 2010 Edition of FHWA's "Summary of the MUTCD Pavement Marking Retroreflectivity Standard (see Section 1A.11)," should be used to maintain retroreflectivity of longitudinal pavement markings at or above the levels identified in Table 3A-1:

- A. *Calibrated Visual Nighttime Inspection – Prior to conducting a nighttime inspection from a moving vehicle and in conditions similar to nighttime field conditions, a trained inspector calibrates his eyes to pavement markings with known retroreflectivity levels at or above those in Table 3A-1. Pavement markings identified by the inspector to have retroreflectivity below the minimum levels are replaced.*
- B. *Consistent Parameters Visual Nighttime Inspection – A trained inspector at least 60 years old conducts a nighttime inspection from a moving vehicle under parameters consistent with the supporting research. Pavement markings identified by the inspector to have retroreflectivity below the minimum levels are replaced.*
- C. *Measured Retroreflectivity – Pavement marking retroreflectivity is measured using a retroreflectometer. Pavement markings with retroreflectivity levels below the minimums are replaced.*
- D. *Service Life Based on Monitored Markings – Markings are replaced based on the monitored performance of similar in-service markings with similar placement characteristics. All pavement markings in a group/area/corridor are replaced when those in the representative monitored control set are near or at minimum retroreflectivity levels. The control set markings are monitored on a regular basis by the visual nighttime inspection method, the measured retroreflectivity method, or both.*

Summary of the MUTCD Pavement Marking Retroreflectivity Standard (2010) Page 3
http://safety.fhwa.dot.gov/roadway_dept/night_visib

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- E. *Blanket Replacement – All pavement markings in a group/area/corridor or of a given type are replaced at specific intervals. The replacement interval is based on when the shortest-life material in that group/area/corridor approaches the minimum retroreflectivity level. The interval is also based on historical retroreflectivity data for that group/area/corridor.*
- F. *Other Methods – Other methods developed based on engineering studies that determine when markings are to be replaced based on the minimum levels in Table 3A-1.*

Option:

Public agencies or officials having jurisdiction may exclude the following markings from their minimum pavement marking retroreflectivity maintenance method(s) and the minimum maintained pavement marking retroreflectivity levels, but not from any requirements in Section 3A.02 to be retroreflective.

- A. Words, symbols, and arrows,
- B. Crosswalks and other transverse markings,
- C. Black markings used to enhance the contrast of pavement markings on a light colored pavement,
- D. Diagonal or chevron markings within a neutral area of a flush median, shoulder, gore, divergence, or approach to an obstruction,
- E. Dotted extension lines that extend a longitudinal line through an intersection or interchange area,
- F. Curb markings,
- G. Parking space markings, and
- H. Shared use path markings

Table 3A-1 Minimum Maintained Retroreflectivity Levels¹ for Longitudinal Pavement Markings

	Posted Speed (mph)		
	≤ 30	35 – 50	≥ 55
Two-lane roads with centerline markings only (2)	n/a	100	250
All other roads (2)	n/a	50	100

1 Measured at standard 30-m geometry in units of mcd/m²/lux
 2 Exceptions:
 A. When RRPMS supplement or substitute for a longitudinal line (see Section 3B.13 and 3B.14), minimum pavement marking retroreflectivity levels are not applicable as long as the RRPMS are maintained so that at least 3 are visible from any position along that line during nighttime conditions.
 B. When continuous roadway lighting assures that the markings are visible, minimum pavement marking retroreflectivity levels are not applicable.

Excerpts from Existing MUTCD Language Related to Minimum Retroreflectivity

Section 3A.02 Standardization of Application

Markings that must be visible at night **shall** be retroreflective unless ambient illumination assures that the markings are adequately visible. All markings on Interstate highways **shall** be retroreflective.

Section 3B.01 Yellow Centerline Pavement Markings and Warrants

Centerline markings **shall** be placed on all paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater. Centerline markings **shall** also be placed on all paved two-way streets or highways that have three or more lanes for moving motor vehicle traffic.

Centerline markings **should** be placed on paved urban arterials and collectors that have a traveled way of 20 feet or more in width and an ADT of 4,000 vehicles per day or greater. Centerline markings **should** also be placed on all rural arterials and collectors that have a traveled way of 18 feet or more in width and an ADT of 3,000 vehicles per day or greater. Centerline markings **should** also be placed on other traveled ways where an engineering study indicates such a need.

Section 3B.04 White Lane Line Pavement Markings and Warrants

Lane line markings **shall** be used on all freeways and Interstate highways

Lane line markings **should** be used on all roadways that are intended to operate with two or more adjacent traffic lanes that have the same direction of travel, except as otherwise required for reversible lanes. Lane line markings **should** also be used at congested locations where the roadway will accommodate more traffic lanes with lane line markings than without the markings.

Section 3B.07 Warrants for Use of Edge Lines

Edge line markings **shall** be placed on paved streets or highways with the following characteristics:

Summary of the MUTCD Pavement Marking Retroreflectivity Standard (2010) Page 5
http://safety.fhwa.dot.gov/roadway_dept/night_visib

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- A. Freeways;
- B. Expressways; and
- C. Rural arterials with a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater.

Edge line markings **should** be placed on paved streets or highways with the following characteristics:

- A. Rural arterials and collectors with a traveled way of 20 feet or more in width and an ADT of 3,000 vehicles per day or greater.
- B. At other paved streets and highways where an engineering study indicates a need for edge line markings.

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PAGE 4

MUTCD Maintenance Methods

More details on these methods can be found in report titled *Methods for Maintaining Pavement Marking Retroreflectivity*, which will be available at http://safety.fhwa.dot.gov/roadway_dept/night_visib. That report should be reviewed prior to using these methods.

A. Calibrated Visual Nighttime Inspection

This is one of two different versions of a visual inspection method. In this method, a trained inspector views "calibrated pavement markings" prior to conducting the nighttime inspection. Calibrated pavement markings have known retroreflectivity levels at or above minimum levels. These pavement markings are set up where the inspector can view them in a manner similar to actual nighttime field inspections. The inspector uses the visual appearance of the calibrated pavement markings to establish the evaluation threshold for that night's inspection activities. The following list provides additional information on the use of this procedure:

- Calibrated pavement markings can be markings on roadways open to public travel or markings in or near an agency's facility. They need to have retroreflectivity levels at or above the levels in Table 3A-1.
- Calibrated pavement markings need to be applied and used in the same manner that nighttime inspections will occur. For example, white edge lines need to be on the right of the inspection vehicle and yellow center lines need to be on the left of the inspection vehicle. The calibrated pavement markings need to be long enough so that they can be viewed at typical viewing distances from the inspection vehicle traveling at typical speeds of the nighttime inspection.
- The retroreflectivity levels of the calibrated pavement marking should be verified periodically with a retroreflectometer.
- Conduct nighttime inspections from a passenger car (not a pickup or SUV) at normal operating speeds with good weather conditions (free of rain or fog and with dry pavement markings). Use low-beam headlamp illumination while minimizing interior vehicle lighting.
- The inspector makes a judgment on whether actual roadway markings are above or below the retroreflectivity level of the calibration markings viewed at the beginning of that night's inspection.

B. Consistent Parameters Visual Nighttime Inspection

This is the second visual inspection method, and is based on similar factors that were used in the research to develop the minimum retroreflectivity levels. It is similar to the visual inspection method described above in that nighttime inspections are conducted from a passenger vehicle at normal operating speeds with good weather conditions (free of rain or fog and with dry pavement markings) using low-beam headlamp illumination while minimizing interior vehicle lighting. The difference is that calibrated markings are not necessary and no special equipment is needed as long as the following factors are satisfied.

- Using a passenger car (not a pickup or SUV) to conduct the inspection.
- Using a model year 2000 or newer vehicle for the inspection.
- Using an inspector who is at least 60 years old.

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The inspector makes a judgment on whether roadway markings are sufficient to meet their driving needs.

C. Measured Retroreflectivity

In this method the pavement marking retroreflectivity is measured and directly compared to the minimum levels in Table 3A-1. The retroreflectivity measurements can either be made with handheld devices or mobile devices, as long as they are measured using the standard 30-meter geometry. Inspectors should follow the instructions provided by the manufacturer to obtain reliable retroreflectivity readings, including periodic calibration of the equipment.

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D. Service Life Based on Monitored Markings

In this method, pavement markings are replaced before they reach the end of their service life, which is when a representative sample of similar markings that are monitored through measurement or visual nighttime inspection have degraded to the retroreflectivity levels in Table 3A-1. This method would include a system for tracking similar groups of pavement markings based on color, type of materials, and other characteristics such as traffic volume. The representative sample must have similar in-service characteristics, rather than being placed at locations such as a maintenance yard or shoulder where they would not be subjected to similar wear.

E. Blanket Replacement

With this method, an agency replaces all of the pavement markings in an area, corridor, and/or of a given marking material type, at pre-selected specified time intervals based on the relevant expected service life (using levels in Table 3A-1). The replacement intervals are based on historical retroreflectivity data for specific roadways and types of marking material. The replacement intervals are based on when the shortest-life material in that group/area/corridor approaches the minimum retroreflectivity levels. This method typically requires that all of the designated pavement markings within a replacement area, or of the particular pavement markings type, be replaced, even if segments of markings were recently installed, following a resurfacing project, for instance.

F. Other Methods

Agencies can choose from the methods described on this page, combine them, or develop other methods based on engineering studies. It is important, however, that if an agency develops a different method, it must be based on an engineering study and must be based on the minimum levels in Table 3A-1.