Methods for Maintaining Pavement Marking Retroreflectivity

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WELCOME!

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AGENDA

1. Welcome and Introductions
2. Overview of FHWA Requirements
3. Dates & Deadlines
4. Requirements vs. Good Safety Practice
5. Avoiding Unintended Consequences of MN MUTCD Requirements
6. General Comments on Methods to Achieve Retroreflectivity Guidelines
7. Recommended Methods
8. Other Methods
9. Q & A
10. Next Steps

What is retroreflectivity?

- Roadway safety control
- Allows pavement markings to reflect headlamp light back to vehicles.
- Degrades over time
- FHWA provides guidance on how to maintain minimum levels

Overview of FHWA Requirements

Overview of MN MUTCD Requirements

DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

23 CFR Part 655

[FHWA Docket No. FHWA–2009–0139]

RIN 2125–AF34

National Standards for Traffic Control Devices; the Manual on Uniform Traffic Control Devices for Streets and Highways; Maintaining Pavement Marking Retroreflectivity

AGENCY: Federal Highway Administration (FHWA), U.S. Department of Transportation (DOT).

ACTION: Final rule.

Minnesota Manual on Uniform Traffic Control Devices

https://www.dot.state.mn.us/trafficeng/publ/mutcd/index.html

3A.3 Maintaining Minimum Pavement Marking Retroreflectivity

Standard

Except as provided in the Option, a method designed to maintain retroreflectivity at or above 50 mcd/m2/lx under dry conditions shall be used for longitudinal markings on roadways with speed limits of 35 mph or greater.

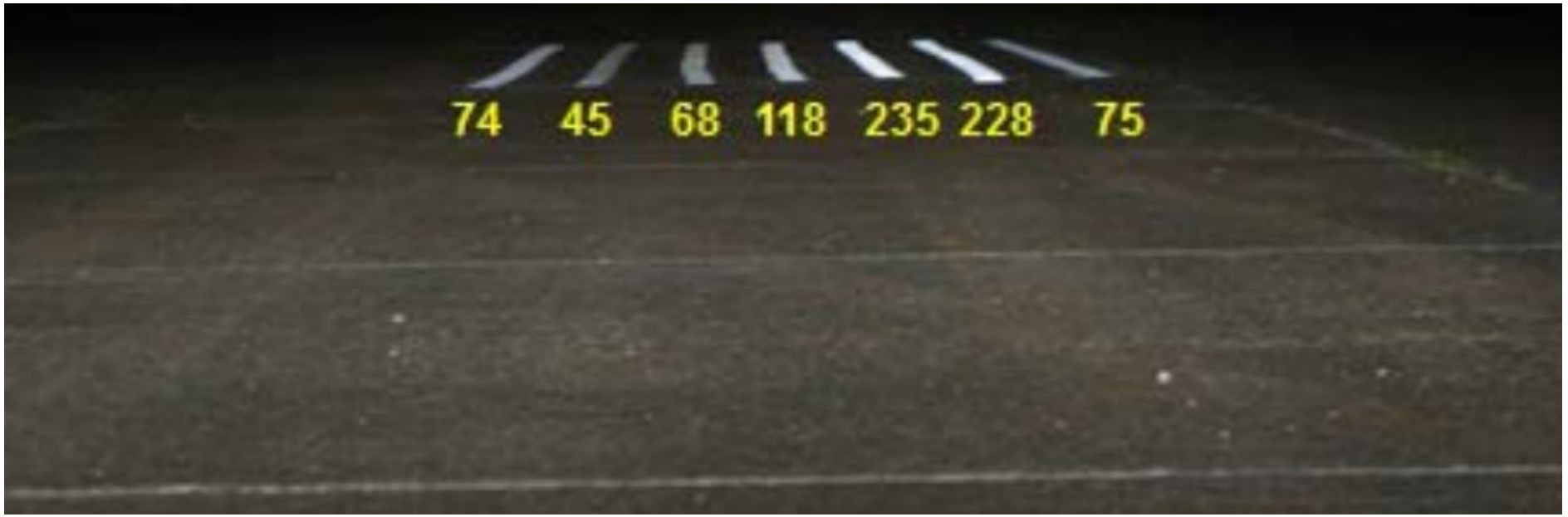
Overview of MN MUTCD Requirements

Speed Limit	ADT	Minimum Retroreflectivity Level
35 mph or greater	6,000 or greater	50 mcd/m2/lx Required
70 mph or greater	All ADT	100 mcd/m2/lx Recommended

Guidance for local agency decision-making

Millicandelas (mcd)

- Photo pavement markings with known retroreflectivity levels (30 meters)



Overview of MN MUTCD Requirements

- Incorporated into the MUTCD August 5, 2022.
- All methods require establishing a plan.
- Inspection methods:
  - **7.1:** Nighttime Visual Inspection - Consistent Parameters
  - **7.2:** Nighttime Visual Inspection – Calibrated Pavement Markings
  - **7.3:** Service Life Based on Historical Data
  - **7.4:** Service Life Based on Monitored Markings
  - **7.5:** Measured Retroreflectivity

Dates & Deadlines

June 2023
MN MUTCD published, providing guidance for local agencies

September 6, 2026
DEADLINE:
Implementation and continued use of a method that is designed to maintain retroreflectivity of longitudinal pavement markings

MN MUTCD Requirements vs. Good Safety Practice

- We are not providing pavement markings to meet FHWA requirements, we are providing markings to ***improve traffic safety***.

Avoiding Unintended Consequences of Requirements

- Agencies reducing the amount of lane markings on roadways to conform to mandates.
- **Goal is not less pavement markings; it is better pavement markings.**
- Provide longitudinal markings on roadways for safety and mobility.
- Safety needs on all paved roadways, especially lower volume/lower design roadways, especially if they experience higher than expected crash rates/severities.

General Comments on the Methods to Achieve Retroreflectivity Guidelines

- Provides a useful basis for decision making, when paired with common sense, local context, and engineering judgement.

General Comments on Methods to Achieve Retroreflectivity Guidelines

No one size fits all

Each agency needs to decide which method is best for them.

Parameters for consideration include:

1. Number of miles or percentage of roadways that require assessment.
2. Historical data on marking performance.
3. May combine methods to best fit agency needs.

Method 1: Nighttime Visual Inspection

Consistent parameters

Overview

- Nighttime review by trained inspector aged 60 years or older.
- Judges adequacy of markings to meet nighttime driving needs.

60+

Method 1: Nighttime Visual Inspection

Consistent parameters

Pros

- Minimal resource investment.
- Collect range of information.
- Repeatable.

Cons

- Agency must establish consistent procedures.
- Nighttime data collection requiring a driver and a trained observer.
- Method is dependent on subjective evaluations.
- Recommended outside of winter season.

Method 1: Nighttime Visual Inspection

Consistent parameters

Requirements

Number of Staff	• Two staff recommended, one driver and inspector as a passenger
Equipment	• Passenger car with low-beam headlamps • Verify proper alignment of the vehicle's low-beam headlamp
Computer/software	• Software not needed but recommend a database such as Excel to record data for future reference
Estimated Time	• Inspections conducted at normal traffic speed from each travel lane

Method 1: Nighttime Visual Inspection

Consistent parameters

Keys to Successful Implementation

1. Conduct inspections at normal speed, and from the travel lane.
2. Use low-beam headlamps while minimizing interior vehicle lighting.
3. Evaluate markings far enough in advance so there is adequate time to respond to curve, changes in the number of lanes, or marking patterns.

Resources

https://safety.fhwa.dot.gov/roadway_dept/night_visib/pm_methods_fhwasa22028.pdf

Method 2: Nighttime Visual Inspection

Calibrated Pavement Markings

Overview

- Calibrated pavement markings have known retroreflectivity at or above MUTCD levels.
- Inspector views calibrated pavement markings ***night prior*** to conducting the inspection.
- Establishes evaluation thresholds for that night's inspection activities.

Method 2: Nighttime Visual Inspection

Calibrated Pavement Markings

Pros

- Does not restrict inspector's age to 60+.
- Minimal resource investment.
- Can collect information including condition, color, worn areas, etc.
- Can be repeated, conducted in varying weather / seasonal conditions.

Cons

- Requires calibration markings that have retroreflectivity levels at or above minimum levels in MUTCD.
- Nighttime data collection.
- Method is subjective.
- Requires a driver and an observer.
- Trained or certified inspector for consistency.

Method 2: Nighttime Visual Inspection

Calibrated Pavement Markings

Requirements

Number of Staff	• Two staff recommended, one driver and inspector as a passenger
Equipment	• Passenger car with low-beam headlamps • Verify proper alignment of the vehicle's low-beam headlamp
Computer/software	• Software is not needed but recommend a database such as Excel to record data for future reference
Estimated Time	• Inspections conducted at normal traffic speed from each travel lane

Method 2: Nighttime Visual Inspection

Calibrated Pavement Markings

Keys to Successful Implementation

1. Trained inspectors for consistent data collection.
2. Calibration at least 10 feet long and inspection vehicle positioned 100 feet in advance of markings.
3. Calibration markings used in a dynamic condition need to be long enough to provide at least 15 seconds of preview time.
4. Ambient conditions must be dark: at least 30 minutes beyond sunset.

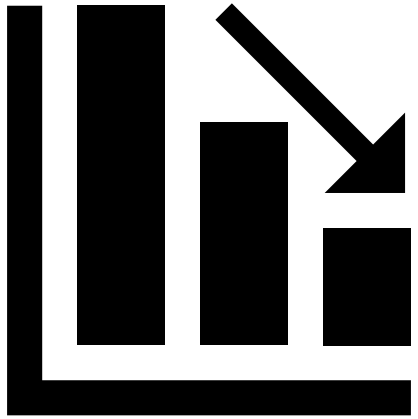
Resources

https://safety.fhwa.dot.gov/roadway_dept/night_visib/pm_methods_fhwasa22028.pdf

Method 3: Service Life
Based on Historical Data

Overview

- Agency tracks and documents marking installation dates.
- Using historical data or research results, develops a replacement schedule.
- Target date of having a plan in place is **September 2026** (3 years)
- Provides time to establish a plan and collect appropriate data.



Method 3: Service Life
Based on Historical Data

Pros

- Easy to establish systemwide needs and schedule maintenance.
- Theoretically, no need to conduct field inspections.
  - Advisable to conduct periodic checks.

Cons

- Need to establish historical data for markings for various marking materials and methods.
- Replacement times can vary depending on many factors.

Method 3: Service Life
Based on Historical Data

Requirements

Number of Staff	• One
Equipment	• Bookkeeping / recordkeeping software
Computer/software	• Bookkeeping / recordkeeping software
Estimated Time	• Dependent on situational factors (mileage, traffic volumes, climate, etc.)

Method 3: Service Life
Based on Historical Data

Keys to Successful Implementation

1. Several years of in-service pavement marking retroreflectivity data.
2. Agencies have established in-house test decks or contracted with researchers to design and monitor test decks.
3. Time consuming but essential to properly estimate the service life of durable pavement markings.

Method 4: Service Life
Based on Monitored Markings

Overview

- Markings replaced based on monitored performance of similar in-service markings.
- All markings in a group are replaced when a representative sample reaches threshold.
- Control set markings are monitored on a regular basis.

Method 4: Service Life
Based on Monitored Markings

Pros

- Available to agencies without historical data.
- Based on retro and performance data of comparable markings.

Cons

- Need to monitor and establish data for a statistical sample of markings and materials for similar roadway conditions.
- Wide variance by year and agency based on snow and ice operations and materials/installation method used.

Method 4: Service Life
Based on Monitored Markings

Requirements

Number of Staff	• 1 - 2
Equipment	• Retroreflectometer(s)
Computer/software	• Device software for downloading, uploading, transferring, viewing, and analyzing data.
Estimated Time	• Dependent on situational factors (mileage, traffic volumes, climate, etc.)

Method 4: Service Life
Based on Monitored Markings

Keys to Successful Implementation

1. Need for established statewide or regional “test sections” to provide service life.
2. Must consider the level of snow and ice control needed, which varies widely.

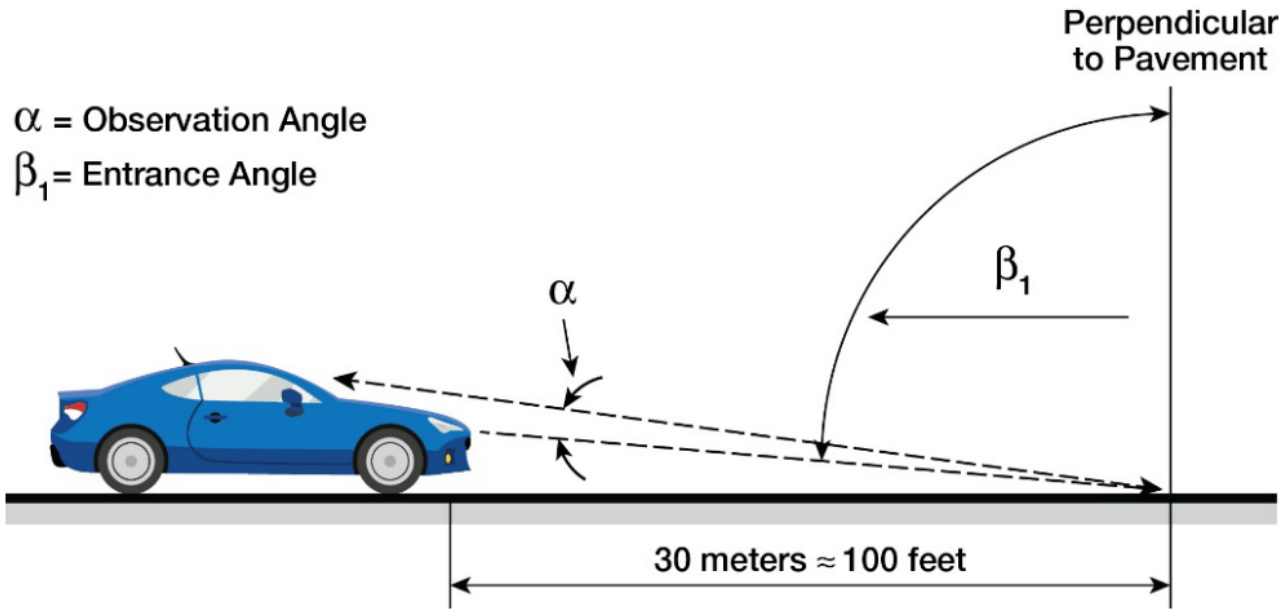
Resources

https://safety.fhwa.dot.gov/roadway_dept/night_visib/pm_methods_fhwasa22028.pdf

Method 5: Measured Retroreflectivity

Overview

- Retroreflectivity is measured and directly.
- Retroreflectivity measurements can be made with either handheld or mobile instruments.



Method 5: Measured Retroreflectivity

Pros

- Daytime data collection
- Consistent and accurate readings
- Potential to measure a representative sample

Cons

- Costly
- Equipment requires calibration and maintenance to obtain accurate data
- Handheld requires traffic control and putting worker in the traffic lane
- Needs to include visual inspection since equipment measures retroreflectivity

Method 5: Measured Retroreflectivity

Requirements

Number of Staff	• Two. More if using handheld retro reflectometers.
Equipment	• Retroreflectometer(s)
Computer/software	• Device software for downloading, uploading, transferring, viewing, and analyzing data.
Estimated Time	• Dependent on situational factors (mileage, traffic volumes, climate, etc.)

Method 5: Measured Retroreflectivity

Keys to Successful Implementation

1. Properly calibrated equipment.
2. Trained staff.
3. Ensure samples are representative.

Resources

https://safety.fhwa.dot.gov/roadway_dept/night_visib/pm_methods_fhwasa22028.pdf

Other Acceptable Methods

- Potential to combine methods or develop other methods based on engineering studies.
- Base methods on study(ies) and/or MN MUTCD minimum levels.
- EX: combined method of performing one of the visual assessment methods to determine the quality of the markings:
  - deemed as failing are replaced
  - deemed as adequate are left alone
  - deemed as marginal are evaluated with a measured retroreflectivity method

Review

Method	Pros	Cons	Comments
Nighttime Visual Inspection Consistent Parameters	• Minimal resource investment • Can collect information on more than retro, color, worn areas, etc. • 60+ aged driver required	• Nighttime data collection. • Subjective measure. • Driver and an observer/recorder. • Trained or certified inspector. • No uniform training.	• Least costly method. • Trained county employee. • Observer/recorder aged 60+ could be agency employee, hired or volunteer.
Nighttime Visual Inspection Calibrated Pavement Markings	• Does not require use of older driver (60+).	• Requires development, maintenance, and use of minimum level sample. • No training.	• Requires development of calibration standards.
Service Life Based on Historical Data	• Easy to establish system wide needs and schedule maintenance.	• Need to establish historical data.	• Most agencies have some data and practice. • Time to establish a plan and collect appropriate data.
Service Life Based on Monitored Markings	• Based on retro and performance data of comparable markings.	• Need to monitor and establish data for a statistical sample. • Varies tremendously.	• Need for established statewide or regional “test sections” that provide service life to implement this method. • Must consider level of snow and ice control needed. • Requires mobile / handheld retro data active monitoring.
Measured Retroreflectivity	• Daytime data collection • Accurate method to determine retro	• Cost, specialized training and equipment or outsource. • Must cover all markings or select a representative sample. • Handheld requirements. • Must include visual inspection.	• More costly. • Reduces staff time.

Other Methods – **Not Recommended by FHWA**

- Sun-over-the-shoulder check
- Comparison panel technique
- Lane line count technique
- Windshield marking technique
- Control sign method
- Comparison light box

Other Methods – Not Recommended by FHWA

Method	Description	Cons
Sun-over-the-shoulder check	• Evaluation of retroreflectivity used to assess quality of fresh markings. QA/QC conducted during daylight hours.	• Does not ensure specific retroreflectivity levels. • Does not have capability to tie the observation to a night retroreflectivity level.
Comparison panel technique	• Place a comparison panel with a known retroreflectivity level at or above a specific level next to an in-service marking. • Inspector views the combination at a specified distance. • If comparison panel appears brighter, marking must be replaced. • Conducted at night with traffic control.	• Deemed unsafe for roadways as it entails risk for inspectors.
Lane line count technique	• Count the number of lane lines visible from test vehicle multiplied by the lane line length and spacing.	• Places inspectors at risk. • Cannot accurately count lane lines. • Not possible on roadway sections without broken lines
Windshield marking technique	• A mark (tape) placed on the windshield at inspector sight line • Visibility distance from preview time of 2.2 seconds at posted or prevailing nighttime speed. • Inspector disqualifies segments where pavement marking cannot be seen at appropriate distance.	• Technique is not directly tied to specific retroreflectivity levels. • Minor changes in the driver position affect accuracy.
Control sign method	• Method to maintain the retrorefletivity of signs (MN MUTCD)	• Not recommended for pavement markings. • Uses in service markings for this method.
Comparison light box	• Composed of a box with a mirror and a light. • Handheld retroreflectometer provides a more objective measure of retroreflectivity and reduces user risk.	• Not appropriate to use a comparison light box. • Inspector must look away from the roadway for a significant period.

Next Steps

Step 1	Local agencies **research** and **review** methods
Step 2	Local agencies **initiate** and **troubleshoot** methods
Step 3	Local agencies **implement** methods
Step 4	**September 6, 2026 – Implementation deadline**