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Meeting Minimum Sign Retroreflectivity Standards

Local public agencies are responsible for installation and maintenance of traffic signs on local roads. The *Manual on Uniform Traffic Control Devices* (MUTCD) regulates traffic control devices for all public roads in the United States, sets standards and provides guidance. Local road officials have a legal responsibility to meet all standards outlined in the MUTCD, including the requirement to ensure minimum retroreflectivity for traffic signs. The Wisconsin Transportation Information Center publishes this fact sheet to help local officials as they work to adopt and implement a plan to meet the minimum retroreflectivity standards by June 13, 2014.

Retroreflectivity refers to how a surface, like a highway sign or pavement marking, reflects or bounces light back to a source. The MUTCD always required that highway signs be clear and visible both day and night. Since it is impossible to judge the night brightness of signs during the day, the most practical way to meet minimum requirements has been to use nighttime inspections and regular sign replacement.

The MUTCD did not have specific standards for minimum levels of retroreflectivity before 2009 and did not require the use of assessment and management methods for maintaining a defined minimum. The Federal Highway Administration added the standard in response to national statistics indicating the crash rate at night is nearly three times greater than during the day and nighttime crashes typically are more severe and lead to more fatalities. Changing demographics also play a part as the population of older drivers increases. Signs clearly visible under nighttime conditions communicate important safety information to all drivers.

Regulations and Deadline for Compliance

The 2009 MUTCD that set standards for minimum retroreflectivity levels of traffic signs included several compliance dates. As of a 2012 revision, the MUTCD requires that public agencies adopt and implement an ongoing plan to use an approved method to meet the retroreflectivity standards for regulatory and warning signs by June 13, 2014.

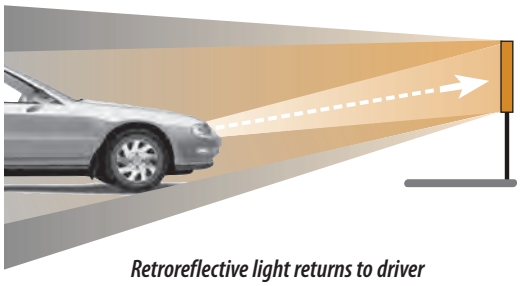
The standard does not require local officials to include ALL traffic signs in the June 2014 plan but those signs still must meet minimum retroreflectivity levels.

The 2009 MUTCD set minimum maintained retroreflectivity levels for each sign type and color. It requires agencies and officials with road maintenance responsibilities to use an assessment or management method to maintain sign retroreflectivity at or above minimum levels. The standard recognizes that some signs occasionally fall below the requirement. The key is to adopt an approved method and fully implement it with the goal of bringing all signs into compliance.

What is Retroreflectivity?

Highway signs are made with sheeting that directly reflects light back to the headlights. This property is called retroreflectivity. For many years, sign materials achieved this using glass beads encapsulated in plastic. Today most local agencies use sheeting materials manufactured with tiny prisms.

As with all retroreflective materials, effectiveness depends on the relative location of the headlights, the sign and the driver's eyes. Because a driver sits higher than the headlights, that reduces the amount of reflected light. For taller vehicles like vans, SUVs or commercial trucks, the increased distance between headlights and the driver's eye reduces the reflected light even more.



Retroreflective light returns to driver from headlight beam striking road sign.

The MUTCD based its retroreflectivity standards on experiments using older drivers driving at various speeds and in various kinds of vehicles to evaluate the visibility of traffic signs placed at proper mounting heights and offsets, with posts plumb and sign faces installed perpendicular to the road centerline.

Studies show that different colors on a sign, as either a background or a message, require different minimum levels of retroreflectivity to be effective. TABLE 1 presents minimum retroreflectivity requirements as measured values for different sign colors and sign types.

Maintaining Night Visibility of Critical Signs a Requirement

Implementation and continued use of an assessment or management method designed to maintain retroreflectivity at or above the established minimum levels in regulatory and warning signs.

– Section 2A.08 of the 2009 MUTCD

Maintaining Signs a Necessity

Objects that obscure signs, like overgrown vegetation or parked cars, can affect visibility. It is important to pay attention to these obstructions when evaluating the effectiveness of a sign in the field and take corrective action as needed.

Exposure to sunlight also affects the reflectivity of sign sheeting. Sign life may vary based on orientation to the sun and the type of sign sheeting material. While manufacturers warrantee Engineer Grade sheeting for seven years and newer prismatic sign materials for 10 to 12 years or longer, those warrantees generally do not a guarantee a particular sheeting will meet specific retroreflective standards.

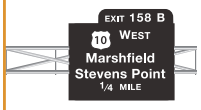
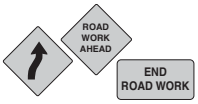
Sign color and type	Minimum level of maintained retroreflectivity (cd/m²)
WHITE on GREEN  Ground mounted	**WHITE ≥ 120** Engineer Grade not allowed. **GREEN ≥ 15** Engineer Grade ≥ 7 allowed.
 Overhead guide signs	**VARIES BY SHEETING TYPE**
BLACK on YELLOW or BLACK on ORANGE  Warning signs  Warning in Work zone	**YELLOW/ORANGE ≥ 50** Signs 48" or more and all bold symbol signs. Engineer Grade not allowed. **YELLOW/ORANGE ≥ 75** Signs less than 48" except symbol signs. Engineer Grade not allowed.
WHITE on RED  Stop, Yield, Wrong Way Do Not Enter, etc.	**WHITE ≥ 35** **RED ≥ 7** Contrast ratio of 3:1 or greater. (White retroreflectivity divided by red retroreflectivity)
BLACK on WHITE  Speed Limit, One Way U.S. Highway, etc.	**WHITE ≥ 50**

TABLE 1. Simplified version of MUTCD Table 2A-3 shows sign types and minimum retroreflectivity levels.

Compliance Methods

The MUTCD gives local agencies a choice of methods to use when complying with sign retroreflectivity standards. The methods fall under one of two categories—assessment or management. Approved assessment methods involve making nighttime visual inspections or taking optical measurements in the day with a retroreflective meter. Approved management methods use the age of a sign and expected sheeting life to replace signs.

The MUTCD requires local public agencies to select and implement one of these methods or a combination of methods for maintaining minimum retroreflectivity of regulatory and warning signs to meet the standards and the June 2014 compliance deadline.

- ☐ Assessment methods
  - – nighttime visual assessment
  - – measured sign retroreflectivity
- ☐ Management methods
  - – expected sign life
  - – blanket replacement
  - – control signs

Assessment Methods

The MUTCD outlines two approaches to assess retroreflectivity levels of existing signs and determine which need replacement. Routine testing by eye at night or with a meter that measures retroreflectivity give agencies data to use in a sign replacement program.

Visual Assessment

Consistent parameters, calibration signs and comparison panels are the three approved visual assessment methods. All involve night inspection to determine which signs do not meet minimum retroreflectivity levels and require replacement.

Visual nighttime inspection works best when done by two people, one to drive and evaluate sign visibility and the other to record

inspection findings on a list of signs. The inspection team should drive the road in both directions to view signs as the driving public does, travel at normal highway speeds and use low headlight beams. Ensure proper adjustment in the vehicle headlights. Useful tools include a clipboard, an inventory list of existing signs and a penlight. Conduct such inspections every year if resources allow.

Inspectors should categorize each sign as in good, marginal or poor condition. GOOD indicates a sign with an acceptable level of night visibility. A POOR rating calls for replacing the sign as soon as practical. Upgrading all MARGINAL signs is the ideal but, if not feasible, inspect them more often. Inspectors also should identify any signs obstructed by vegetation or other objects and schedule them for correction.

In detail, the visual assessment methods that meet the MUTCD are:

Consistent parameters: "old guy in a van"

- Use van, pickup truck or SUV model year 2000 or newer as the inspection vehicle. These vehicles have higher driver positions and newer headlight designs that replicate vehicles used in experiments to develop the standards.
- Use an inspector who is at least 60 years old.
- Identify if a sign is bright enough to give adequate time for drivers to safely respond. Using one inspector for this procedure creates a consistent approach to evaluating sign condition. Field tests confirm this as a conservative method compared to meter measurement of sign retroreflectivity.

Calibration signs

- Use any vehicle type and any age inspector.
- Use a set of calibration signs that are at the minimum level of retroreflectivity.
- Select the calibration signs of each color using a retroreflectivity meter. Signs removed from service are good source for calibration signs. Agencies also can

use new Engineer Grade signs for this purpose, but these are likely to produce more conservative inspection results.
- Position calibration signs consistent with normal sign mounting height and location.
- View calibration signs at normal highway speeds to establish a comparison for subsequent inspection in the field.
- Return to the calibration sign site periodically to refresh the eye's calibration during the inspection process.
- Protect calibration signs when not in use so their retroreflectivity does not change over time.

Comparison panels

- Use any type of vehicle and any age of inspector.
- Obtain comparison panels about 4″ x 8″ in size of sign material in each color that meet minimum retroreflectivity levels. Cut comparison panels from signs no longer in service that meet the standard or from new Engineer Grade signs.
- Conduct a night inspection to identify sign condition.
- Document signs rated GOOD; schedule replacements for signs rated POOR.
- Do additional evaluation of MARGINAL signs, attaching matched color comparison panels to the sign. View the sign at a distance of 25 feet holding a flashlight at eye level aimed at the sign. Mark for replacement any sign that does not appear to exceed the retroreflectivity of the comparison panels.
- Protect the comparison panels by storing them so that they are not exposed to light or dirt that can reduce retroreflectivity over time.

Of the three visual inspections methods, comparison panels require the least amount of judgment but it involves additional work with the attachment of comparison panels to MARGINAL signs. Both the comparison panel and calibration sign methods require obtaining signs at the minimum retroreflectivity level to use for comparison.

Measured Sign Retroreflectivity

This assessment method removes the judgment required when using one of the visual assessment options and it eliminates the need for night work. But it does require a retroreflectivity meter and an inspector well trained in its use. Purchasing a meter is a significant expense, but agencies can hire a contractor to take measurements on all existing signs, or rent or borrow a meter from another agency.

The steps in this method are:
- Measure the retroreflectivity of every sign: take four readings of each color and average them to establish a sign's retroreflectivity level.
- Compare the measured average retroreflectivity level for each color to the minimum retroreflectivity values in Table 2A-3 of the MUTCD (simplified version shown on previous page).

Management Methods

Agencies that use management methods can meet minimum requirements without inspecting the retroreflectivity of each sign. These methods use industry knowledge of typical sign life or testing of representative sample signs to identify those that need replacement. Because this does not involve inspection of all signs, agencies may take some signs out of service before they fall below minimum requirements or miss premature deterioration in other signs. Although these methods require significantly less field inspection time than assessment methods, a good sign program should include inspections to identify signs that are installed improperly, damaged, missing or obstructed by vegetation.

The three management methods are:

Expected Sign Life

- Replace signs at the end of their expected useful life.
- Establish expected useful sign life for each sheeting type and color.
- Use data from sign sheeting warranties, industry sheeting life studies or agency studies to establish sign life.
- Remove and replace signs when they reach the established useful life.
- Track when signs are due for replacement using a sign inventory or by marking installation dates on the back of signs.

Blanket Replacement

- Replace all signs in a specified area or all signs of a certain type on an established schedule. For example, replace all signs in a subdivision or replace all STOP signs in a jurisdiction.
- Establish a blanket replacement schedule based on expected sign life.

Control Signs

- Mount signs that include each sheeting type and color the agency uses in a test location or designate specific installed signs as test signs.
- Monitor sign retroreflectivity of test signs to determine the useful life of the each sheeting type and color. Establish a standard testing procedure using a retroreflectivity meter.
- Note installation dates and track age of all signs in the system with an inventory.

Combining Methods

The MUTCD allows a combination of assessment and management methods. One example is to use the consistent parameter assessment method to identify marginal signs and use a retroreflectivity meter to test them. Another example is to combine expected sign life for identifying older signs with a visual nighttime assessment to decide if specific signs of that age require replacement.

An agency also can begin using one method and switch to another method later. Local road officials may start with an assessment method, for example, and then change to a management method that relies on a sign inventory and reliable data on expected sign life.

Characteristics of an Approved Plan

Complying with the MUTCD requirement to have a plan in place by June 2014 for managing and maintaining minimum levels of retroreflectivity for regulatory and warning signs starts with documenting details about how the agency will implement the chosen assessment or management method. Include a statement that indicates the policy is to meet all MUTCD standards, including retroreflectivity. Agencies also should identify the kind of signs covered in the plan, set a target date for initial compliance and make sign replacements integral to budget planning.

Sign Sheeting Materials

Sign sheeting materials continue to evolve. For many years, Engineer Grade-type sheeting was the standard and many of these signs are still in use. Manufacturers now sell prismatic sign materials that increase sign retroreflectivity and durability. Since their effective life span is longer than Engineer Grade, these more expensive materials are gaining in popularity.

Because the initial retroreflectivity values of Engineer Grade sheeting are at or below the minimum retroreflectivity values required for yellow, orange and green signs, the MUTCD prohibits using the material for warning, work zone and green guide signs. Agencies can choose Engineer Grade for red and white regulatory signs, recognizing the material as only slightly above minimum retroreflectivity levels and not long lasting. As a result, most state and local agencies are using high-intensity prismatic material for new signs.

Agencies should stay informed about ongoing sign material developments and be prepared to compare the initial total cost—including installation—and the life expectancy of different sheetings types when selecting sign materials. Considering the costs of installation, signs made from longer lasting, but more expensive materials often cost less over time.

Create a Sign Inventory

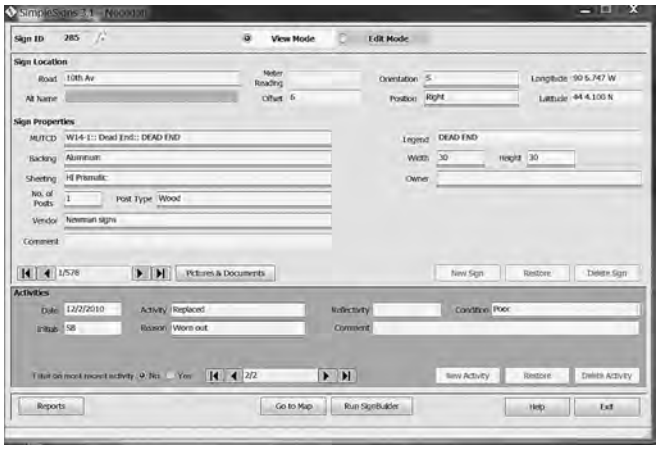
A sign inventory is useful for meeting sign replacement requirements, budgeting maintenance and overall sign management. There are a growing number of commercial computer-based sign inventory systems. Other options are computer spreadsheets, inventories on paper or recording data on stickers placed on sign backs.

Basic information in a sign inventory includes: sign location, height, offset, sign type, sheeting material, sign installation date and condition. Computer systems can use GPS data for sign location and mapping. A simpler approach for location is to use road name and mileage, cross street or address information. Gather data for an initial inventory by driving the road in each direction and recording the basic information on all existing signs. The safest approach is for two people to conduct this survey during the day.

Summary

Highway agencies are responsible for sign installation and maintenance programs that contribute to making the roads safe and accessible. Drivers need signs that are visible both day and night. While nighttime visibility is a long-established MUTCD standard, the 2009 update set standards that define specific values for sign retroreflectivity. The MUTCD also identifies the methods agencies can follow to bring their signs into compliance with new minimum levels.

The variety of practical assessment and management methods that are available offer agencies options to match their capabilities and budget resources. As local governments gain knowledge and experience in managing their sign replacement program using one or a combination of methods, the process of keeping all signs in compliance with minimum retroreflectivity standards should become part of routine highway and public works operations.



Screen shot of a computerized sign inventory page.

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