Arkansas Roads & Streets

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Technology Transfer Brief

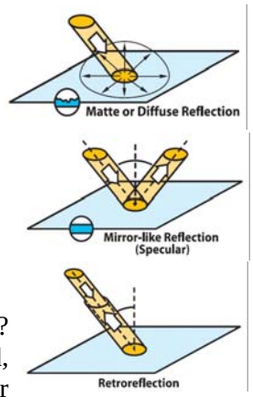
New MUTCD Criteria: Maintaining Minimum Sign Retroreflectivity

The 1993 DOT Appropriation Act states "The Secretary of Transportation shall revise the MUTCD to include a standard for a minimum level of retroreflectivity that must be maintained for traffic signs and pavement markings which apply to all roads open to public travel." Through this revision came Final Rule for minimum sign retroreflectivity. On Dec 21 2007, it was published in the Federal Register and became effective January 22, 2008. The revision is officially described as Revision 2 of the 2003 Edition of the MUTCD and its compliance dates, as established according to the Federal Register publication date, are as follows:

- Jan 22, 2012 - identify and begin using method(s)
- Jan 22, 2015 - replace identified regulatory, warning, and ground-mounted guide signs
- Jan 22, 2018 - replace identified street name and overhead guide signs

One of the changes made with this revision was the time period for implementation. Since some agencies have budget review cycles that do not fall within the previously proposed 2 – year implementation period, the Final Rule includes a change that extends the initial deadline from 2 to 4 years. However, the 7 and 10 year deadlines remain the same for sign replacement.

MUTCD Compliance periods
Final Rule: More time provided
4 yrs - identify and begin using method(s)
7 yrs - replace identified regulatory, warning, and ground-mounted guide signs
10 yrs - replace identified street name and overhead guide signs



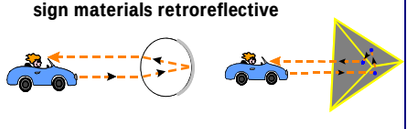
Retroreflectivity

The MUTCD talks about maintaining minimum retroreflectivity. So, what is retroreflectivity? First we'll start with a brief description of reflection. Reflection is the return of light, heat, sound, etc., after striking a surface. The two most common types of reflection are diffuse and specular reflection.

For example, when light hits a sheet of paper, it is reflected in all directions. This is diffuse reflection. With a mirror, the light reflects from the surface at the same angle (angle of incidence equals the angle of reflection). This is specular reflection. With retroreflection, as seen in the diagram above, light is reflected back in the direction that it came from. When the reflected light from objects reaches our eyes, it makes the objects visible to us. *Retroreflectivity* redirects a majority of the light shining on an object back toward the light's source.

Retroreflective Elements

- Glass spheres and microsized prisms are the current technologies used to make sign materials retroreflective

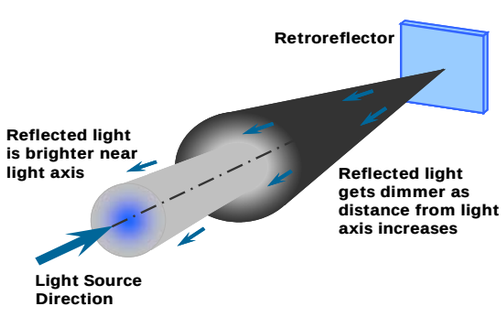


- The light is returned to the source in a cone shaped pattern

The retroreflected light is distributed in some beam pattern, usually a cone or near conical distribution. Because a driver's eyes are within this cone around the headlight, the sign becomes visible to the driver. Glass bead technology typically provides a more nearly conical distribution, while prismatic retroreflectors may be designed to produce quite different retroreflected beam patterns.

The retroreflective materials actually use diffused or mirror concepts to make it work. Light enters the sheeting cover, hits the glass bead, refracts (bends), and hits the back of the bead; for encapsulated sheeting there is a silver mirror surfacethere which uses mirror technology to reflect the light. The light then returns in the same direction it came. For engineering grade sheeting, the light must go beyond the back of the bead, thru more plastic, eventually reaching a mirror surface.

Cone of Retroreflection



The light redirected back toward the source is purposely spread out in a cone shape pattern so that the light reaches the drivers eyes and does not all go straight back to the vehicle headlamps. You can think of the light as being reflected back in a cone shape. The light is brighter in the center, which is called the illumination axis. As you move further away from the axis, the reflected light gets dimmer. In our case, the closer a driver's eyes are to the headlight, the brighter the sign appears.

Sign Retroreflectivity Maintenance

New MUTCD language states "public agencies or officials having jurisdiction shall use an assessment or management method that is designed to maintain sign retroreflectivity at or above the minimum levels in Table 2A.3." It also states "Compliance with the above STANDARD is achieved by having a method in place and using this method to maintain the minimum levels established in Table 2A-3. Provided that an assessment or management method is being used, an agency or official having jurisdiction would be in compliance with the above Standard even if there are some individual signs that do not meet the minimum retroreflectivity levels at every point in time." In short, public agency's in charge of maintaining their City's or County's traffic signs must have a plan to identify noncompliant traffic signs in place and put into use by the 4 year implementation period which ends Jan 22, 2012.

Visual Inspection

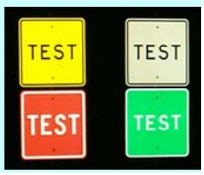
- **Nighttime visual inspection by trained inspector**
- **Conduct on regular basis**
- **Options:**
  - *Calibration signs*
  - *Consistent parameters*
  - *Comparison panels*

When planning sign retroreflectivity maintenance, one or more of the following methods should be used (as stated in the MUTCD. See MUTCD section 2A.09):

Visual Nighttime Inspections: The trained inspector should conduct their inspection during nighttime conditions in a moving vehicle on a regular basis. Research has shown that nighttime inspections can be effective, especially with trained/educated inspectors. Therefore, it is important that the inspector be trained in the proper procedures for conducting the evaluation. Nighttime visual inspections can be performed using calibration signs, consistent parameters or comparison panels.

Calibration Signs

- **"Calibrate" eyes with calibration signs**
- **Calibration signs are near minimum retro**
- **Evaluate signs compared to calibration signs**



Consistent Parameters

- **Inspection process replicates criteria used to develop minimum levels**
  - *Inspector – older driver (>55 years)*
  - *SUV type vehicle*
  - *Cutoff headlamps (properly aimed)*

Comparison Panels

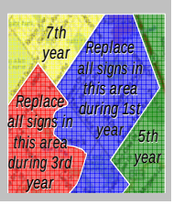
- **Small panels at/near minimum retroreflectivity levels**
- **Clipped to sign - viewed from distance**
- **Replace sign if panel is brighter**

Measured Sign Retroreflectivity: Sign's retroreflectivity is measured using a reflectometer. Procedures for measuring the signs can be found in ATSM E1709. Signs should be measured an average of 4 times and the average compared to minimum retro requirement. Those signs approaching a retro value near the minimums established by FHWA research should be scheduled for replacement.

Expected Sign Life: This is based on expected life of given sheeting material used in your geographical area. The expected life time could be determined by an agency's evaluation, or by borrowing the results of research from an area near your region. The end of life retroreflectivity value would be from FHWA research results. Set up a replacement program that ensures signs are replaced prior to no longer meeting the driver's needs. This method should be verified by periodic nighttime inspections. When signs are installed, the installation date is labeled or recorded so that the age of a sign is known.

Blanket Replacement

- **Replace all signs in an area/ corridor each replacement cycle**
  - *10 yr life, ➔ 10 areas*
  - *Annual replacement in each area*



Blanket Replacement: All signs in an area/corridor, or of a given type, should be replaced at specified intervals. This eliminates the need to assess retroreflectivity or track the life of individual signs. The replacement interval is based on the expected sign life, compared to the minimum levels, for the shortest-life material used on the affected signs. *NOTE: There will be times where not all signs will be in compliance based on sign replacement cycles.*

Control Signs: Replacement signs in the field are based on the performance of a sample of control signs. The control signs might be a small sample located in a maintenance yard or a sample of signs in the field. The control signs are monitored to determine the end of retroreflective life for the associated signs. All field signs represented by the control ample should be replaced before the retroreflectivity levels of the control ample reach the minimum levels.

Other methods: Agencies may use any combination of the above mentioned methods or other methods developed based on actual engineering studies.

For more information about sign and marking retroreflectivity go to www.fhwa.dot.gov/retro or www.retroreflectivity.net. Contact information for subject matter experts at FHWA is Greg Schertz at 720-963-3764 (Retroreflectivity Team Leader), Carl Andersen at 202-493-3366 (Research Office), and Matt Lupes at 202-366-6994 (Safety Office).

Information gathered from Revision 2 of the 2003 Edition of the MUTCD and Sign Retro Rule Presentation from the office of Matt Lupes, FHWA.

Arkansas State Highway and Transportation Department
Attn: Danny Moore, Technology Transfer Program
P.O. Box 2261
Little Rock, Arkansas 72203-2261

Contact
Danny Moore at (501) 569-2380
danny.moore@arkansashighways.com