UNH T² Center Technical Note

Signage & Retroflectivity

By Christopher Bourque, Project Assistant

Introduction

Traffic control devices (TCDs) are essential for safe roads, especially at night. In order to be most useful, they must be maintained and clearly visible. The Federal Highway Administration (FHWA) plans to revise the Manual on Uniform Traffic Control Devices (MUTCD) to require minimum levels of retroreflectivity.

The compliance date for achieving minimum levels of retroreflectivity for traffic signs has not been set. FHWA will publish the final rule on 11/30/07. (See page 4 of this technical note for the minimum proposed levels.)

Signs during the day and the same signs at night.

Why Retroreflectivity is Important

Retroreflectivity is a sign and pavement marking technology that reflects light on the sign or pavement marking back towards the light source at the same angle.

Retroreflective TCDs save lives. Annual fatalities on US highways have declined from 50,331 in 1978 to 42,643 in 2003, this is in part due to retroflective devices. Approximately 50% of fatal crashes occur at night. According to statistics:

- The night crash rate is three times higher than day-time crashes.
- Drivers are likely to be more fatigued and intoxicated at night.
- Visual cues that delineate roadway alignment are harder to see at night
- Regulatory, warning, and guidance information is compromised under dark conditions or when headlight illumination is less than optimal.
- Glare from opposing traffic can adversely affect the driver's ability to detect changes in road alignment or to see TCDs.
- Adverse weather further reduces night visibility of the

road and TCDs.

- The driving population is aging. Visual acuity decreases as a person ages

How it Works

Retroreflectivity uses prisms or beaded coatings to reflect the light, that contacts the sign surface, back at the light source rather than deflected away. The prisms or beads capture light, refract it, and return it.

To be able to see, people need a certain amount of light. Light must be reflected off an object and enter the eye for vision to occur. As people age, the amount of light needed to see properly increases considerably. Studies show that starting after age 20, the amount of light needed to see, doubles every 13 years.

Many vehicles are equipped with cut-off headlights, which are flat on the top rather than round. Cut-off headlights produce very little forward light. Therefore the headlights produce less light on the sign, making it more difficult to see.

Sheeting Materials

There are four types of retroreflective sheeting materials:

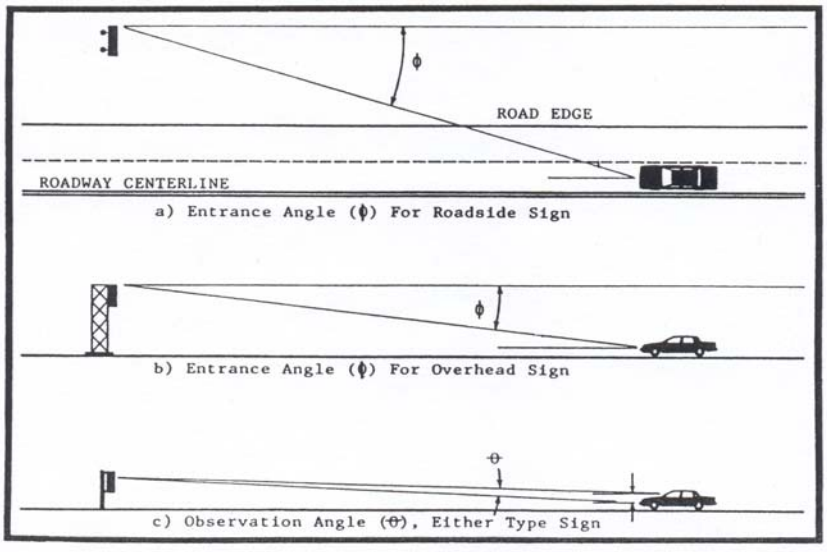
- Type 1 "engineering grade" is a medium-intensity retroreflective sheeting that utilizes enclosed lens glass-bead sheeting
- Type 2 "super engineering grade" is a medium-intensity retroreflective sheeting that uses enclosed lens glass-bead sheeting
- Type 3 high-intensity retroreflective sheeting using embedded lens glass-bead sheeting retroreflective material
- Type 4 high-intensity retroreflective sheeting that uses nonmetal micro-prisms for retroreflectivity.

Glass beads in type 1 and type 2 sheeting materials are set into an adhesive material, usually a sticky vinyl. In type 3, embedded glass-beads are enclosed in a layer of plastic resin and attached to an adhesive. In type 4, micro-prisms are enclosed in a layer of resin. All of these sheeting materials are surrounded by a protective liner. The materials differ in the amount of light they reflect. Type 4 is the most retroreflective and type 1 the least.

Increasing and Maintaining Sign Visibility

When a sign no longer meets minimum retroreflectivity standards, a municipality may repair or replace it.

One method to increase sign visibility is to light the sign or use overhead light fixtures, such as street lights, to illuminate a sign. These methods are far more costly than using retroreflective materials.

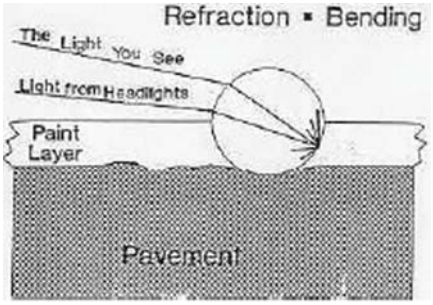


The top image illustrates no retroflectivity as the light is extremely reflect away from the driver. The bottom image shows near optimum retroreflectivity.

Managing Retroreflectivity

FHWA suggest the following management and assessment methods for agencies to use to maintain traffic signs. Combining two or more of the proposed methods is acceptable, depending on the agency size and available resources.

A. Visual Nighttime Inspection The retroreflectivity of an existing sign is assessed by a trained sign inspector. Inspection is conducted from a moving vehicle at night. Replace



This image demonstrates retroreflectivity in pavement markings. It follows the same principles as signs, light is reflected off the glass bead and back towards the light source.

signs below minimum retroreflectivity levels.

B. Measure Sign Retroreflectivity Sign retroreflectivity is measured using a retroreflectometers. Replace signs below minimum retroreflectivity levels.

C. Expected Sign Life When signs are installed, the installation date is labeled or recorded. The sign's age is compared to the expected sign life. The expected sign life is based on the experience of sign retroreflectivity degradation in a geographic area compared to the minimum levels. Replace signs older than the expected life.

D. Blanket replacement Replace all signs in an area/corridor, or of a given type, 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.

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

Place priority for replacing signs at critical areas such as stops, crash sites, and curves. Priority may also be given to the necessity of the signs:

- **High Priority Signs** Stop, Do Not Enter, and Wrong Way signs.
- **Middle Priority Signs** Warnings signs such as curve or merge signs
- **Low Priority Signs** Informational signs such as signs indicating exits or other directions.

Implementation is costly. There are low-cost user-friendly tools for local agencies. One downloadable tool is a safety software suite available at: http://waylon.engr.usu.edu. This suite is royalty free, GIS based, and includes a sign management module as well as a crash analysis module. Technical support is handled through a user forum.

It is crucial to replace signs to maintain legibility, contrast, color, placement and other such physical qualities of the signs. A municipality may choose to use any of these assessment methods or combine methods to suit their needs and budget.

Sources:
Cunard, Richard. *Traffic Signing Handbook.* Institute of Transportation Engineers. Washington D.C., United States. 1997.
Pietrucha, Martin *Traffic Sign Retroreflectivity "Sign Retro 101"*. Federal Highway Administration Visibility Team Power Point. 2/02/07.
How Safe Are Your Roads at Night? Mass Interchange Newsletter. Bay State Roads Program: Local Technical Assistance Program (LTAP) Vol 18 Issue 3.
Retroreflectivity. Tech Note #43. Bay State Roads Program: Local Technical Assistant Program (LTAP) Fall 2006.

Special Thanks to G. Stuart Thompson, UT LTAP for his help with this article.

Technology Transfer Center
New Hampshire LTAP at UNH