

*North Dakota State Township
Board Meeting
December 7, 2009*

NDLTAP

UPPER GREAT PLAINS TRANSPORTATION
INSTITUTE, NDSU

**TRAFFIC SIGN
RETROREFLECTIVITY
REQUIREMENTS**



Retroreflectivity Requirements

- ◆ Discussion Items
 - ◆ Legislation
 - ◆ Why it was Implemented
 - ◆ Visibility Issues
 - ◆ Define Retroreflectivity
 - ◆ Regulations Requirements

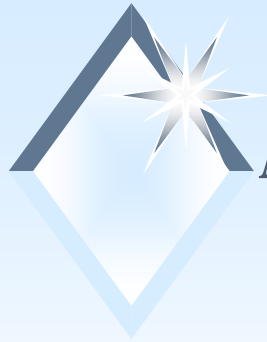


Congressional Legislation

1993 DOT Appropriations Act

“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.”



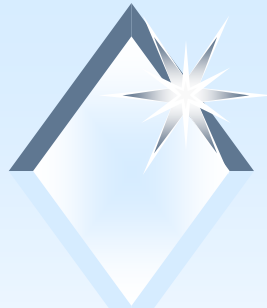


New MUTCD Language

Maintaining Minimum Retroreflectivity

In Dec or 2007 the Federal Register added a new standard to the MUTCD in Section 2A.09

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



Federal Study on Cost to Local Agency

- ◆ Estimates are based on the majority of sign replacements as part of normal maintenance
- ◆ 7 Year Implementation Period for Regulatory, Warning and Guide Signs
- ◆ 10 Years to replace Street Name and Overhead Guide Signs
- ◆ Total Cost \$ 37.5 Million for entire Nation
- ◆ Cost is minimal to each local agency



Another Federal Study





Are the New Regulations Necessary?





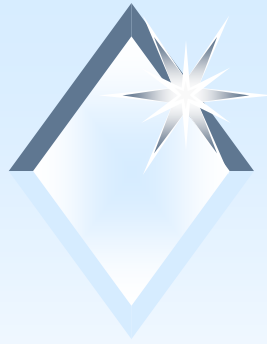
Why do we need Signs to be Retroreflective?

- ◆ About 42,000 people die each year on US roads.
- ◆ Rural roads are the most dangerous roads in the nation.
- ◆ 28% of all vehicle miles traveled occur on rural, non-interstate roads, yet 52% of all fatalities occur there.
- ◆ Night crash rate 3 times higher than day.



Why do we need Signs to be Retroreflective?

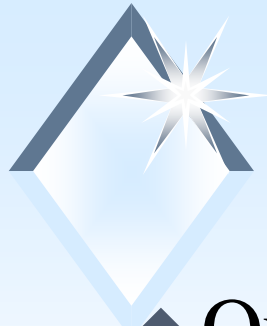
- ◆ 25% of travel occurs at night, 50% of fatal crashes happen during night time hours.
- ◆ Driver population is aging.
- ◆ A 59 year old driver needs 8 times more light than a 20 year old to see the same object.
- ◆ Delineation treatments are the most cost effective way to reduce crashes and fatalities.



Nighttime Visibility Issues

- ◆ Headlamps
 - ◆ Amount of light for signs
- ◆ Driver
 - ◆ Age & Visual capabilities
- ◆ Sign Retroreflectivity
- ◆ Vehicle Size





Headlamps

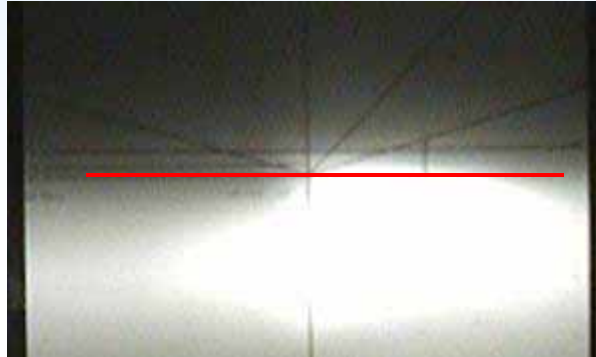
- ◆ Out of control of traffic engineers
- ◆ Evolving considerably in last decades



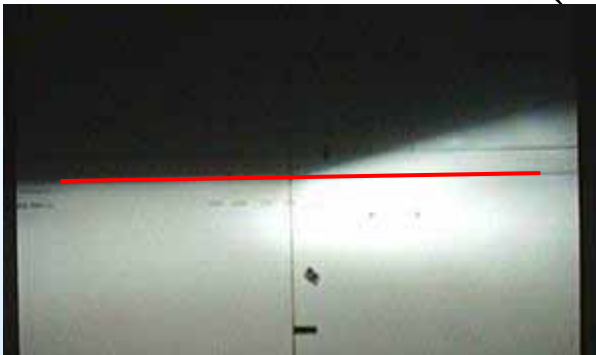


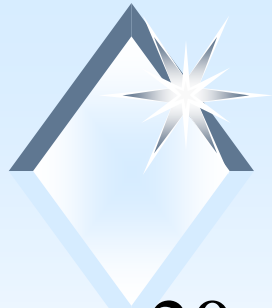
Headlamps

◆ Older Sealed Beam Pattern



◆ Modern Cutoff Pattern (Reduces Glare)

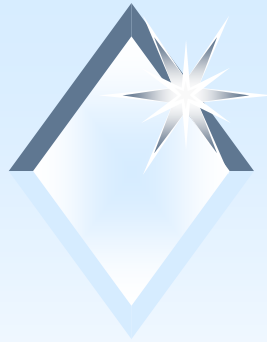




Older Drivers

- ◆ 20.6 million drivers age 70+ in 2006
 - ◆ 48% increase from 1990 to 2006
 - ◆ 1990 — 8% of drivers were 70+
 - ◆ 2006 — 10.2% of drivers were 70+





Nighttime Driving

Daytime

Many cues available

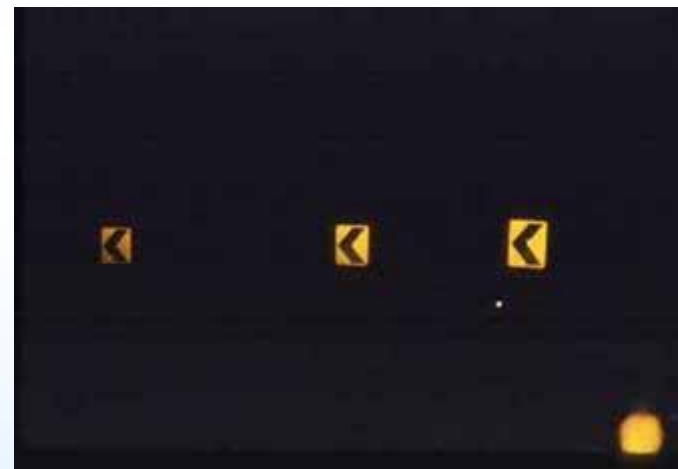
Driver task relatively easy



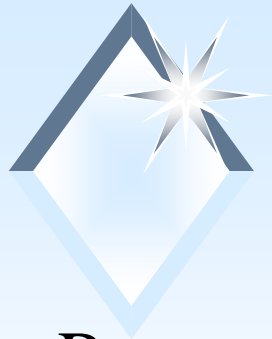
Nighttime

Few cues remain

Task more difficult



Retroreflectivity provides nighttime guidance

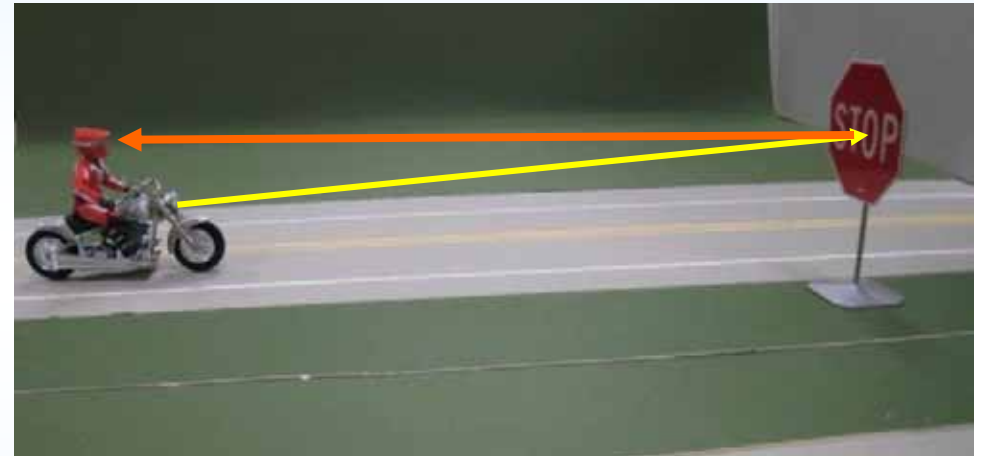


Sign Retroreflectivity,

What is it?

Informal Definition

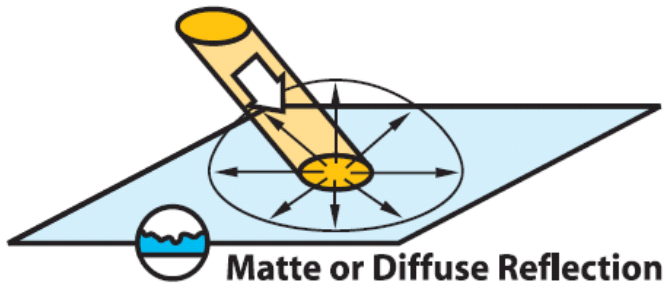
- ◆ Retroreflectivity is the ability of a material to bounce light back in the direction it came from.
- ◆ A way to measure the efficiency of a material



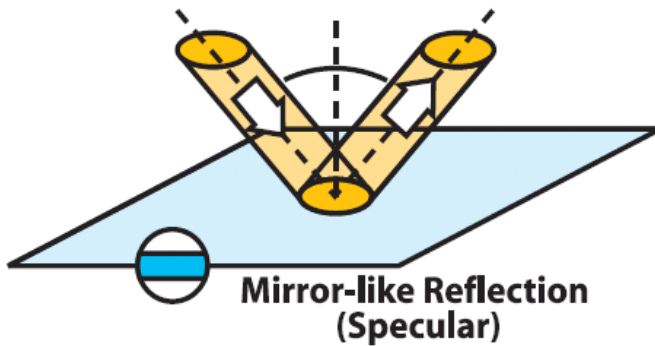
$$\frac{\text{Light OUT of sign}}{\text{Light INTO sign}} = \text{Retroreflectivity}$$



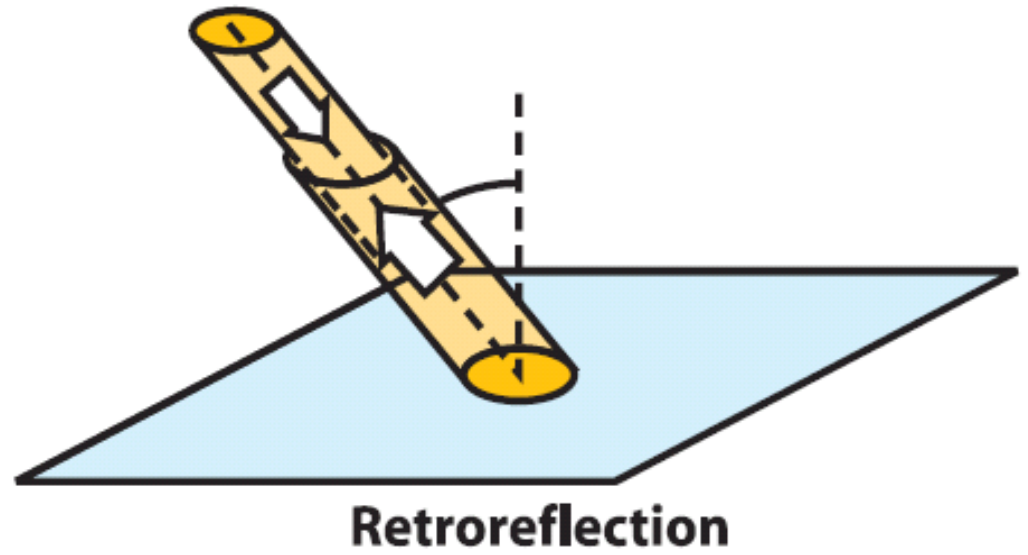
*RETRO*reflection



Matte or Diffuse Reflection



Mirror-like Reflection
(Specular)

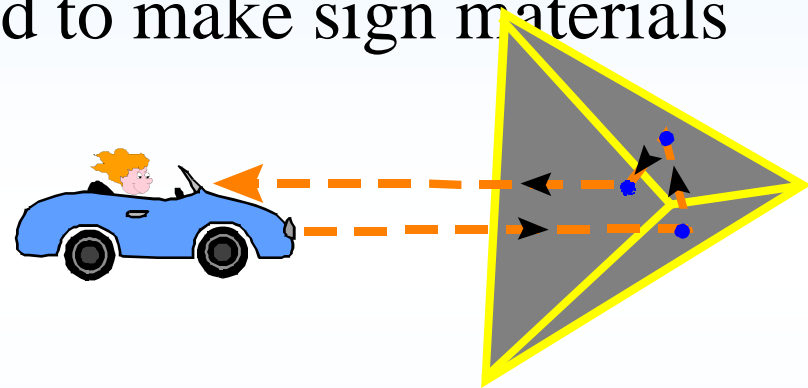
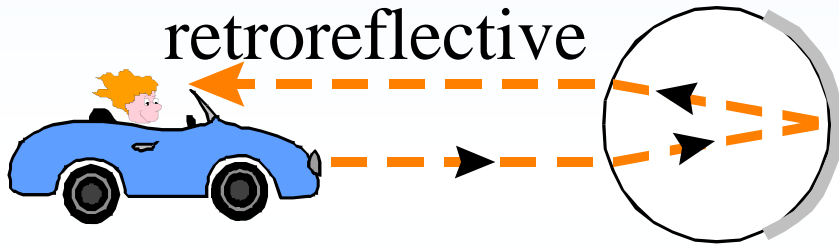


Retroreflection

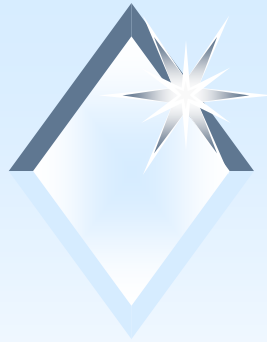


Retroreflective Elements

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

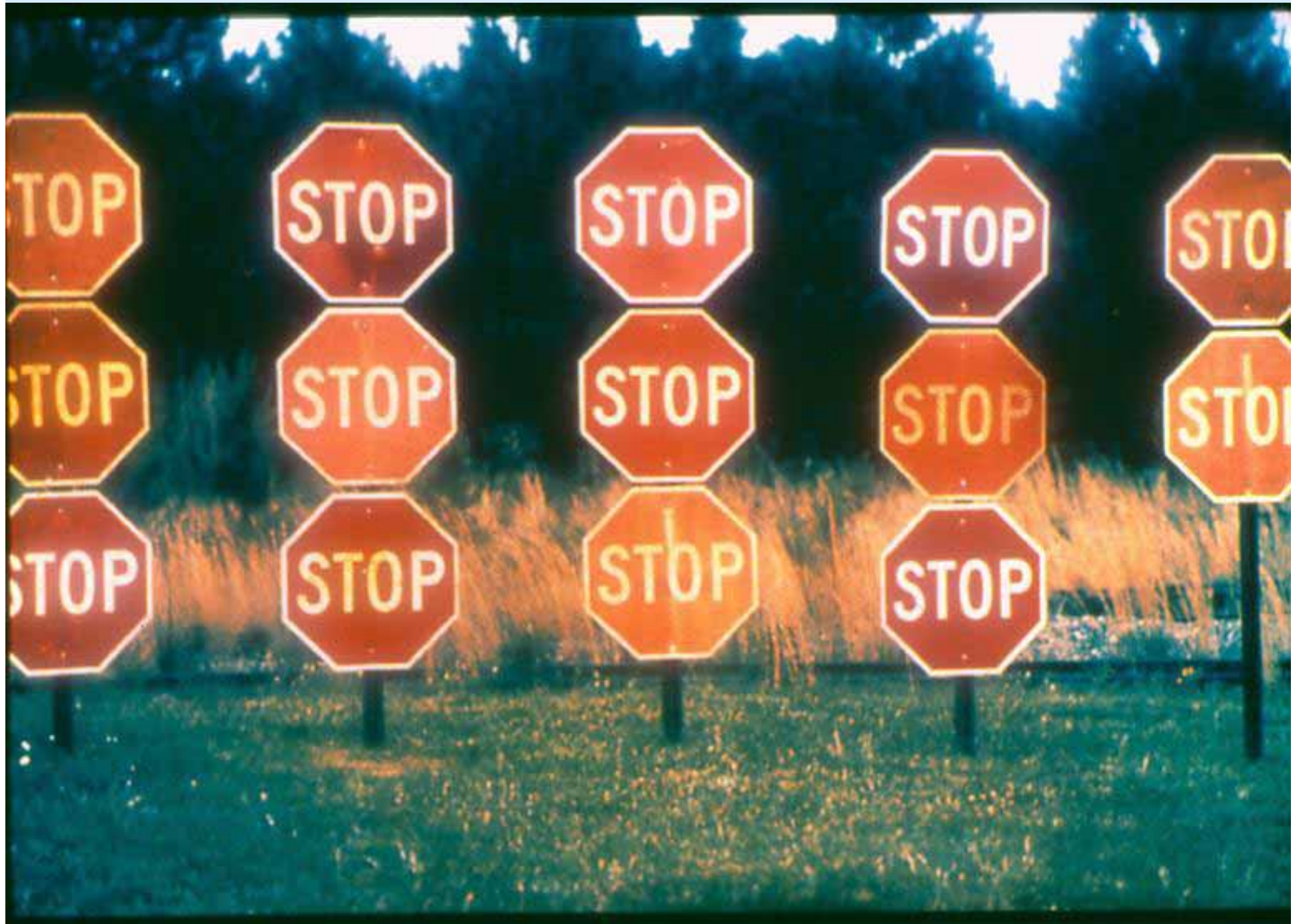


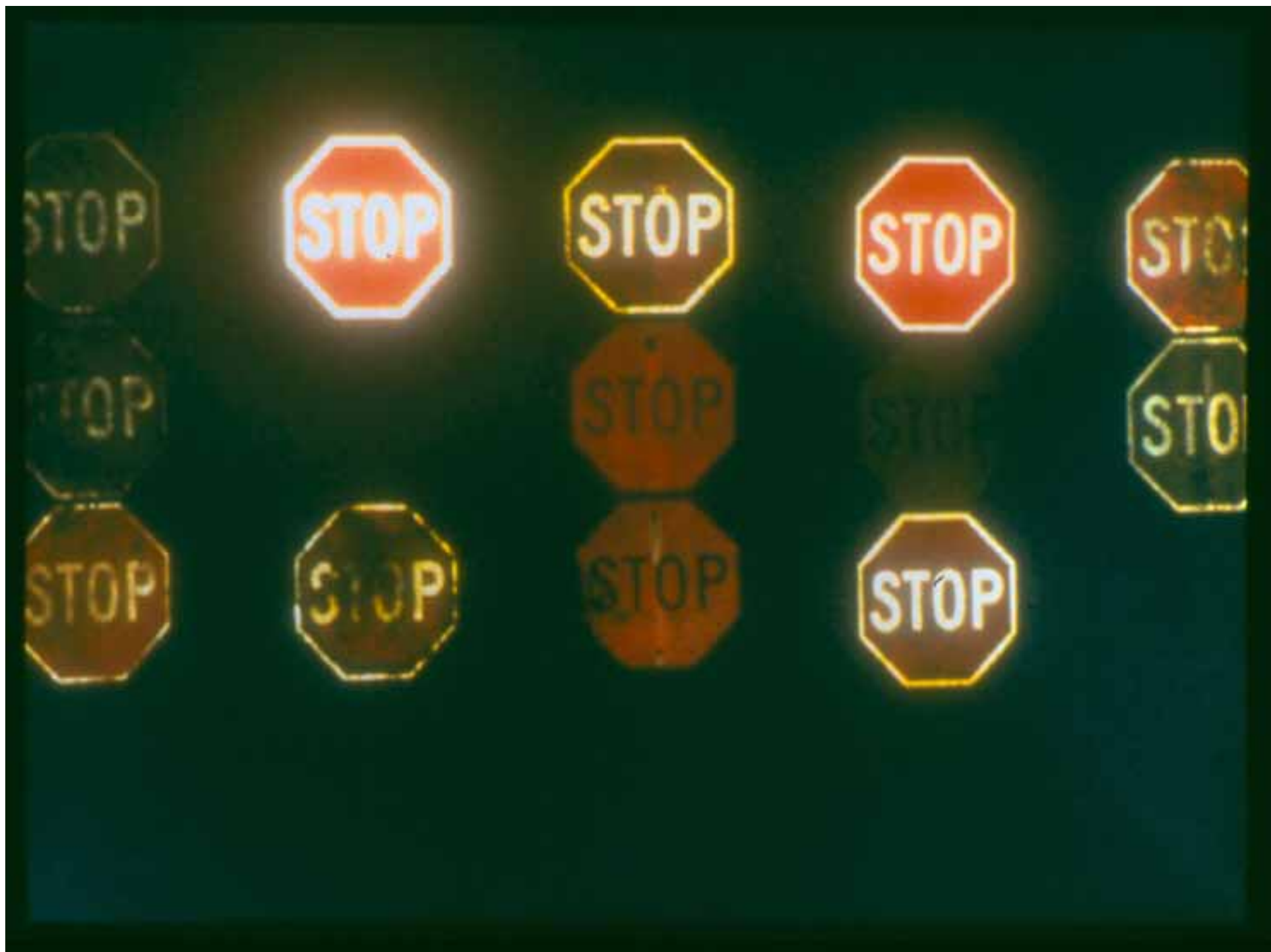
- ◆ Glass beads allow the light to be returned to the source in a cone shaped pattern
- ◆ Prisms can be designed to allow the light to be returned in patterns similar to a cone



Retroreflectivity

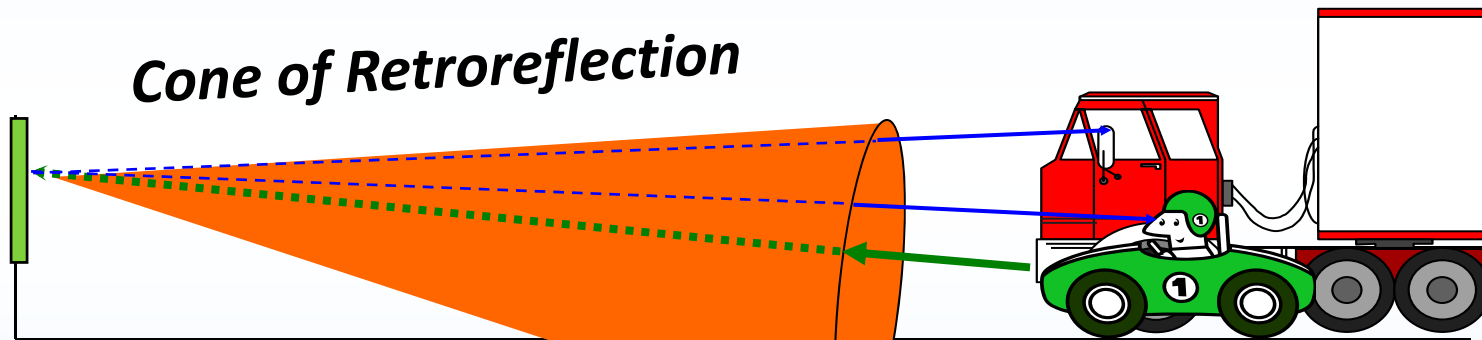
- ◆ Retroreflectivity can deteriorate
 - ◆ Weather
 - ◆ Sunlight/UV light
 - ◆ Fungus/mold
 - ◆ Vandalism
- ◆ Signs may look good in daylight, but no longer reflect light at night.

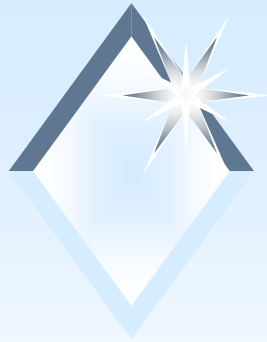






Vehicle Size & Cone of Retroreflection



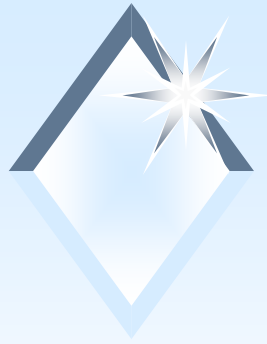


New MUTCD Language

Section 2A.09 Maintaining Minimum Retroreflectivity

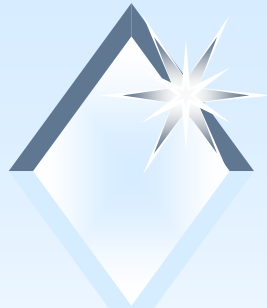
- ◆ “Standard:
 - ◆ Public agencies or officials having jurisdiction **shall** use an assessment or management method that is designed to maintain sign retroreflectivity at or above the minimum levels in Table 2A-3”

- ◆ There is no enforcement agency



No formal enforcement of Retroreflectivity Requirements





New MUTCD Language

Section 2A.09 Maintaining Minimum Retroreflectivity

Compliance... is achieved by having a method in place and using the method to maintain the minimum levels established in Table 2A-3. Provided that... a method is being used, an agency would be in compliance... even if there are some individual signs that do not meet the... levels at a particular point in time.

New MUTCD Table 2A.3

Minimum Maintained Retroreflectivity Levels

Sign Color	Sheeting Type (ASTM D4956-04) ①				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
White on Green	W* G ≥ 7	W* G ≥ 15	W* G ≥ 25	W ≥ 250; G ≥ 25	Overhead
	W* G ≥ 7	W ≥ 120; G ≥ 15			Ground-mounted
Black on Yellow or Black on Orange	Y*; O*	Y ≥ 50; O ≥ 50			②
	Y*; O*	Y ≥ 75; O ≥ 75			③
White on Red	W ≥ 35; R ≥ 7				④
Black on White	W ≥ 50				—

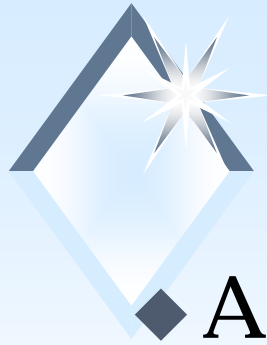
① The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.

② For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs

③ For text and fine symbol signs measuring less than 1200 mm (48 in)

④ Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity)

* This sheeting type should not be used for this color for this application.



Assessment or Management Methods

◆ Assessment Methods

◆ Nighttime Visual Inspection

- ◆ Calibration, Comparison or Consistent Parameters

◆ Retroreflectivity Measurements

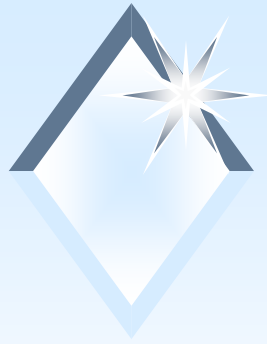
◆ Management Methods

◆ Expected Sign Life

◆ Blanket Replacement

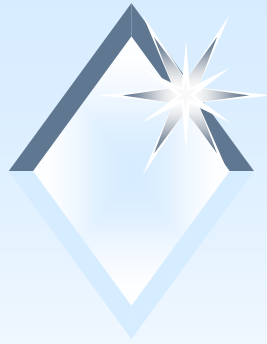
◆ Control Signs

◆ Other methods



Nighttime Visual Inspections

- ◆ Requires trained inspectors.
- ◆ Conduct inspections at normal speed.
- ◆ Use low-beam headlights, minimize interior lighting.
- ◆ Evaluate sign at typical distance that allows adequate response time.



Nighttime Visual Inspection Calibration signs procedure

- ◆ Requires Calibration Sign for each Color of Sign.
- ◆ Must store and maintain calibration signs properly to prevent deterioration.
- ◆ View at typical viewing distance using inspection vehicle prior to Nighttime Inspection.
- ◆ Perform Inspection



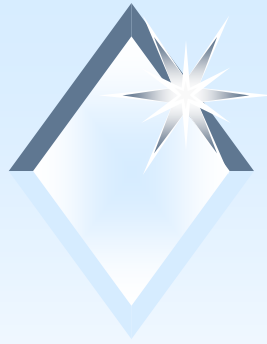
Nighttime Visual Inspection Comparison Panels Procedure

- ◆ Use Comparison sign panels fabricated at or above minimum levels.
- ◆ When nighttime inspection identifies a sign as marginal, a comparison panel is attached.
- ◆ Sign and comparison panel is viewed and compared by inspector from vehicle at typical distance.



Nighttime Visual Inspection Consistent Parameter Procedure

- ◆ Use SUV or Pickup to conduct nighttime inspections.
- ◆ Use a vehicle model year 2000 or newer for the inspection.
- ◆ Use an inspector who is at least 60 years old.



Retroreflectivity Measurements

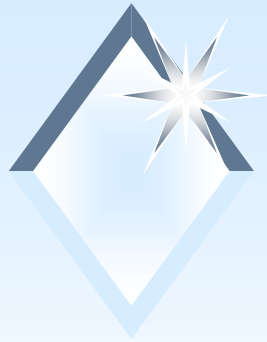
- ◆ Take Retroreflectivity Measurements.
- ◆ Take measurements during the daytime.
- ◆ Use a Calibrated Retroreflectometer.
- ◆ Follow ASTM E1709, Standard Test Method for Measurement of Retroreflective Signs.



Maintenance Management Methods

◆ Expected Sign Life

- ◆ Replace signs before they reach the end of their service life.
- ◆ Record date installed. Compare age to expected sign life. Replace old signs.
- ◆ Requires method to track sign age.
- ◆ Can be as simple as placing a sticker on sign to show when fabricated or installed



Maintenance Management Methods

◆ Blanket Replacement

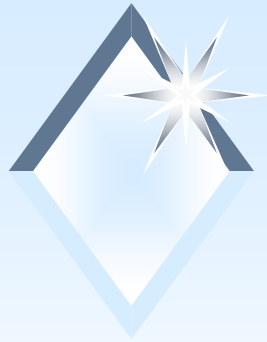
- ◆ Replace all signs in area or of a given type at specified intervals.
- ◆ Replacement interval can be based on expected sign life.
- ◆ The major drawback is the potential amount of waste if relatively new signs are removed during a normal replacement cycle.



Maintenance Management Methods

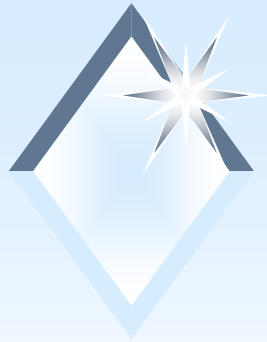
◆ Control Signs

- ◆ Replacement of signs is based on the performance of a sample of control signs.
- ◆ Control signs can be in-service signs or signs in a maintenance yard.
- ◆ Agency periodically check retroreflectivity of control signs with an assessment method.



Maintenance Management Methods

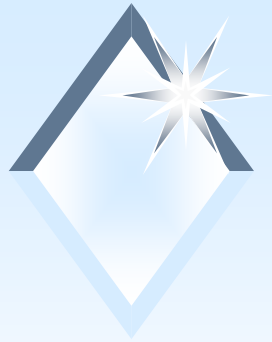
- ◆ **Other methods**
 - ◆ Other methods can be combinations of the other methods listed as long as the method is reasonable and documented.
 - ◆ Other methods based on engineering studies may be used.
- ◆ **Whichever method you choose you must remember to document what you do.**



EXAMPLE of Life/Cycle Costs

(costs are very rough estimates)

- ◆ Assume cost to replace a sign includes substrate, sheeting & labor
- ◆ Cost per year might look like:
 - EG: \$160 / 0 (est. life) = Sheeting doesn't meet minimums
 - SEG: \$164 / 7 yrs (est. life) = \$23 / yr ??
 - HI: \$168 / 12 yrs (est. life) = \$14 / yr ??
 - Pris: \$192 / 16 yrs (est. life) = \$12 / yr ??
- ◆ Add in potential cost of traffic hazard



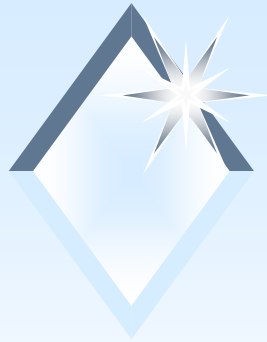
Compliance Periods

From “Effective” Date of Final Rule (January 22, 2008):

- ◆ **Establish and implement method(s)**
 - ◆ 4 yrs (January, 2012)

- ◆ **Replace identified regulatory, warning, ground-mounted guide signs (except street-name)**
 - ◆ 7 yrs (January, 2015)

- ◆ **Replace identified street name & overhead guide signs**
 - ◆ 10 yrs (January, 2018)



Risk Management

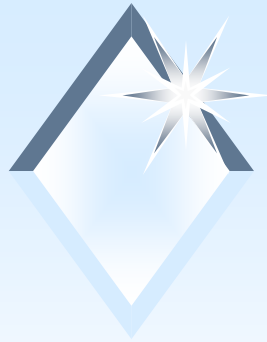
- ◆ With new rules, agencies are concerned about their risk of tort liability.
- ◆ Past experience has shown that agencies can limit their risk by having a reasonable process in place to cover their responsibilities.
- ◆ The key to Tort Liability is Good Records.



What Should I Do Next?

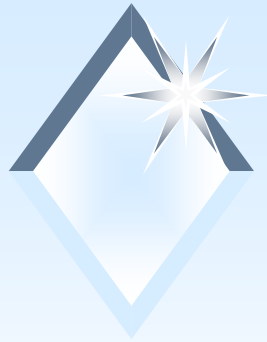


Act casual,
say nothing
and hope no one
notices, or ?



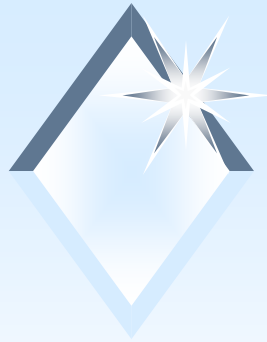
What should I Do Next?

- ◆ Identify methods and procedures adaptable to existing practices.
- ◆ Determine which inspection method is best for you.
- ◆ Adopt minimum requirements to serve as a baseline for decision making.



What Should I Do Next?

- ◆ Train inspectors
- ◆ Implement maintenance method(s)
- ◆ Decide on sheeting types
 - ◆ Consider initial and life cycle costs
- ◆ Budget for future sign replacement
- ◆ Manage your sign information effectively.



Computer Software

- ◆ Sign Inventory & Management Program
(Version 7.0) *by Russ McDaniel*
- ◆ Free Copy available online at:
www.ndltap.org
- ◆ *Will now run with Microsoft's Windows XP,
VISTA and Windows 7 operating system.*