

Conducting Sign Retroreflectivity Inspections

Training for Conducting Visual Sign Retroreflectivity Inspections and Measuring Retroreflectivity of Traffic Signs

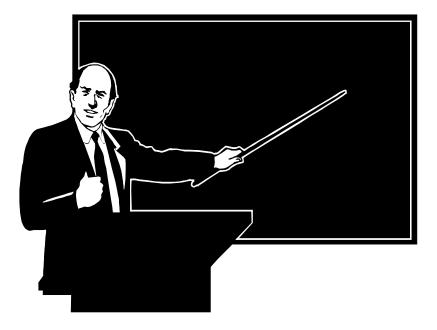
Ground Rules

- Facilities
 - Restrooms, drinks, snacks, phones
 - Other considerations
- Cell phones and pagers on silent
- Ask questions and make comments to the group as they occur to you
- Be considerate of others

Course Instructor(s)

Names

– Short bio



Participant Introductions

Name

- Agency
- Position/duties



Purpose of Course

- Provide background information
- Describe MUTCD
- Review <u>new</u> MUTCD minimum retroreflectivity requirements
- Understand sign inspection methods that can be used to evaluate sign retroreflectivity in compliance with new requirements.
- Learn traffic sign inspection techniques that can assess retroreflectivity

Content & Schedule

ΤΟΡΙϹ		TIME
•	Welcome	15
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•	Retroreflectivity	40
•	New retroreflectivity requirements	15
•	Training Slides	
	 Visual Inspection Methods 	
	 Comparison Panel Procedure 	30
	 Calibrated Signs Procedure 	30
	 Consistent Parameters Procedure 	30
	 Retroreflectivity Measurements 	30
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Questions



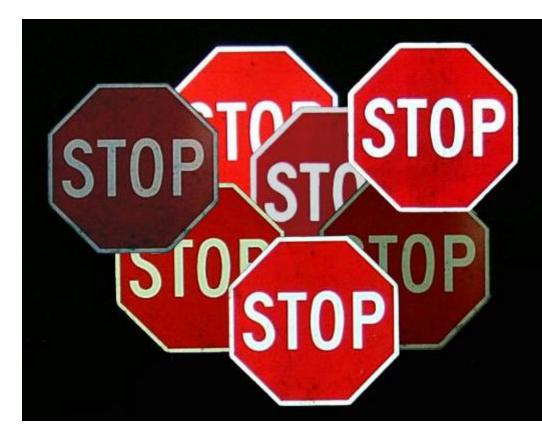


Why Do We Install Signs?

Required by MUTCD?

Engineering Decision? YES!

Why? To help drivers safely navigate roadways (including older)



Key Issue: Older Drivers

- 18.9 million drivers age 70+ in 2000
- 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+

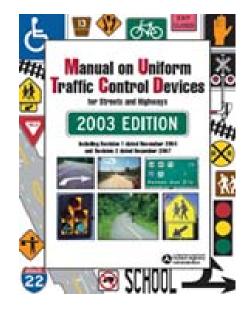


 "Older" driver population will continue to grow as baby-boomers age

MUTCD

Manual on Uniform Traffic Control Devices

- MUTCD applies to all roads .. "open to public travel"
 - includes toll roads and roads within shopping centers, parking lots, airports, sports arenas, and other similar business and recreation facilities that are privately owned but where the public is allowed to travel without access restrictions.



MUTCD

Section 2A.06 – Design of Signs

 The basic requirements of a highway sign are that it be legible to those for whom it is intended and that it be understandable in time to permit a proper response. Desirable attributes include:

- High visibility by day and night; and
- High legibility (adequately sized letters or symbols, and a short legend for quick comprehension by a road user approaching a sign).

MUTCD

- Section 2A.08 Retroreflectivity or Illumination
 - ...signs shall be retroreflective or illuminated to show the same shape and similar color by both day and night, unless specifically stated otherwise...
 - The requirements for sign illumination shall not be considered to be satisfied by street or highway lighting.
- The responsibility for the design, placement, operation, <u>maintenance</u>, and uniformity of traffic control devices shall rest with the public agency or the official having jurisdiction.

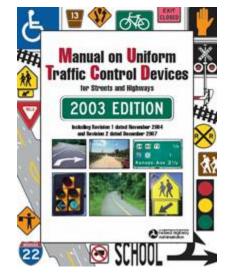
MUTCD Sign Maintenance

MUTCD Section 2A.22 Maintenance

Maintenance activities should consider proper position, cleanliness, legibility, and daytime and nighttime visibility (see <u>Section 2A.09</u>). Damaged or deteriorated signs should be replaced.

To assure adequate maintenance, a schedule for inspecting (both day and night), cleaning, and replacing signs should be established.

Steps should be taken to see that weeds, trees, shrubbery, and construction, maintenance, and utility materials and equipment do not obscure the face of any sign.



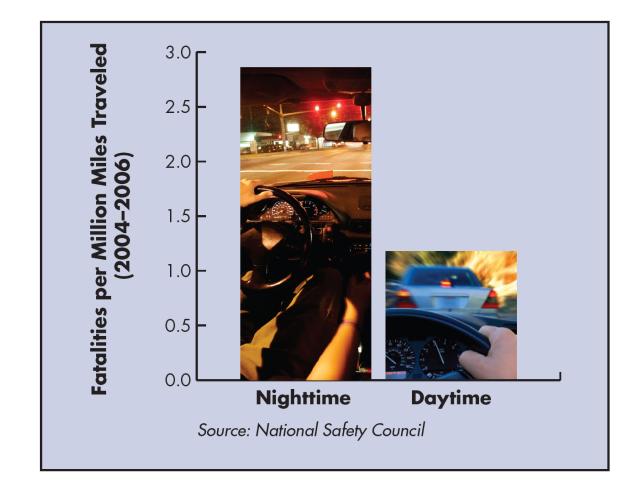
More than just Retroreflectivity

Reasonably safe for day or night travel?

MUTCD Principles:

- Fulfill a need;
- Command attention;
- Convey a clear, simple meaning;
- Command respect from road users; and
- Give adequate time for proper response.

Night Travel and Crashes



Nighttime Driving

Daytime Many cues available Driver task relatively easy

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Nighttime Few cues remain Task more difficult



Retroreflectivity provides nighttime guidance

Retroreflective Signs



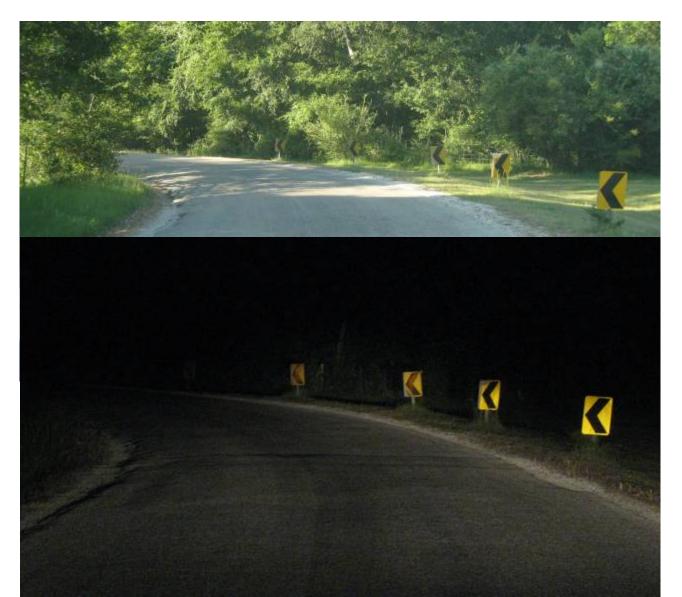
Another Day/Night Example



Another Example





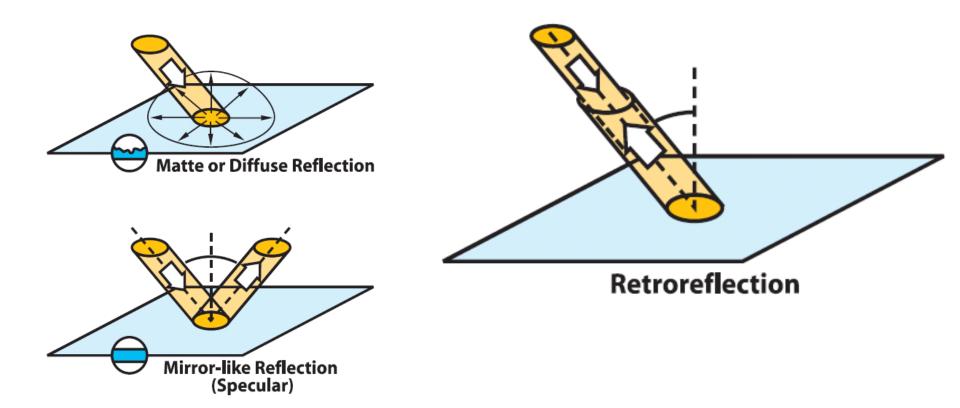






Retroreflectivity Concepts

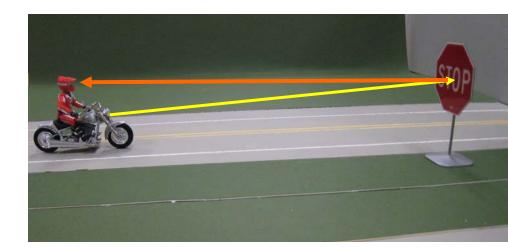
RETROreflection





Retroreflection

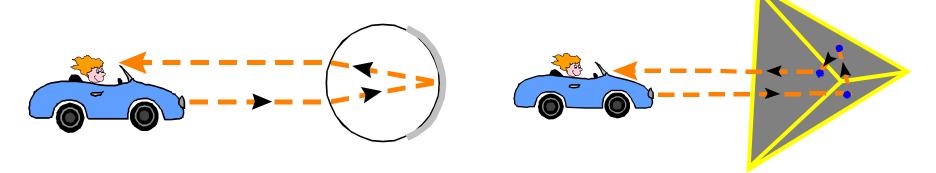
- A ratio of the amount of light returned from a sign versus the amount hitting the sign
- A way to measure the efficiency of a material



Light OUT of sign Light INTO sign = Retroreflectivity

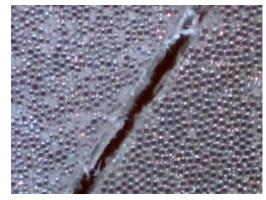
Retroreflective Elements

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

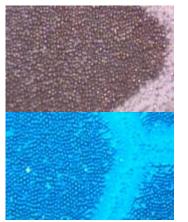


• The light is returned to the source in a cone shaped pattern

Sign Sheeting Materials



Engineering Grade



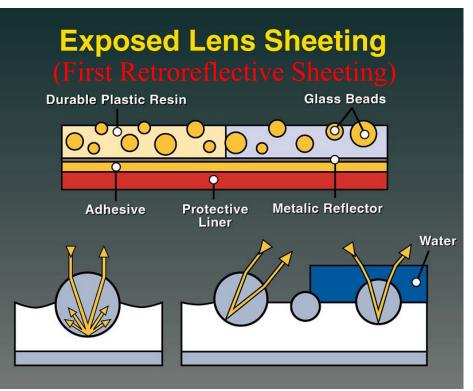
Hi-Intensity Beaded



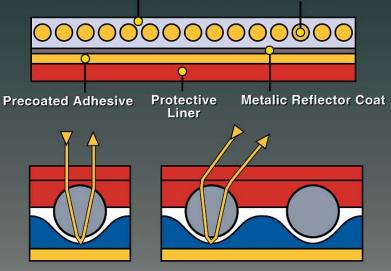
Microprismatic



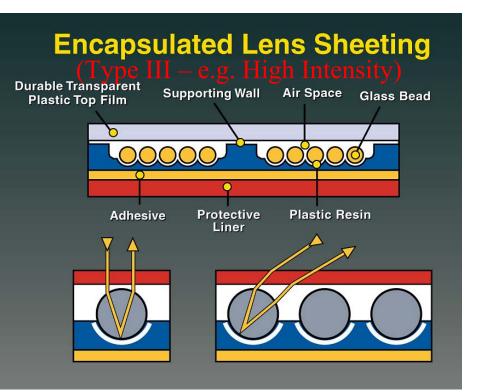
Sign Sheeting

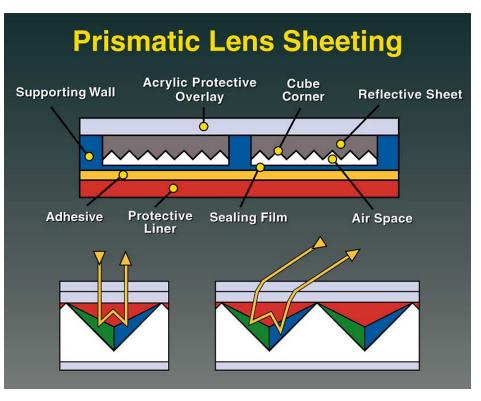


Enclosed Lens Sheeting Types I & II – e.g. Engineering Grades) Durable Transparent Plastic Glass Bead



Sheeting Types

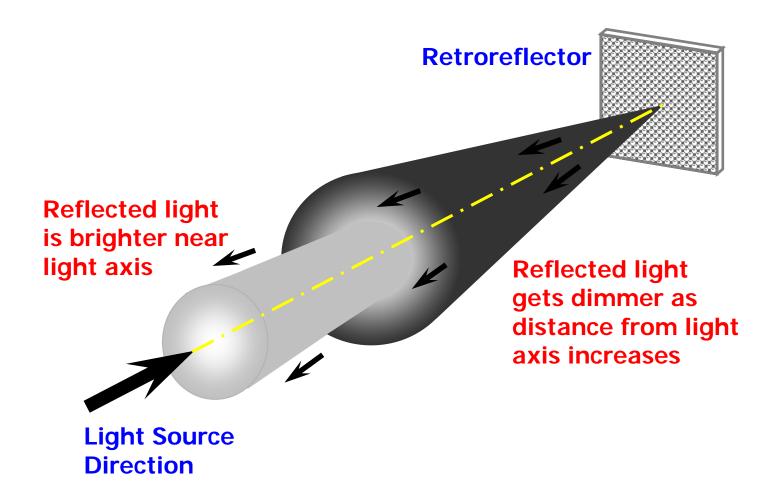


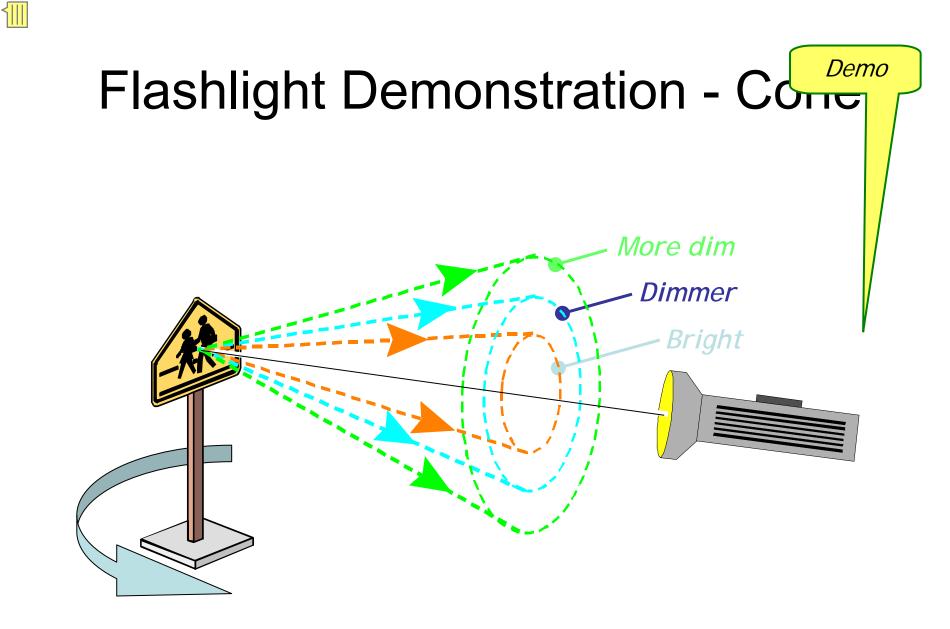


Video Demonstration



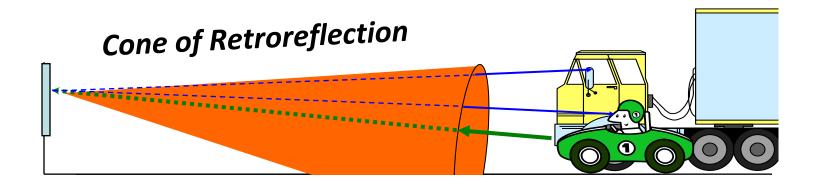
Retroreflectivity Cone



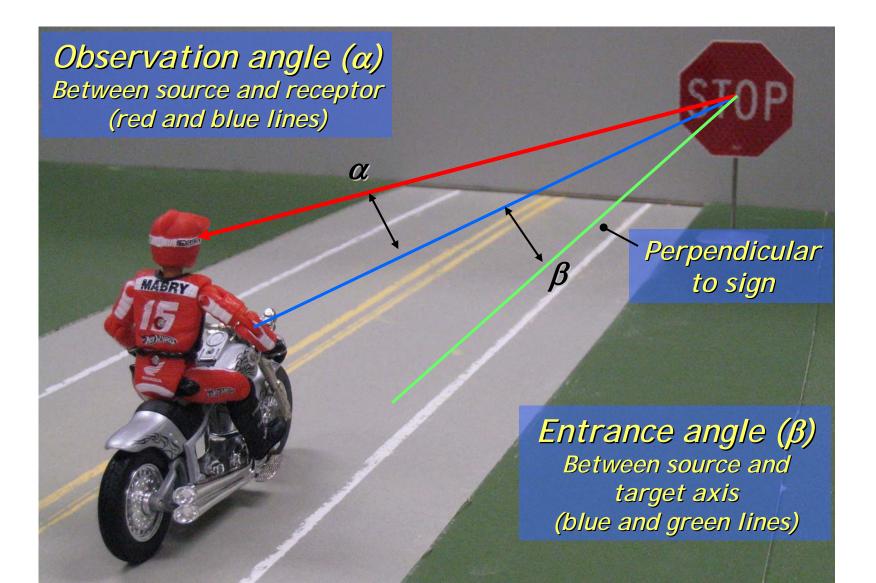


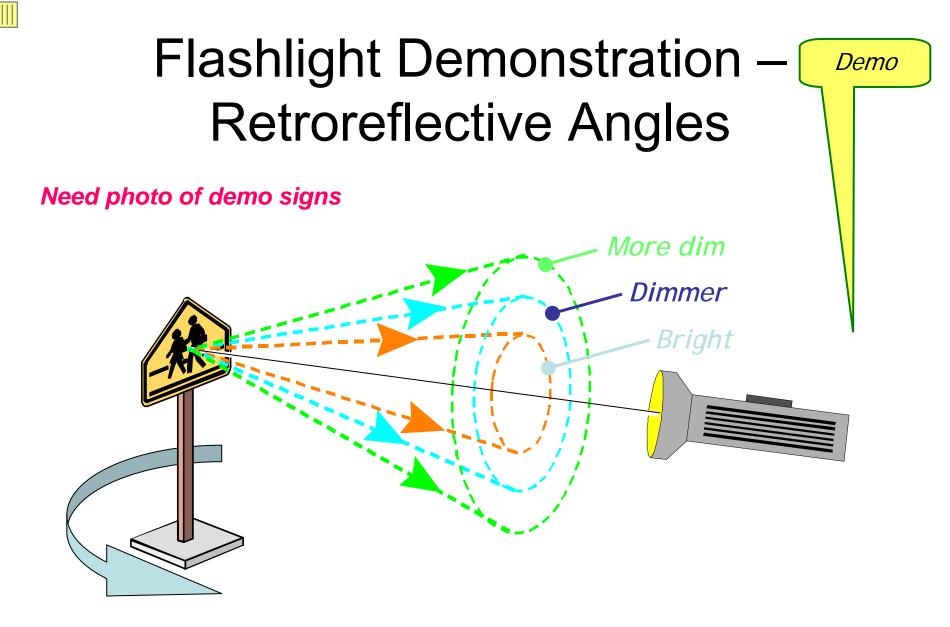
Greg will get sample materials

Cone Size is Important

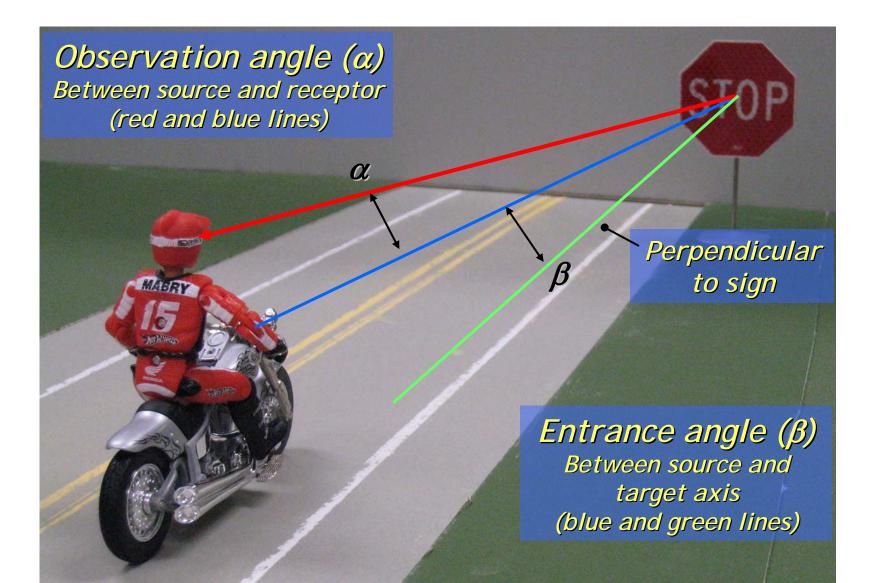


Key Geometry Angles





Key Geometry Angles



Summary

 Does retroreflectivity by itself describe how bright a sign will look?

 Everything else equal, how will a driver in a sports car see a nighttime sign versus a driver in a big truck?



Questions



Questions for You

- What is unique about RETROreflection?
- Where do you find examples of retroreflection?

• Why is the cone of retroreflection important?



New Requirements

MUTCD Sign Retroreflectivity Maintenance Requirements

Final Rule



- Published on Dec 21, 2007
 Vol 72, No. 245
- Revision #2 of the 2003 Edition of the MUTCD

• Effective Jan 22, 2008

MUTCD Changes

- Portions of the MUTCD revised:
- Introduction
 - Compliance dates
- Part 1
 - 1A.11 relation to other publications
- Chapter 2A
 - 2A.09 minimum sign retroreflectivity
 - 2A.22 sign maintenance
- Minor editorial changes to cross-references
 2A, 2B, and 6F

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"

New MUTCD Language Section 2A.09 Maintaining Minimum Retroreflectivity

• "Support:

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 Language

"...One or more of the following assessment or management methods should be used..."

- Visual Nighttime
 Inspection
 - Calibration Signs
 - Comparison Panels
 - Consistent
 Parameters
- Measured Sign Retro

- Expected Sign Life
- Blanket Replacement
- Control Signs
- Future Method Based On Engr. Study
- Combination Of Any

New MUTCD Table 2A.3 Minimum Maintained Retroreflectivity Levels

Sign Color	Beaded Sheeting			Prismatic Sheeting	Additional Criteria	
	I	II		III, IV, VI, VII, VIII, IX, X	entena	
White on Green	$\begin{array}{c} W^{\star} \\ G \geq 7 \end{array}$	W* G ≥ 15	W* G≥25	$W \ge 250; G \ge 25$	Overhead	
	$\begin{matrix} W^* \\ G \geq 7 \end{matrix}$		Ground- mounted			
Black on	Y*; O*	$Y \geq 50; \ O \geq 50$			2	
Yellow or Black on Orange	Y*; O*		3			
White on Red			4			
Black on White						

 \textcircled 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°.

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

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

@Minimum Sign Contrast Ratio \geq 3:1 (white retroreflectivity \div red retroreflectivity)

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

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FHWA doe	es are shown as should verify that is not endorse of the Sheeting	at the sheeting or approve any	they use compl material nor do	ies with their s	specifications or e type category	ASTM D4956. (s) for material		applications.	0
F	Retroreflec	tive Sheet	ing Materia	als for Rigi	id Sign Sur	faces Made	e with Glas	ss Beads	
Example of Sheeting (Shown to scale)		4	42						
ASTM Type	I	II	II	III	III	III	III	III	III
Manufacturer	See note A	Avery Dennison®	Nippon Carbide	3M™	ATSM, Inc.	Avery Dennison®	Kiwalite®	LG Lite	Nippon Carbide
Brand Name	Engineer Grade	Super Engineer Grade	Super Engineer Grade	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity
Series Number	Several	T-2000	15000 17000 18000	2800 3800	ASTM HI	T-5500	22000	LH8000 LH8100	N500 N800
NOTES:	A	-				1000			
	Retroref	ective She	eting Mate	erials for R	ligid Sign S	urfaces M	ade with P	risms	
Example of Sheeting (Shown to scale)									
ASTM Type	III, IV	III, IV, X	VII, VIII, X	VIII	IV, VIII	IX	IX	X	Unassigne
Manufacturer	Avery Dennison®	3M™	3M™	Avery Dennison®	Nippon Carbide	3M™	Avery Dennison®	Nippon Carbide	3M™
Brand Name	High Intensity Prismatic	High Intensity Prismatic	Diamond Grade™ LDP	MVP Prismatic	Crystal Grade	Diamond Grade™ VIP	Omni-View™	Crystal Grade	Diamond Grade™ D0
Series Number	T-6500	3930	3970	T-7500	94000 (IV) 92000 (VIII)	3990	T-9500	93000	4000
NOTES: A – All the manufa	B	В	B,D		B,C			C	

What signs need replaced?



Pictures do not accurately show retroreflectivity!

Exempt Signs

EXIT 2

Buffalo Bill's

RIGHT

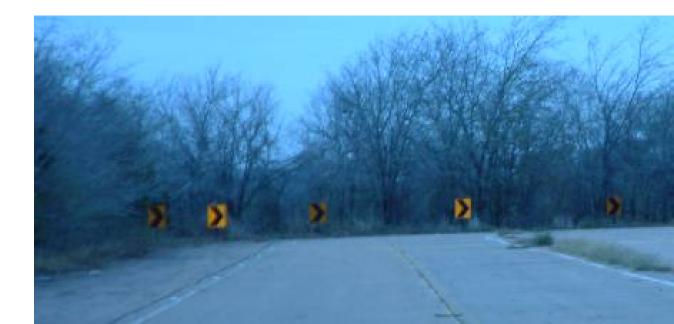
- Parking/Standing/Stopping
- Walking/Hitchhiking
- Adopt-A-Highway
- Blue or Brown Backgrounds
- Exclusive Use of Bikes or Peds

Note: Must still meet other requirements in MUTCD (inspections, retroreflective, etc,)



Clarification

- Fluorescent colors
 - fluorescent yellow -- > yellow
 - fluorescent yellow-green -- > yellow
 - fluorescent orange -- > orange



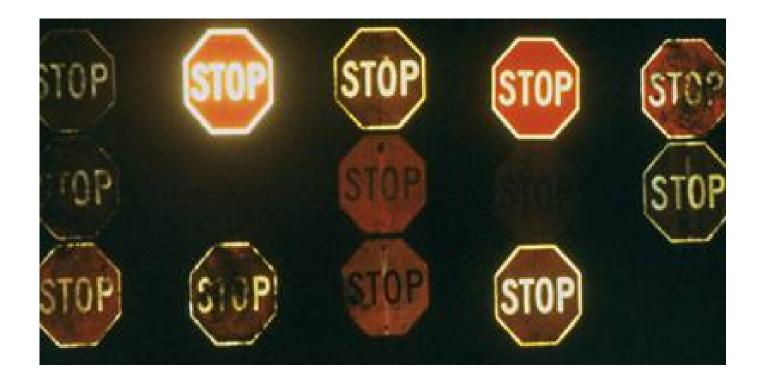
Summary

 Do the new MUTCD requirements specify how often you need to inspect your signs for retroreflectivity?

 If the requirements are in the MUTCD, what types of roads need to be in compliance?

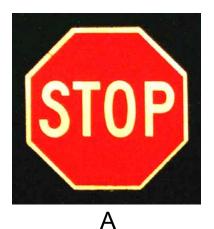


Can we decide to replace signs based on daytime inspections?



Quiz

- Which of these signs:
 - Needs to be replaced?
 - Is near the minimum retroreflectivity level?
 - Is adequate and good for a few more years?







Quiz Answers

- Pictures of retro are sensitive to light and position of camera/flash
 - More light = brighter sign
- Example:
 - Same: sign, camera, and camera/flash position
 - Different: flash intensity (amount of light)





Training for Inspectors

MUTCD Methods

- Visual assessment
- Measured retroreflectivity
- Expected sign life
- Blanket replacement
- Control signs
- Future methods
- Combination of methods

Management Methods Methods for Maintaining Traffic Sign Retroreflectivity

www.fhwa.dot.gov/retro

Methods Using Inspection

- Visual Inspection Method
 - Comparison Panel Procedure
 - Calibrated Sign Procedure
 - Consistent Parameter Procedure
- Retroreflectivity Measurement Method

 Measurements made with Hand-Held Devices

Visual Inspection Requirements

- Trained inspector
- Nighttime inspection
- Need to tie to minimum values by using one of the following techniques
 - Comparison panels procedure, or
 - Calibration signs procedure, or
 - Consistent parameters procedure

Visual Inspection Method: Comparison Panel Procedure





New MUTCD Language

"...One or more of the following assessment or management methods should be used..."

- Visual Nighttime
 Inspection
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 Parameters
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Overview

- Any vehicle, any inspector age is OK.
- The "initial" inspection occurs at highway speeds.
- When a marginal sign is spotted,
 - Safely pull over to inspect the sign,
 - Install comparison panel on the sign,
 - Evaluate from at least 25 feet,
 - Hold a flashlight near inspector's ear.

Comparison Panels

- Comparison panels must have a retroreflectivity level at least that designated in the MUTCD
- The procedure must be done at night

These panels have retroreflectivity levels at the levels in the MUTCD minimum retroreflectivity table



New MUTCD Table 2A.3 Minimum Maintained Retroreflectivity Levels

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Source of Comparison Panels

- With a retroreflectometer, an agency can find in-service signs near the minimum levels. These signs can be removed from service and cut into smaller pieces.
- An agency can also look through their scrap yard.
- As of June 2008, there are no known sources for ordering comparison panels.

Field Procedure



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Comparison Panel Procedure

Field Procedure



Comparison Panel Procedure





Comparison Panel Procedure









Comparison Panel Procedure

Comparison Panel Demonstration Using MiniSigns

- Need comparison panels.
- Commercial grade yellow.
- 3 x 6 inch substrates
- 100 panels.
- Sticker for back that says for demo purposes only
- Send finished product to Greg.
- AD commercial grade ordered (June 11)
- Centerline DFW making panels (July 16)

Comparison Panel Checklist

- Be well rested
- Select inspection vehicle and have headlamps aimed
- Select inspection routes (both directions)
- Prepare inspection forms (example shown later)
- Have sign list if available (for each inspection route, a list of signs you expect to see, in order of the direction of travel)
- Clip board, pen lights, dash cam, tape recorder, laptop,
- Comparison panels
- Ladder
- Retroreflective garments
- Flashing lights for safety when installing comparison panel
- Cannot start in earnest until complete darkness





Quiz

- How often do you need to stop and use the comparison panels?
- What size do the comparison panels need to be?
- What color do the panels need to be?
- What retroreflectivity level should the panels be?

Inspection Method : Calibrated Signs Procedure



New MUTCD Language

"...One or more of the following assessment or management methods should be used..."

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 Inspection
 - Comparison Panels
 - Calibration Signs
 - Consistent
 Parameters
- Measured Sign Retro

- Expected Sign Life
- Blanket Replacement
- Control Signs
- Future Method Based
 On Engr. Study
- Combination Of Any

Overview

- Any vehicle, any inspector age is OK.
- Before leaving the maintenance yard, the inspectors visually inspects a set of representative signs in an effort to calibrate their eye before starting the nighttime inspections.
- The calibration signs should be viewed at distances from 600 to 100 feet
- Use low beams.
- The inspection occurs at highway speeds.

Calibration Signs

- Calibration signs must have a retroreflectivity level at least that designated in the MUTCD
- The inspection has to be done at night



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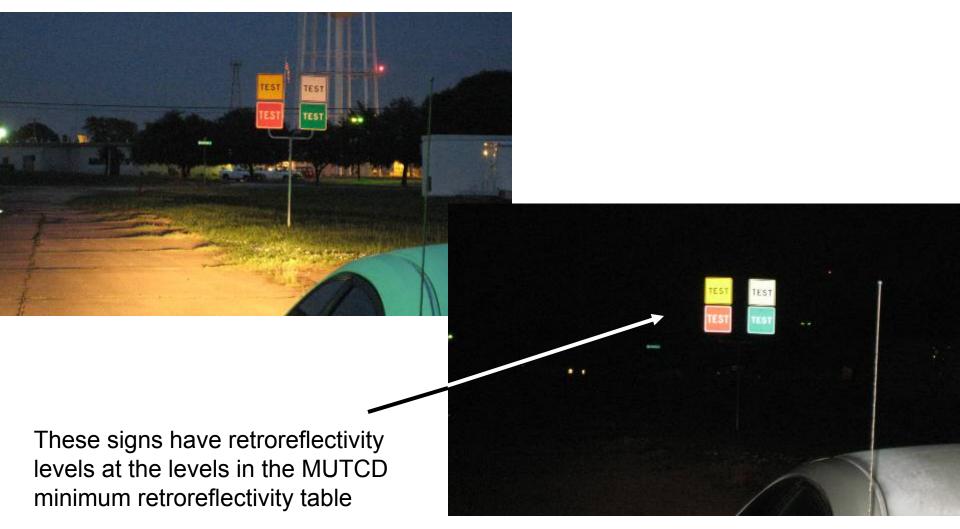
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Source of Calibration Signs

- With a retroreflectometer, an agency can find in-service signs near the minimum levels. These signs can be removed from service and stored until nighttime sign inspections commence.
- An agency can also look through their scrap yard for representative signs.
- As of June 2008, there are no known sources for ordering calibrated signs.



Field Procedure



Calibrated Signs Procedure

Field Procedure

- Use the same vehicle that will be used during the visual inspection
- View the calibration signs from the inspection vehicle at distances from 600 feet to 100 feet before leaving the maintenance yard / parking lot
- During the visual inspection, look for signs less bright than the calibration signs
- Mark these signs for replacement
- May include a route that allows inspector to review calibration signs during inspection.

Quiz

- What type of vehicle is needed for this method?
- How old does the inspector need to be?
- How does this method compare to the comparison panel method?
- How many calibration signs do you need?

Checklist

- Be well rested
- Select inspection vehicle and have headlamps aimed
- Select inspection routes (both directions)
- Prepare inspection forms (example shown later)
- Have sign list if available (for each inspection route, a list of signs you expect to see, in order of the direction of travel)
- Clip board, pen lights, dash cam, tape recorder, laptop,
- Cannot start in earnest until complete darkness
- View calibration signs before starting your inspection routes



6 different types of material used on these Stop signs



7 different types of material used on these Stop signs

Visual Inspection Method: Consistent Parameter Procedure



New MUTCD Language

"...One or more of the following assessment or management methods should be used..."

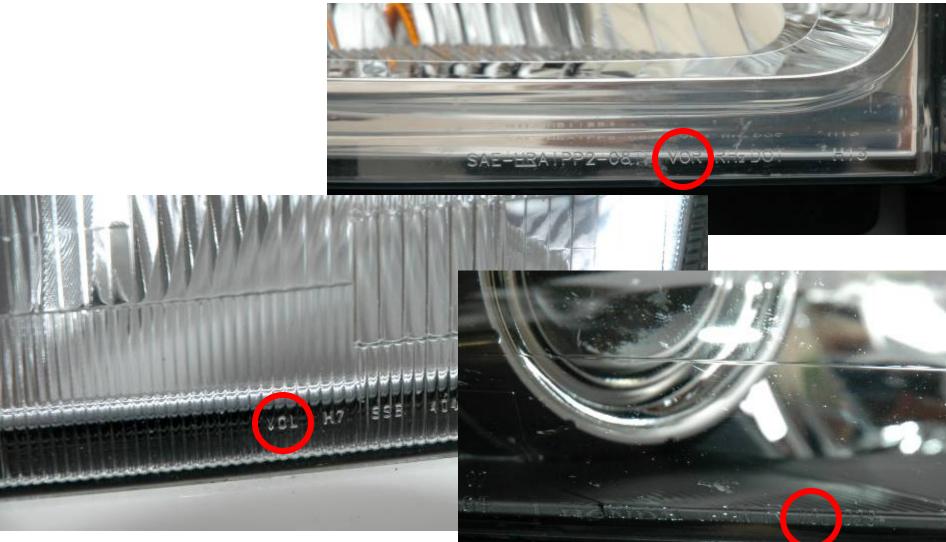
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 On Engr. Study
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Overview

- With this method, a SUV or truck has to be used with specific headlamps (described later) and the inspector needs to be at least 60 years old.
- The inspection occurs at highway speeds.
- No calibration signs or comparison panels are needed.
- This method simulates the conditions of the research which FHWA used as a foundation for the minimum retroreflectivity levels.

Headlamp Identification



Consistent Parameter Procedure

Field Technique

- Preferable to use a two person crew.
- Must have a SUV, pick-up, or similar vehicle with VOA style headlamps.
- Driver can be any age but inspector needs to be at least 60 years old.
- Inspection occurs at highway speeds.
- Inspector concentrates on judging sign retroreflectivity.
 - Example: adequate, marginal, poor (replace)
- Driver concentrates on driving safely.

Quiz

- What are the advantages of this method?
- What are the limitations of this method?
- Of all the visual inspections methods, which is your preferred method? Why?
 - Comparison Panels
 - Calibration Signs
 - Consistent Parameters

Checklist

- Inspector and driver need to be well rested
- Have SUV/ Truck vehicle with VOA headlamps aimed properly
- Have routes selected
- Prepare enough inspection forms
- Have sign list if available
- Clip board, pen lights, dash cam, tape recorder, laptop,
- Be fueled up
- Cannot start in earnest until complete darkness
- Remember to evaluate both colors of signs with two retroreflective colors (white on green, white on red, etc.)

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Common Visual Inspection Features

- Aim inspection vehicle headlamps (take to certified auto mechanic)
- Two-person crew works best
- Having an inventory is preferred
- Use low-beam headlamps
- Have evaluation form and criteria
 - Example: good or bad (replace)
- Conduct evaluations at roadway speed

Visual Inspection Tips

- It is preferred to have a list of the signs along the inspection route.
 - Adds consistency to the inspections
 - Reduced need for writing during inspection
 - Only need a score for each sign such as: good, marginal, replace.
 - Provides documentation that the inspections were conducted --- just in case!
 - Allows identification of missing signs

Sign List Example

Sign Retroreflectivity Inspection Form

Date:

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Route start point:_____ Route end point:_____

Inspector:	
•	

Sign	Sign	Odom.	RETROREFLECTIVITY		
Description	Color	Reading	Good	Marginal	Replace
Stop	Red	0.1			
Route Mkr	Wht	0.2			
Spd Lmt	Wht	0.5			

Retroreflectivity Measurement Method





New MUTCD Language

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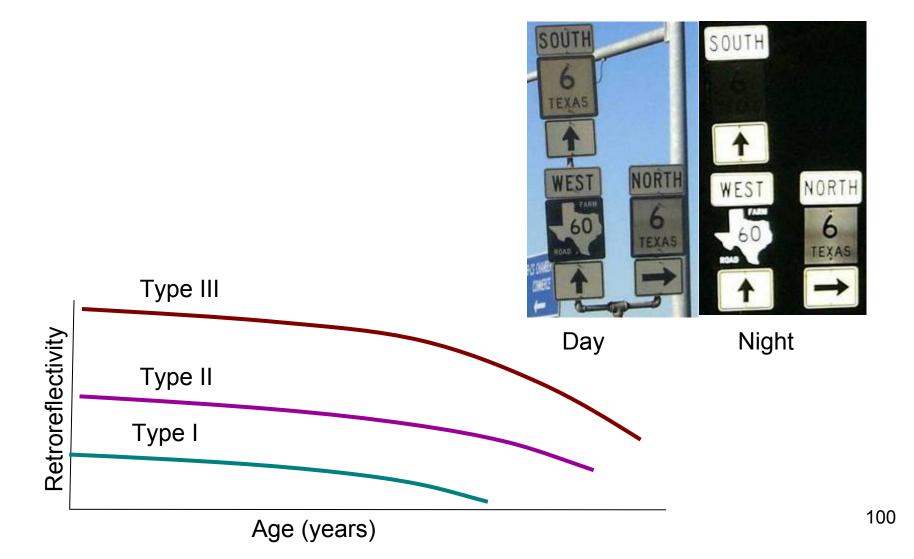
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Overview

- This method includes sign retroreflectivity measurements of in-service signs
- The measurements are made with devices similar to cordless drills
- The measurement devices must be in contact with the sign face
- The measurements need to be periodically repeated (e.g., annually or every other year)

Sign Sheeting Degrades over Time



Devices Available in the US

* as of June 2008



* FHWA does not endorse specific products

Available Features



RoadVista Model 922

- Annular Device (one measurement on prismatics)
- Measurement Point: 1 inch in Diameter
- Aperture reducer (for measuring narrow text)
- GPS
- Data storage (4,500 readings) & Download Software
- Removable / Rechargeable Battery
- Entrance Angle -4.0 degrees
- Measures 2 observation angles at the same time (0.2 & 0.5)
- Bar code reader
- ASTM E1709 compliant
- Extension Pole Kit is Available & Adjustable Entrance Angle Attachment
- Built in USA



• Delta RetroSign GR3

- Point Device (two measurements on prismatics 0 / 90 degrees)
- Measurement Point: 1.2 inches
- Aperture reducer (for measuring narrow text, .625 +/-)
- GPS
- Data storage (250,000 readings) & Download Software
- Removable / Rechargeable Battery
- Entrance Angle -4.0 degrees
- 4500 Measures 1 observation angle (0.2)
- GR3 Measures 3 observation angles at the same time (0.2 0.5 & 1)
- RFID reader (field tag reading device)
- ASTM E1709 compliant
- Extension Pole Kit is Available

Important Common Features

- Measurements are provided at standard geometry (defined by ASTM)
 - 0.2 degree observation angle
- Ability to store data
- Easy to use
- Rechargeable batteries

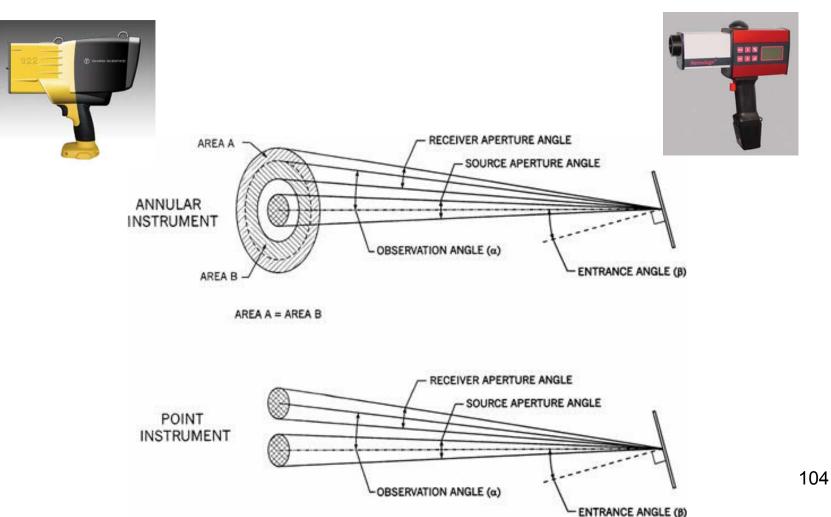
Important Distinctions

RoadVista Model 922

Annular Device

Delta RetroSign GR3

Point Device



Practical Differences

- Sign sheeting materials made with <u>glass</u> <u>beads</u> - **NONE**
- Sign sheeting materials made with prisms

 Measurements from different devices can be
 as much as 25% different.
- Always make measurements with devices held at the same orientation

Measurement Rotation Example

• 0 degree rotation





Measurement Rotation Example

• 45 degree rotation





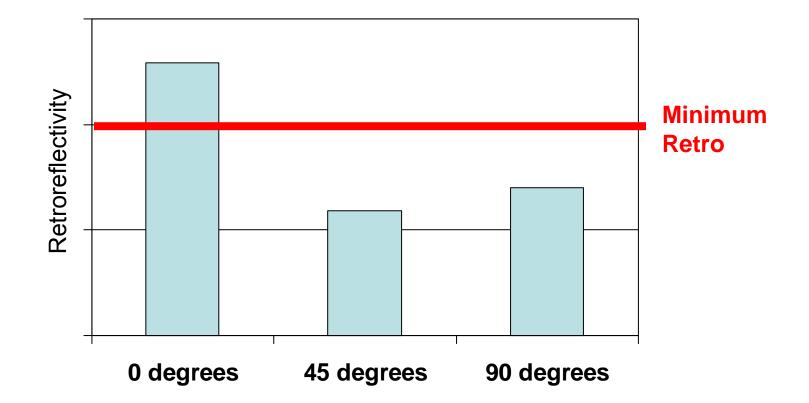
Measurement Rotation Example

• 90 degree rotation





Measurement Rotation Example Results (Observation = 0.2°)



Field Procedure

- Make note of the type of sheeting
- Measure each color that is retroreflective
- Multiple measurements should be made to compute an average
- A measurement protocol should be developed
- An extension pole or ladder will be needed

FHWA doe	es are shown as should verify that is not endorse of the Sheeting	at the sheeting or approve any	they use compl material nor do	ies with their s	specifications or e type category	ASTM D4956. (s) for material		applications.	0
F	Retroreflec	tive Sheet	ing Materia	als for Rigi	id Sign Sur	faces Made	e with Glas	ss Beads	
Example of Sheeting (Shown to scale)		4	42						
ASTM Type	I	II	II	III	III	III	III	III	III
Manufacturer	See note A	Avery Dennison®	Nippon Carbide	3M™	ATSM, Inc.	Avery Dennison®	Kiwalite®	LG Lite	Nippon Carbide
Brand Name	Engineer Grade	Super Engineer Grade	Super Engineer Grade	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity	High Intensity
Series Number	Several	T-2000	15000 17000 18000	2800 3800	ASTM HI	T-5500	22000	LH8000 LH8100	N500 N800
NOTES:	A	-				1000			
	Retroref	ective She	eting Mate	erials for R	ligid Sign S	urfaces M	ade with P	risms	
Example of Sheeting (Shown to scale)									
ASTM Type	III, IV	III, IV, X	VII, VIII, X	VIII	IV, VIII	IX	IX	X	Unassigne
Manufacturer	Avery Dennison®	3M™	3M™	Avery Dennison®	Nippon Carbide	3M™	Avery Dennison®	Nippon Carbide	3M™
Brand Name	High Intensity Prismatic	High Intensity Prismatic	Diamond Grade™ LDP	MVP Prismatic	Crystal Grade	Diamond Grade™ VIP	Omni-View™	Crystal Grade	Diamond Grade™ D0
Series Number	T-6500	3930	3970	T-7500	94000 (IV) 92000 (VIII)	3990	T-9500	93000	4000
NOTES: A – All the manufa	B	В	B,D		B,C			C	

Measurement Protocol Example



- For Stop signs, an agency may require a minimum of 4 measurements per color as shown to the left
- The average of the 4 measurements would be used to assess the condition of the sign retroreflectivity

New MUTCD Table 2A.3 Minimum Maintained Retroreflectivity Levels

Sign Color	Be	aded Sheet	ing	Prismatic Sheeting	Additional Criteria		
	I	II III III, IV, VI, VII, VIII, IX, X					
White on	$\begin{array}{c} W^{\star} \\ G \geq 7 \end{array}$	W* G ≥ 15	W > 250 ($i > 25$		Overhead		
Green	$\begin{array}{c} W^{\star} \\ G \geq 7 \end{array}$		Ground- mounted				
Black on	Y*; O*	$Y \geq 50; \ O \geq 50$			2		
Yellow or Black on Orange	Y*; O*		3				
White on Red		4					
Black on White	$VV \ge 50$ —						
 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°. For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs For text and fine symbol signs measuring less than 1200 mm (48 in) Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity ÷ red retroreflectivity) 113 * This sheeting type should not be used for this color for this application. 							

New MUTCD Table 2A.3 Minimum Maintained Retroreflectivity Levels

Sign Color Beaded Sheeting Prismatic Sheeting Criteria I II III III, IV, VI, VII, VIII, IX, X Criteria							
IIIIIIIII, IV, VI, VII, VIII, IX, XWhite on Green M^* $G \ge 7$ $G \ge 15$ W^* $G \ge 25$ $W \ge 250; G \ge 25$ Overhead mountedW* $G \ge 7$ W^* $G \ge 7$ $W \ge 120; G \ge 15$ Ground- mountedBlack on Yellow or Black on Orange Y^*, O^* $Y \ge 50; O \ge 50$ $@$ White on Red $W \ge 35; R \ge 7$ $@$ White on Red $W \ge 35; R \ge 7$ $@$ Black on White $W \ge 50$ $=$ 0The 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° . $@$ For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs	Sign Color	Ве	aded Sheet	ting	Prismatic Sheeting	Additional Criteria	
White on Green $G \ge 7$ $G \ge 15$ $G \ge 25$ $W \ge 250; G \ge 25$ Overhead mountedW $G \ge 7$ W* 		I	II III III, IV, VI, VII, VIII, IX, X				
W G \geq 7W \geq 120; G \geq 15Oronna mountedBlack on Yellow or Black on OrangeY*, O*Y \geq 50; O \geq 502White on RedY*; O*Y \geq 75; O \geq 753White on RedW \geq 35; R \geq 74Black on WhiteW \geq 50-Orange of the minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m²-The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m²-Por text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs-					$W \ge 250; G \ge 25$	Overhead	
Yellow or Black on OrangeY*; O*Y \geq 75; O \geq 753White on RedW \geq 35; R \geq 74Black on WhiteW \geq 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-							
Black on Orange $Y^*; O^*$ $Y \ge 75; O \ge 75$ $③$ White on Red $W \ge 35; R \ge 7$ $④$ Black on White $W \ge 50$ \bigcirc 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		¥, 0*	$Y \ge 50; \ O \ge 50$			2	
Black on White $W \ge 50$ ① The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m²measured at an observation angle of 0.2° and an entrance angle of -4.0°.②For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of boldwmbol signs	Black on	Y*; O*		3			
 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°. ②For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs 	White on Red		4				
measured at an observation angle of 0.2° and an entrance angle of -4.0°. ②For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold ymbol signs	Black on White		_				
(a) Minimum Sign Contrast Ratio \geq 3:1 (white retroreflectivity \div red retroreflectivity)	measured at an o ②For text and fir symbol signs ③For text and fir	observation ne symbol s ne symbol s	angle of 0. igns measu igns measu	.2° and an e uring at leas uring less th	entrance angle of -4.0°. It 1200 mm (48 in) and for al an 1200 mm (48 in)	I sizes of bold	

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

Contrast Ratio



- For red and white signs, there is a contrast ratio requirement of ≥ 3.
- Contrast ratio equals:

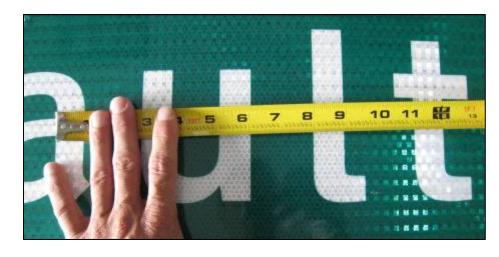
Average of white measurements

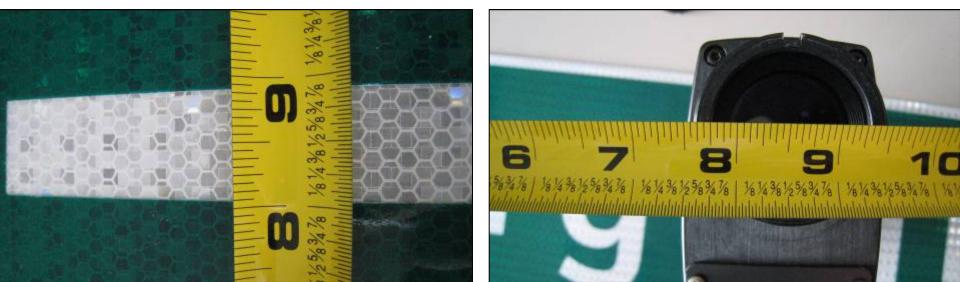
Average of red measurements

 Faded or pink looking Stop signs indicate that the contrast ratio may be too low for nighttime driving

Measuring Letters







Measuring Letters

The reduction cap decreases the aperature size to 0.5 inch



Taking Measurements

- You will be in the ROW so safety is ultimately the highest priority
- Signs are usually out of reach so a ladder or extension pole will be needed.
- For overhead signs, a bucket truck will be needed.
- The device memory can be used to save the readings or a notepad or a palm device

Taking Measurements



Orientation of Sign Sheeting



Advantages / Disadvantages

- Advantages:
 - Provides the most direct means of monitoring the maintained retroreflectivity levels
 - Removes subjectivity
- Disadvantages:
 - Cost of instruments (approx \$10,000 to \$12,000)
 - Measuring all signs in a jurisdiction can be time consuming
 - Using retroreflectivity as the only indicator of whether or not a sign should be replaced may end up neglecting other attributes of the sign's overall appearance.

Quiz

- How many measurements are needed on each sign?
- How often should signs be measured?
- Should you clean the sign before taking a measurement?
- Would you rather measure signs during the daytime or conduct a nighttime inspection technique as described earlier?

Additional Considerations

- Will the methods we reviewed today be effective in all conditions?
- Can you think of some other field methods that might be used to evaluate traffic sign retroreflectivity?

Sign Conditions



Rural vs Urban Areas

- The minimum retroreflectivity levels in the MUTCD are based on
 - Older drivers vision
 - Sign recognition and legibility
 - Rural areas without background complexity

• What happens in urban areas?

Can you see the sign?



New MUTCD Language

"...One or more of the following assessment or management methods should be used..."

- Visual Nighttime
 Inspection
 - Comparison Panels
 - Calibration Signs
 - Consistent
 Parameters
- Measured Sign Retro

- Expected Sign Life
- Blanket Replacement
- Control Signs
- Future Method Based On Engr. Study
- Combination Of Any

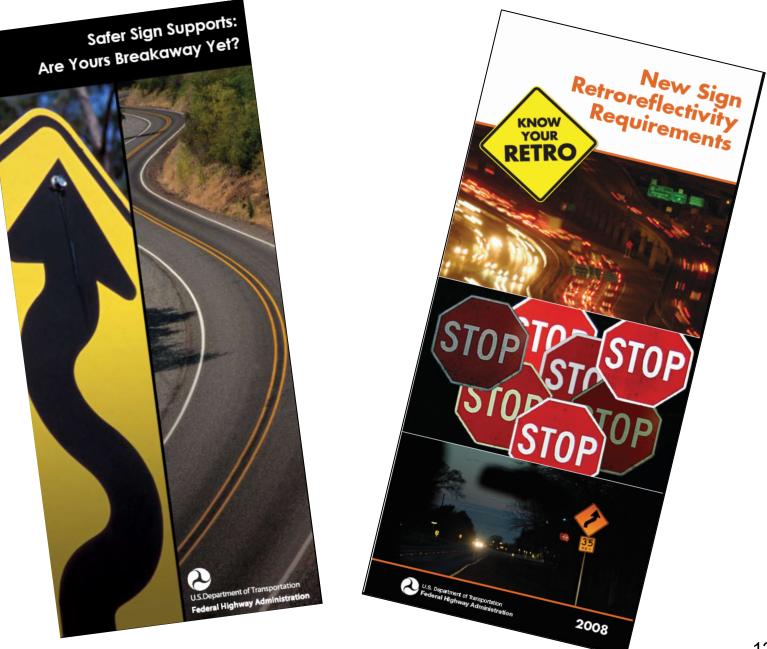
Resources

• Your local LTAP Center

Some have retroreflectometers for loan

- Methods for Maintaining Traffic Sign Retroreflectivity, 2007

 FHWA-HRT-08-026
 - <u>http://safety.fhwa.dot.gov/roadway_dept/retro/hrt08026/</u>
- FHWA <u>fhwa.dot.gov/retro</u>
- ATSSA <u>www.retroreflectivity.net</u>



http://safety.fhwa.dot.gov/roadway_dept/safersigns.pdf

Your job is the most important part of making this new regulation successful

Increase safety Increase nighttime visibility