

Traffic Sign Retroreflectivity

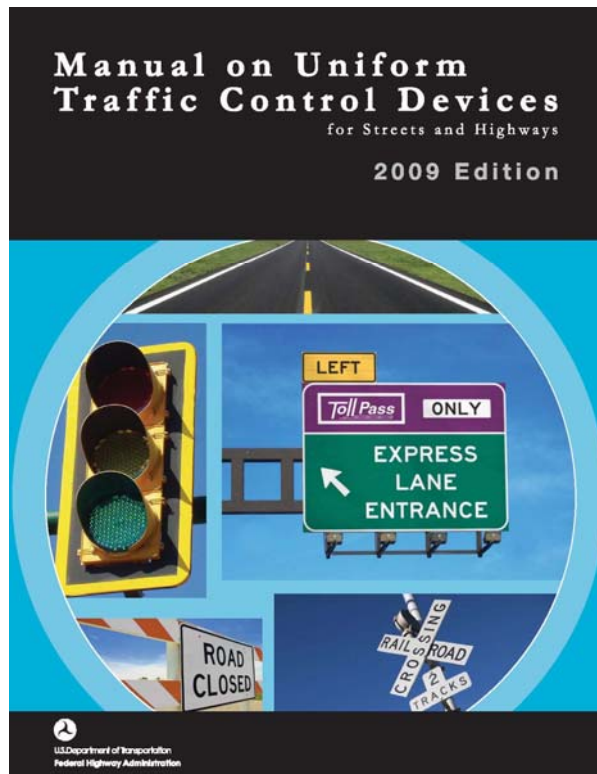


- Rule
- Requirements
- Sign Maintenance Methods



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MUTCD Requirement



Section 2A.07 Retroreflectivity and Illumination

Standard:

Regulatory, warning, and guide signs and object markers shall be retroreflective (see Section 2A.08) or illuminated to show the same shape and similar color by both day and night, unless otherwise provided in the text discussion in this Manual for a particular sign or group of signs.

The requirements for sign illumination shall not be considered to be satisfied by street or highway lighting.



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Nighttime Driving

Daytime

Many cues available

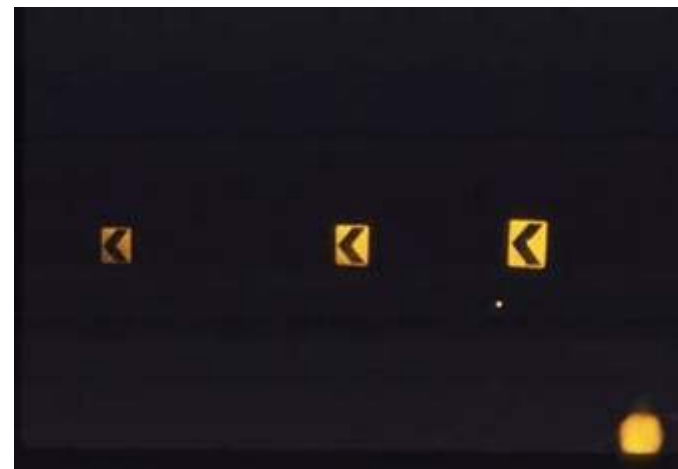
Driver task relatively easy



Nighttime

Few cues remain

Task more difficult

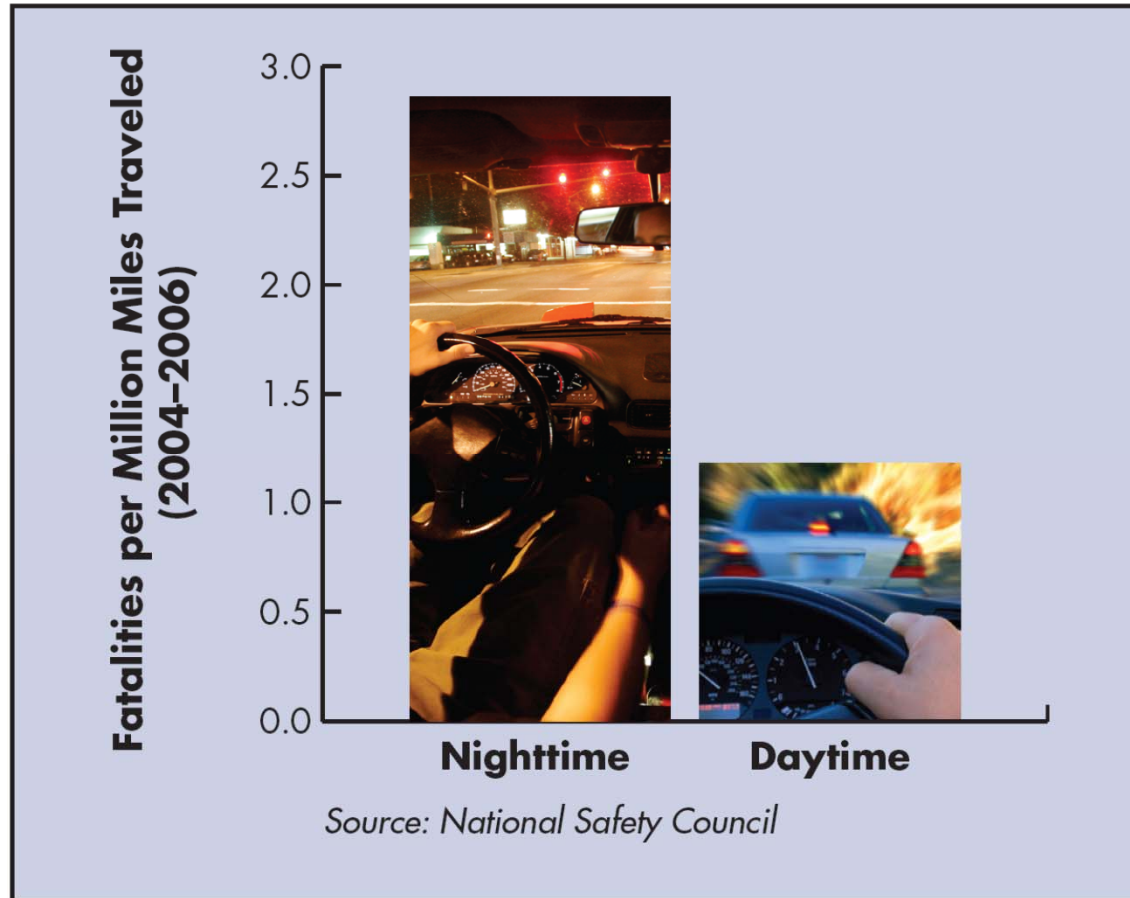


Retroreflectivity provides nighttime guidance



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Night Travel and Crashes



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Why Create Minimums?



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Retroreflectivity



**Retroreflectivity
Degrades Over
Time**

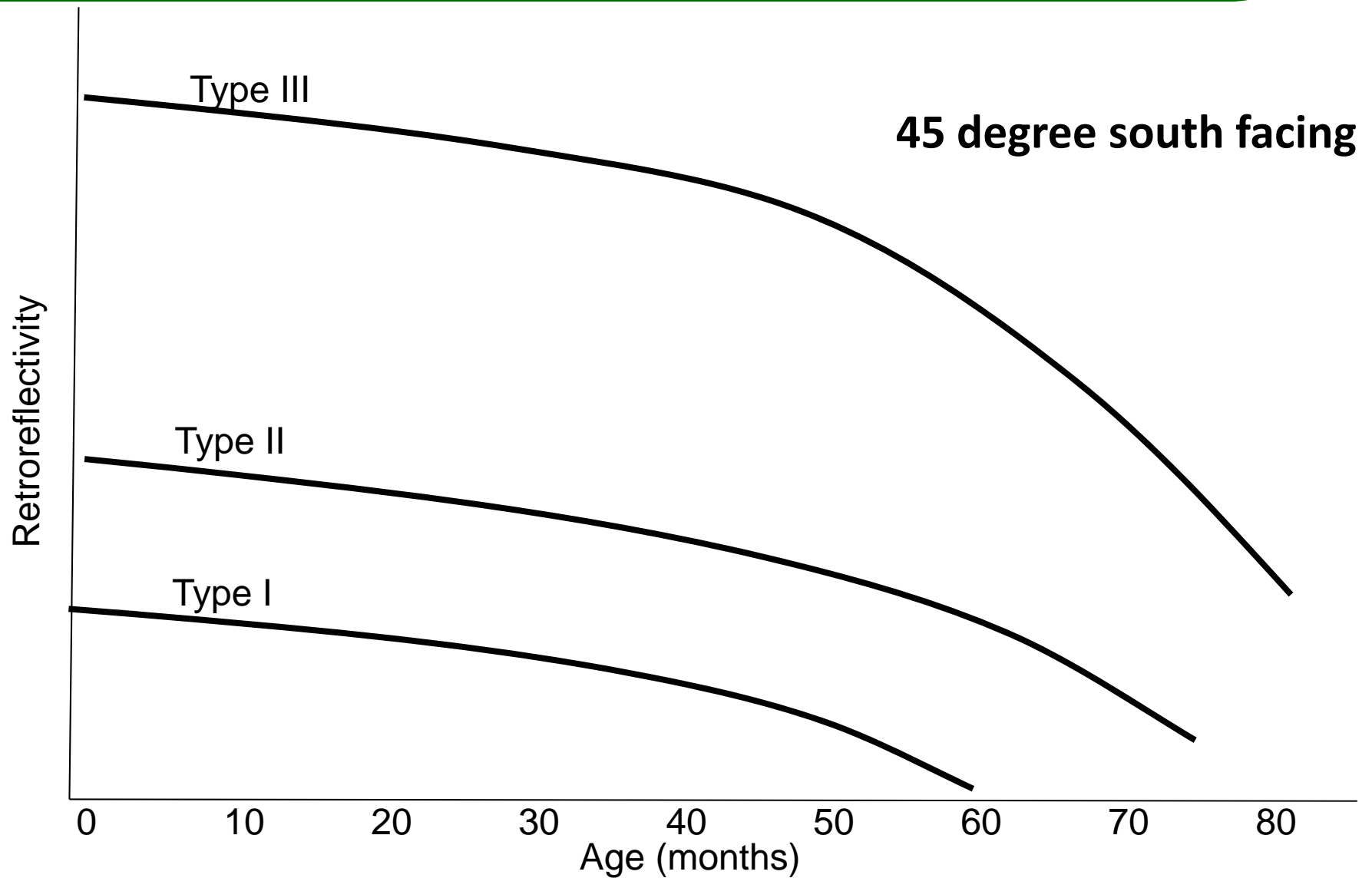


**When do we
replace the
sign?**



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Typical Outdoor Durability Testing



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”
- “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.



Retroreflectivity Minimum Values

- Table 2A-3 Minimum Maintained Retroreflectivity Levels

New MUTCD Table 2A-3. Minimum Maintained Retroreflectivity Levels ①					
SIGN COLOR	SHEETING TYPE (ASTM D4956-04)				ADDITIONAL CRITERIA
	Beaded Sheeting			Prismatic Sheeting III, IV, VI, VII, VIII, IX, X	
	I	II	III		
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/m ² 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.					
BOLD SYMBOL SIGNS					
<ul style="list-style-type: none"> • W1-1, -2 – Turn and Curve • W1-3, -4 – Reverse Turn and Curve • W1-5 – Winding Road • W1-6, -7 – Large Arrow • W1-8 – Chevron • W1-10 – Intersection in Curve • W1-15 – 270 Degree Loop • W2-1 – Cross Road • W2-2, -3 – Side Road • W2-4, -5 – T and Y Intersection • W2-6 – Circular Intersection 		<ul style="list-style-type: none"> • W3-1 – Stop Ahead • W3-2 – Yield Ahead • W3-3 – Signal Ahead • W4-1 – Merge • W4-2 – Lane Ends • W4-3 – Added Lane • W4-6 – Entering Roadway Added Lane • W6-1, -2 – Divided Highway Begins and Ends • W6-3 – Two-Way Traffic • W10-1, -2, -3, -4, -11, -12 – Highway-Railroad Advance Warning • W11-2 – Pedestrian Crossing 		<ul style="list-style-type: none"> • W11-3 – Deer Crossing • W11-4 – Cattle Crossing • W11-5 – Farm Equipment • W11-6 – Snowmobile Crossing • W11-7 – Equestrian Crossing • W11-8 – Fire Station • W11-10 – Truck Crossing • W12-1 – Double Arrow • W16-5p, -6p, -7p – Pointing Arrow Plaques • W20-7a – Flagger • W21-1a – Worker 	
FINE SYMBOL SIGNS – Symbol Signs Not Listed As Bold Symbol Signs					
SPECIAL CASES					
<ul style="list-style-type: none"> • W3-1 – Stop Ahead: Red retroreflectivity ≥ 7 • W3-2 – Yield Ahead: Red retroreflectivity ≥ 7; White retroreflectivity ≥ 35 • W3-3 – Signal Ahead: Red retroreflectivity ≥ 7; Green retroreflectivity ≥ 7 • W3-5 – Speed Reduction: White retroreflectivity ≥ 50 • For non-diamond shaped signs such as W14-3 (No Passing Zone), W4-4p (Cross Traffic Does Not Stop), or W13-1, -2, -3, -5 (Speed Advisory Plaques), use largest sign dimension to determine proper minimum retroreflectivity level. 					








Exempt Signs

- 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,)



Sheeting Types that meet Minimums

Common Sheeting Name ▶	Engineer Grade	Super Engineer Grade	High Intensity Beaded	Prismatic (many common names)
ASTM Sheeting Type ▶	I	II	III	III, IV, V, VII, VIII, IX, X
Type of Sign ▼				
 Warning (Yellow & Orange)	NO	●	●	●
 White Legend On Overhead Green Guide	NO	NO	NO	●
 White Legend On Ground-Mounted Green Guide	NO	●	●	●
 Green Background on All Guide Signs	●	●	●	●
 White Regulatory with black legend	●	●	●	●
 Red and White Regulatory*	●	●	●	●
 White on Blue White on Brown Parking Bikeway	Excluded from minimum maintained retro regulation but must still be retroreflective			
* Except Parking Signs				● YES ● NO

FHWA Retroreflective Sheeting Identification Guide – September 2005

Notes: ASTM Types are shown as stated by the manufacturers using ASTM D4956-04 "type" designations. Agencies should verify that the sheeting they use complies with their specifications or ASTM D4956. FHWA does not endorse or approve any material nor does it determine type category(s) for materials. This side of the Sheeting ID Guide is for rigid surfaces only. The other side is for flexible surfaces and non-signing applications.



Retroreflective Sheeting Materials for Rigid Sign Surfaces Made with Glass Beads

Example of Sheeting (Shown to scale)									
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								

Retroreflective Sheeting Materials for Rigid Sign Surfaces Made with Prisms

Example of Sheeting (Shown to scale)									
ASTM Type	III, IV	III, IV, X	VII, VIII, X	VIII	IV, VIII	IX	IX	X	Unassigned
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™ DG3
Series Number	T-6500	3930	3970	T-7500	94000 (IV) 92000 (VIII)	3990	T-9500	93000	4000
NOTES:	B	B	B,D		B,C			C	

A – All the manufacturers listed on the other side of this guide (except Reflexite) provide Engineer Grade sheeting. Engineer Grade sheeting is uniform without any patterns or identifying marks. Visually, it is indistinguishable from lower quality grades (i.e., utility and commercial grades).

B – These materials can be classified as different ASTM Types.

C – These materials are visually indistinguishable from one another.

D – The arrow or "water mark" on this product is no longer included with new productions.



Inventory

Agency _____

Sheet ___ of ___

Traffic Sign Inspection Sheet – SAMPLE 1

Date Surveyed _____

Zone _____ Roadway _____ Location/Direction _____

From _____ To _____

Milepoint	Direction	Sign Type	MUTCD Number	Sign Size	Sign Message	Retroreflectivity OK	Remove Sign	Replace Sign	Adjust Height	Steel Post	Wood Post	New Post	Level Post	Remarks



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New MUTCD Language

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

Assessment Methods

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

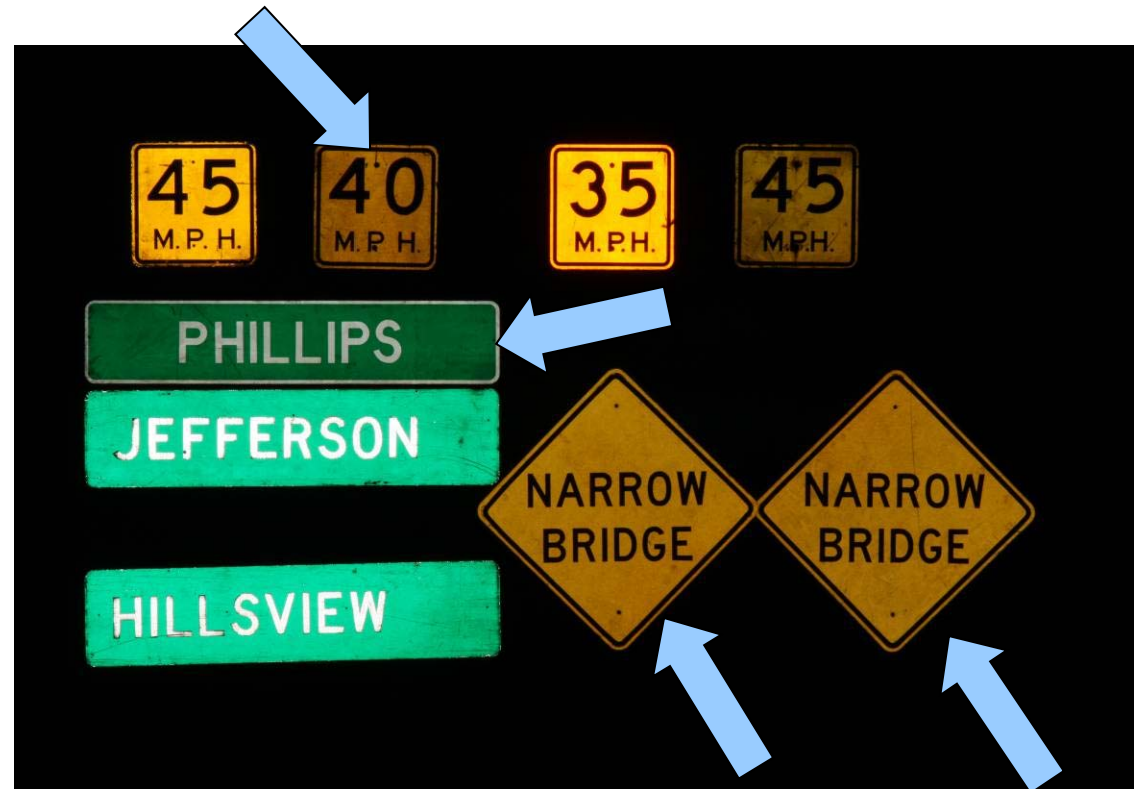
Management Methods

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



Method 1: Visual Assessment

- “Calibrate” eyes with calibration signs
- Calibration signs are near minimum retro
- Evaluate signs compared to calibration signs



Method 2: Measure Sign Retro

- Use a portable instrument
- Receive proper training
- Have a protocol for consistency
- Compare readings to minimum values



Method 3: Expected Sign Life

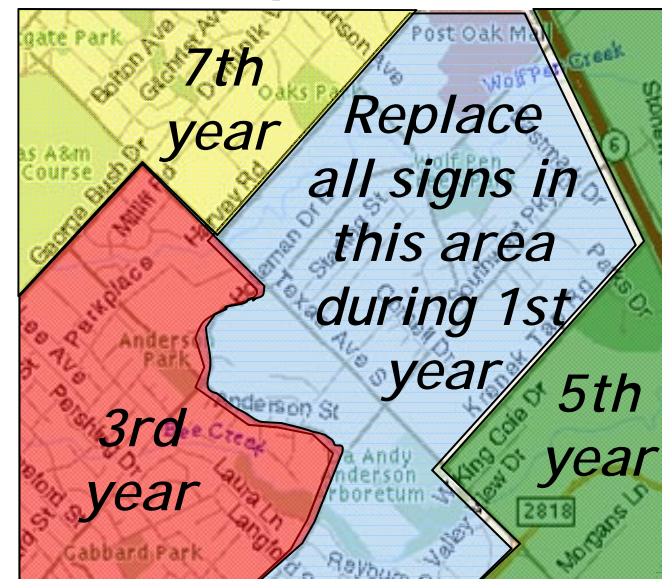
- Find the life of the sheeting type in your area
- Replacement based on expected life for individual signs



Method 4: Blanket Replacement

- Divide agency into areas/corridors or zones to replaced at the same time
- Interval set based on expected sign life
- Replace all signs in an area/ corridor each replacement cycle
 - 10 yr life, → 10 areas
 - Annual replacement in each area

Example



Method 5: Control Signs

- Sign life is estimated using a subset of control signs representing an agency's inventory.
- Control signs can be in-service signs or signs in a maintenance yard.
- Agency monitors control signs to estimate condition & measure retroreflectivity of the of control signs.

Example of Control Signs



Method 6: Other Options

- Flexibility is provided for future advancements in technology and methods that have not been fully developed
- Must be based on an engineering study
- Documented



Compliance Dates

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



What Should I Do Next?

- Select maintenance method(s)
- Budget to implement method
- Train inspectors (ask LTAP for slides)
- Implement maintenance method(s)
- Decide on sheeting types
 - Consider initial and life cycle costs
- Budget for future sign replacement



Sign Sheeting Material Costs

- What are reasonable costs you can expect for these materials:
- Assume per sq. ft
 - Engineering Grade _____
 - Super Engineer Grade _____
 - High Intensity Beaded _____
 - High Intensity Prismatic _____
 - Other Prismatic (Avery, NCI, or DG3) _____



Sign Sheeting Material Costs

- Cost of new 36x36 inch warning sign with engineer sheeting (ASTM1) = **\$65**
(includes substrate, materials and installation)
- Assume per sq. ft
 - Engineering Grade = **\$.80**
 - Super Engineer Grade = **\$1.00**
 - High Intensity Beaded = **\$1.15**
 - High Intensity Prismatic = **\$1.5**
 - Other Prismatic (Avery, NCI, or DG3) = **\$3.25**



Sign Sheeting Material Costs

- Cost of new 36x36 inch warning sign with engineer sheeting (ASTM1) = \$65
(includes substrate, materials and installation)
- Initial cost of a 36x36 inch warning sign
 - Engineering Grade = \$65
 - Super Engineer Grade = \$67
 - High Intensity Beaded = \$68
 - High Intensity Prismatic = \$71
 - Other Prismatic (Avery, NCI, or DG3) = \$87



Life Costs of Warning Signs with Different Sheetings

- Warning sign (36x36 inch)
 - Engineering Grade = $65 \div 7 = \$9.29/\text{yr}$
 - Super Engineer Grade = $67 \div 10 = \$6.68/\text{yr}$
 - High Intensity Beaded = $68 \div 12 = \$5.68/\text{yr}$
 - High Intensity Prismatic = $71 \div 12 = \$5.94/\text{yr}$
 - Other Prismatic = $87 \div 16 = \$5.80/\text{yr}$

Expected sign life (in years)

***Now what if you have
2000 warning signs?***



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Life Costs of Warning Signs with Different Sheetings

Now what if you have 2000 warning signs?

- Warning sign
 - Engineering Grade = \$18571
 - Super Engineer Grade = \$13360
 - High Intensity Beaded = \$11358
 - High Intensity Prismatic = \$11883
 - Other Prismatic = \$11607



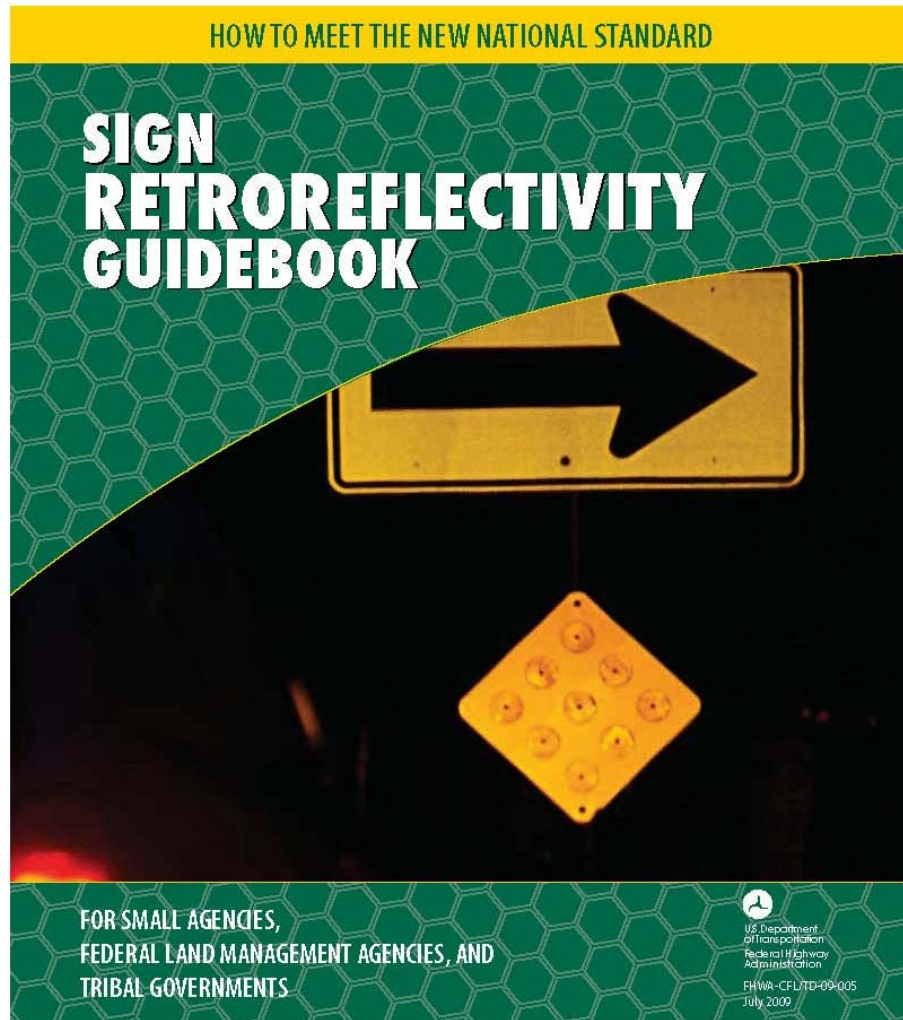
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Impact on Your Agency?

- What is your sign maintenance system now?
- Do you have a system that addresses nighttime visibility of signs?
- What is the nighttime visibility condition of your signs?
- What types of sheeting do you use now?



Guidebook



- Small Agencies
- Sample Inventories
- Sample Budgets



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Indiana LPA Sign Review

- **Visited 10 local agencies**
 - Counties
 - Towns
- **Talked with agency representative**
- **Driving tour observing signs**



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Observations

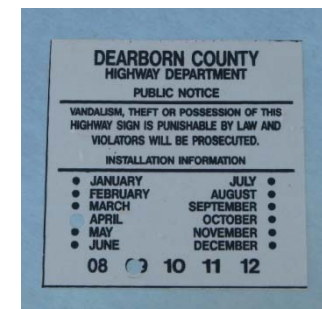
- **No one is done yet!**
- **Inventory**
 - **Card file to Think Map database**
- **Method**
 - **Most plan visual night time**
 - **Many updating older signs prior to initial baseline review**



Observations

● Sign Sheeting

- Everything type of sheeting is being used
- Many are upgrading to HIP - Others using EG
- Many using stickers



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MUTCD

- **Not all are using the correct MUTCD**
- **Current MUTCD is the 2008 Indiana MUTCD**
 - **INDOT website**
 - <http://www.in.gov/dot/div/contracts/design/mutcd/mutcd.html>
 - **Based on 2003 MUTCD**
- **Next IMUTCD will be based on the 2009 MUTCD**



Sign Upgrades

- **Once you touch the sign you should update it to MUTCD/IMUTCD standards**
 - **Height**
 - **Lateral Offset**
 - **Breakaway**



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What Should Be Done Next?



Act casual,
say (do) nothing
and hope no one
notices... ?



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