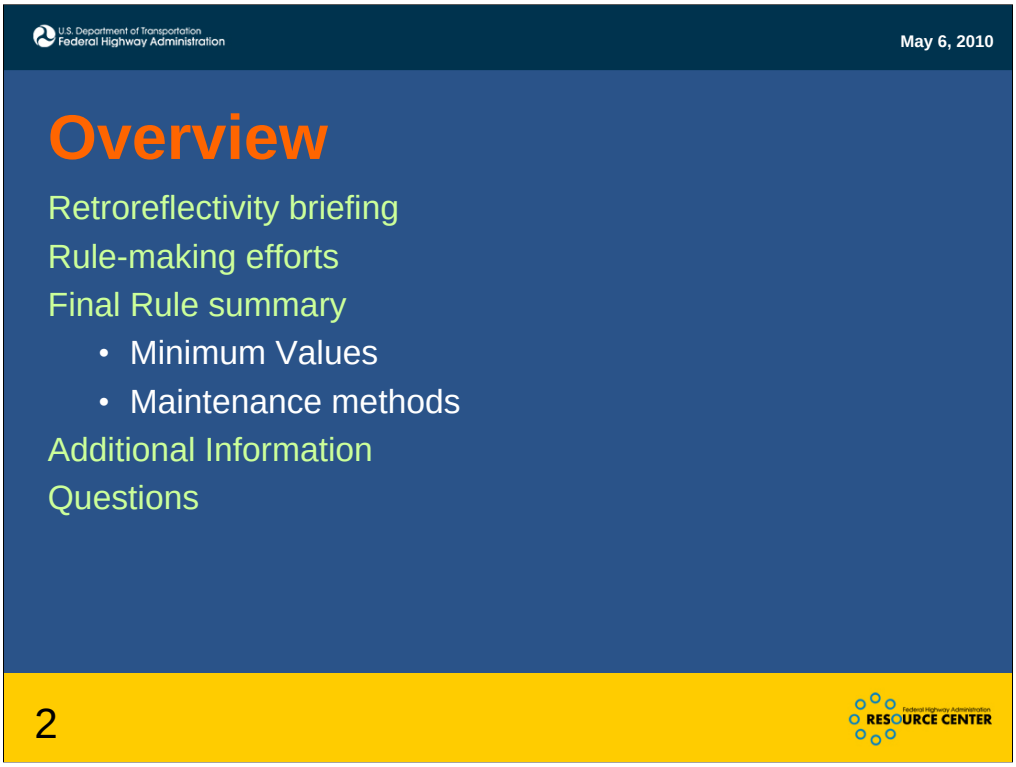
U.S. Department of Transportation
Federal Highway Administration

Federal Highway Administration
RESOURCE CENTER

May 6, 2010

# Federal Requirements for Sign Retroreflectivity




In this presentation I will summarize this list of topics, spending the majority of my time talking about the new minimum retroreflectivity requirements.

A National Goal:

# 1.0 Fatalities

per 100M VMT by 2008

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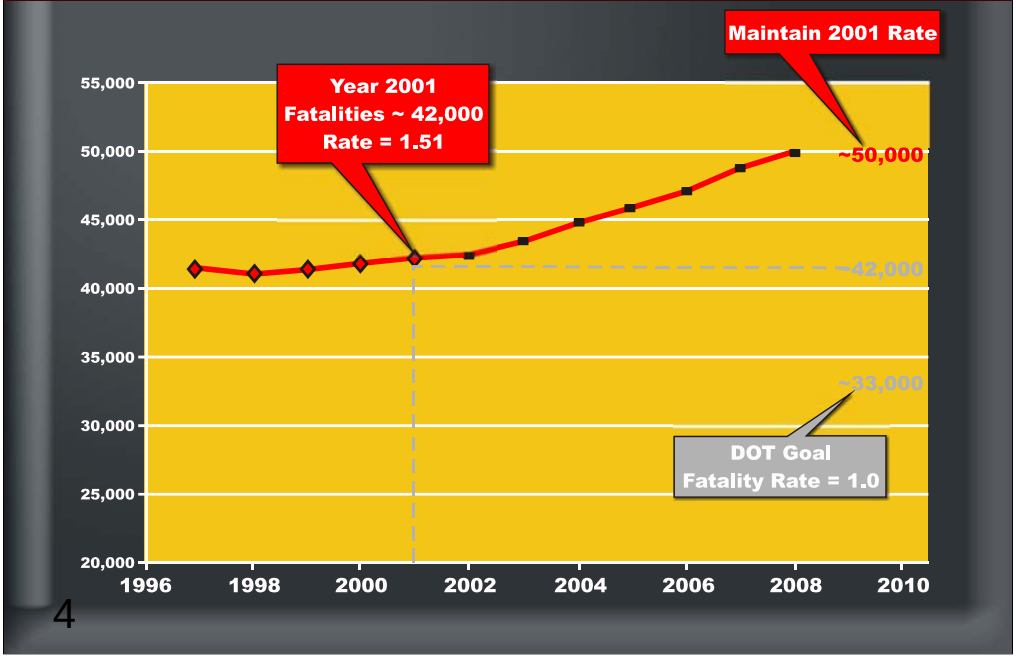
Federal Highway Administration

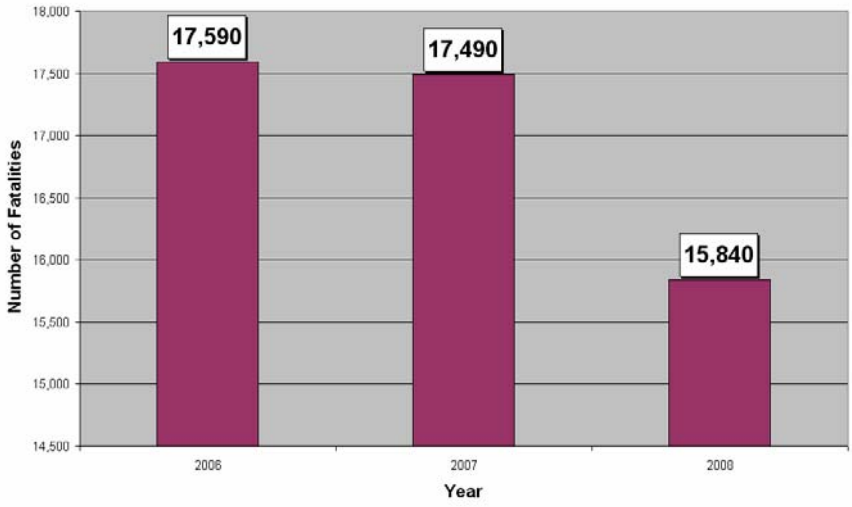
U.S. Department of Transportation
FMCSA
Federal Motor Carrier Safety Administration

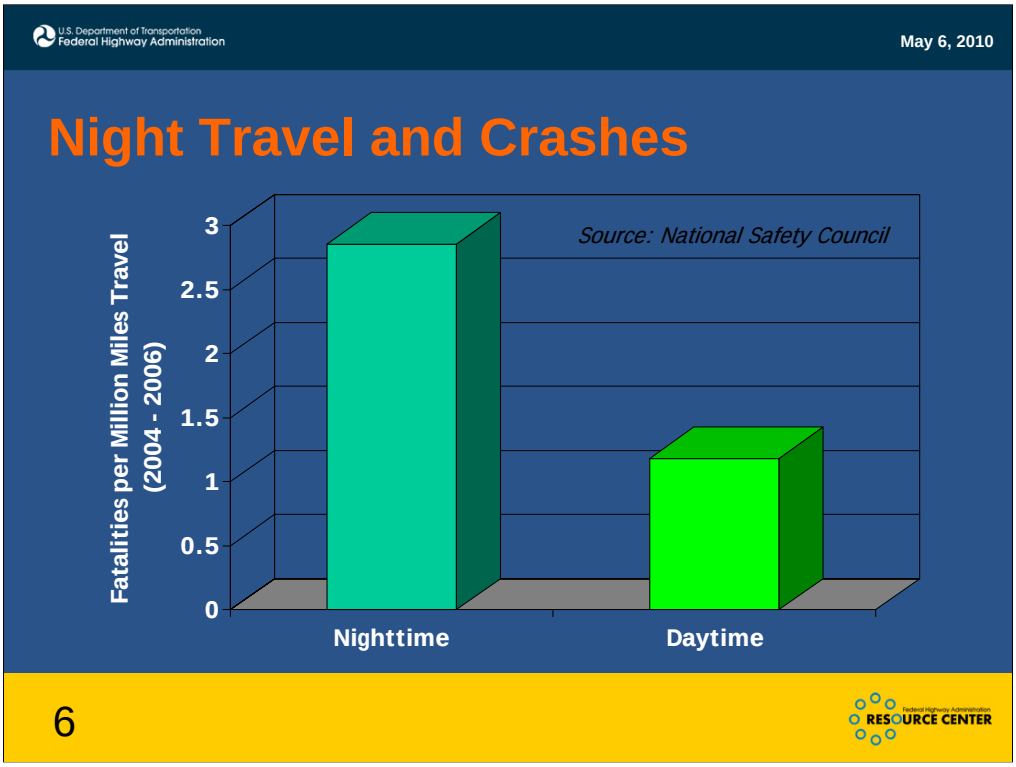
U.S. Department of Transportation
NHTSA
People Saving People
www.nhtsa.dot.gov

# 2008 Goal Is Challenging



## National Fatalities in the First 5 Months of the Last 3 Years

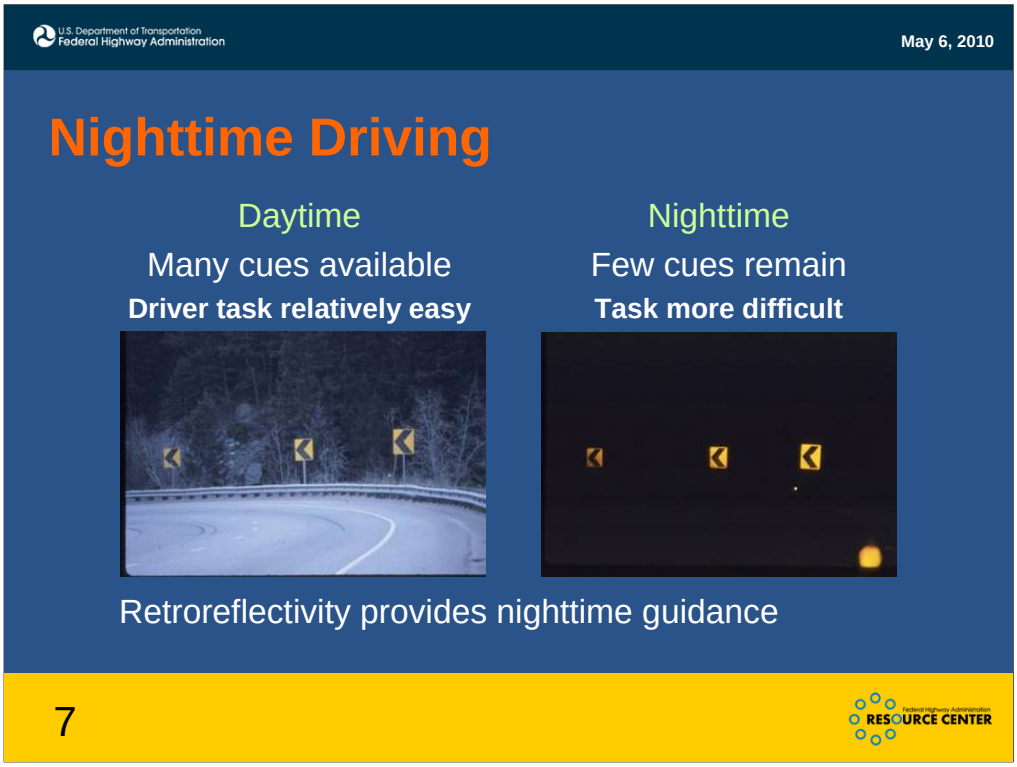





This graph shows the disparity of fatalities between nighttime and daytime. PRESENTER: Pause and let audience figure out the graph.

There are several reasons for this disparity. Alcohol and fatigue play a major role. However, we also believe that lack of drive cues may play a role.

Nighttime visibility of traffic control devices is becoming increasingly important as our population ages. By the year 2020, about one-fifth of the U.S. population will be 65 years of age or older. In general, older individuals have declining vision and slower reaction times. Signs that are easier to see and read at night can help older drivers retain their freedom of mobility and remain independent.

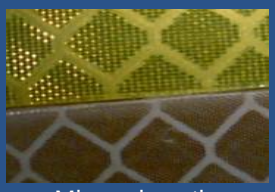



Same location, day/night.

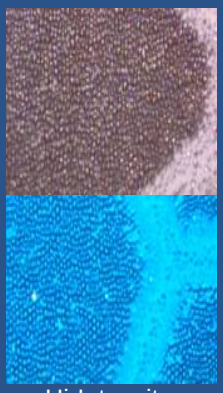
Day: drivers have so many cues, they don't even think about the driving and can probably do it relatively safe. Cues available: guardrail, vegetation, snow banks in the winter, textured shoulders, and TCDs. Night, only retroreflective TCDs remain. With so few cues remaining at night, they become critical! They become the only remaining method to pass vital information to drivers.

# Sign Sheeting Materials

Engineering Grade

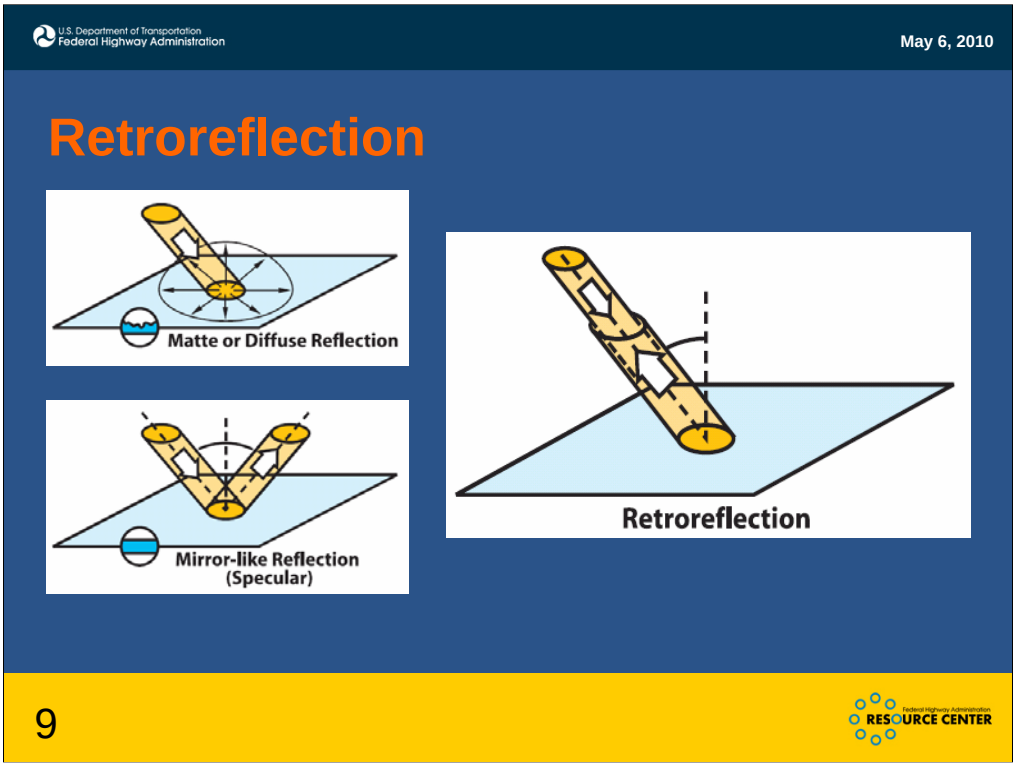


Microprismatic

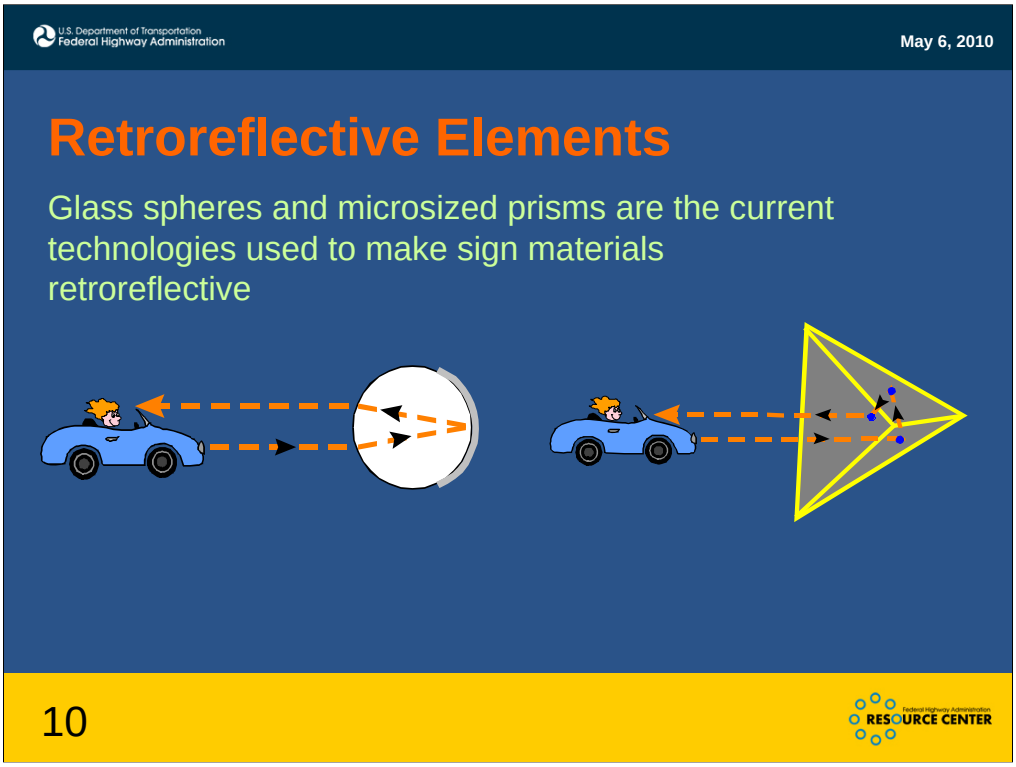




Hi-Intensity
Beaded



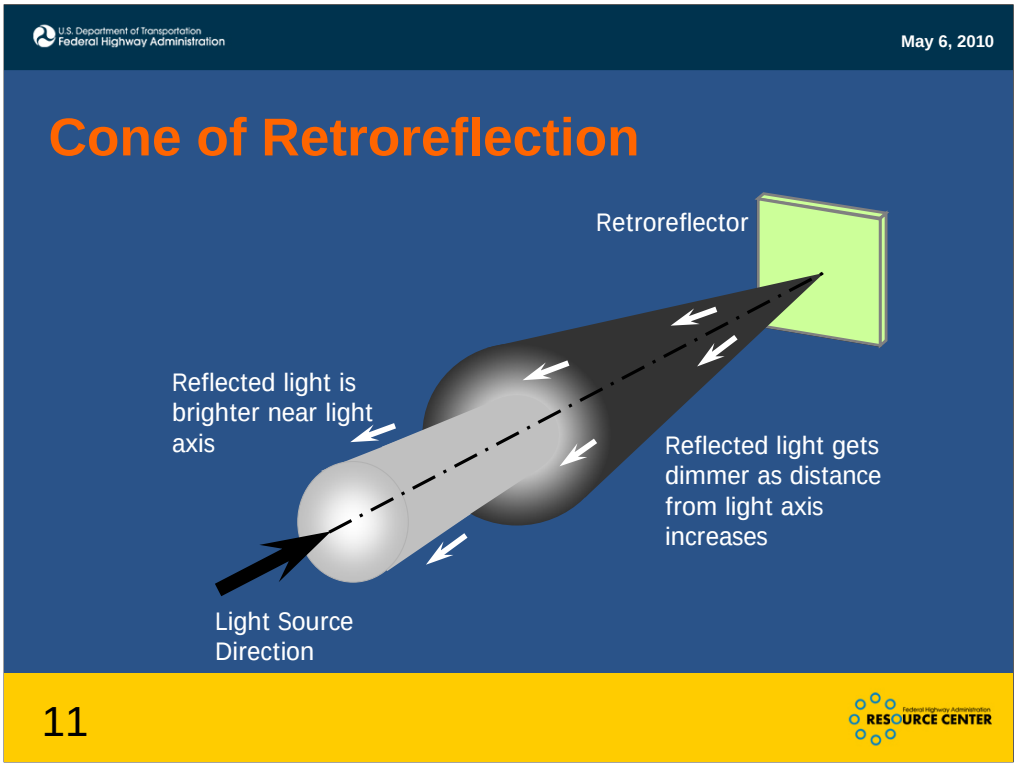

Let me first quickly describe retroreflectivity. The two most common types of reflection are diffuse and specular, shown on the left. The way you can see objects is dependent on how much light reaches your eyes FROM THE OBJECT. For example, the screen used for this presentation is designed to be a good diffuse reflector so that the same color and brightness is reflected in all directions and is therefore seen from many angles. Retroreflection, shown in the diagram on the right, occurs when light is redirected back toward the source. For example, if this projection screen was a good retroreflector, the light would be redirected back toward the projector and the presentation would not be visible to most of you in the audience.




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 materials are not "perfect" retroreflectors, or else all of the incident light would be reflected back to the original source (i.e.: your headlights). Rather, 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 retroreflected beam shape and the various sign sheeting materials will be discussed later, but simply, the retroreflective materials actually use diffused or mirror concepts to make it work. Light enters the sheeting cover, hits the glass bead, refracts (bends), hits the back of the bead, for encapsulated sheeting there is a silver mirror surface there which uses mirror technology to reflect the light. The light 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.




<ANIMATED> It is better to view this slide from a slide show; simply click on slide show or Shift+F5

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.


ANIMATED

You need to have four things in order to see retroreflective devices at night. The four things are a sign (or target), headlamps which produce illumination source, a driver that is the receptor, and the vehicle. The size of the vehicle matters.

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Federal Highway Administration

May 6, 2010

# Final Rule

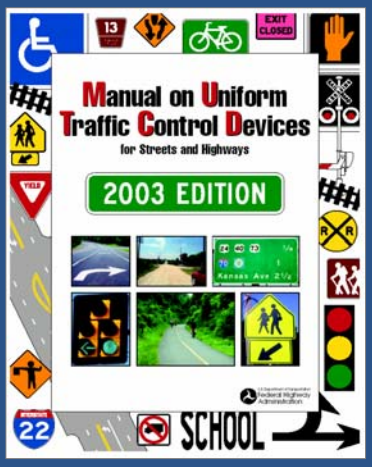
Published on Dec 21, 2007

- Vol 72, No. 245

Revision #2 of the 2003 Edition of the MUTCD

Effective Jan 22, 2008

Federal Register

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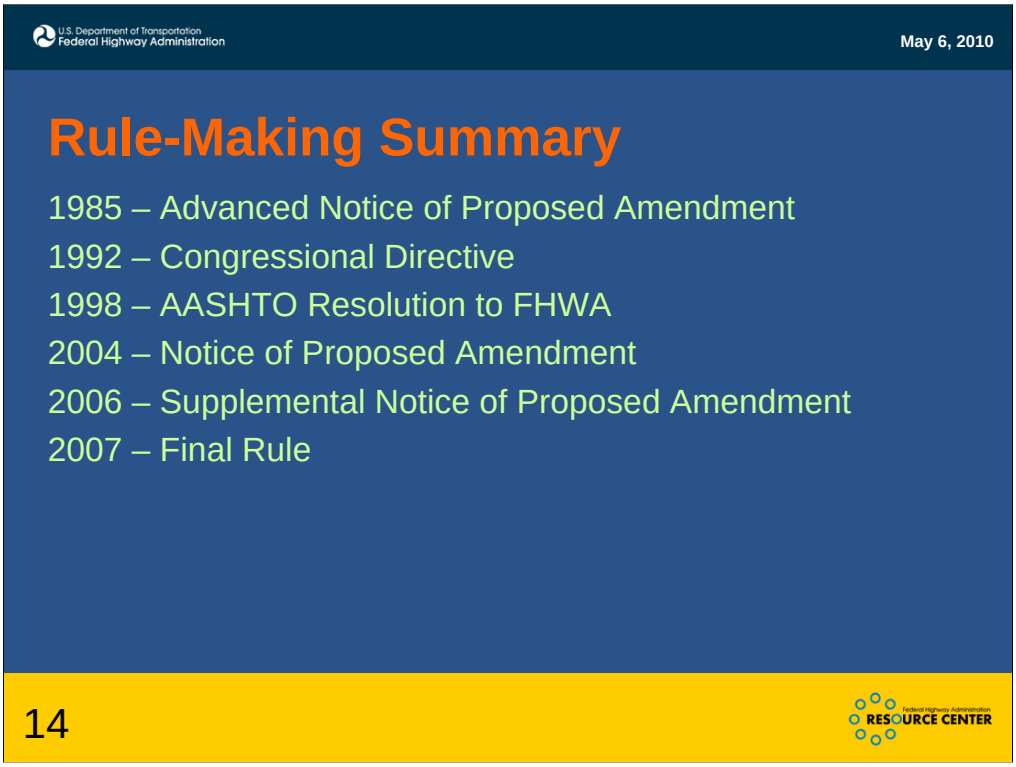
On Dec 21 2007, the Final Rule for minimum sign retroreflectivity was published in the Federal Register. This change to the MUTCD is officially described as Revision 2 of the 2003 Edition of the MUTCD. Let's look closer at the Final Rule.




FHWA had started investigating minimum retroreflectivity before the Congressional Directive of 1992.

The NPA in 2004 was based on the AASHTO input and input from a round of 4 agency workshops. It generated 85 letters totaling about 350 comments. FHWA considered the comments and made significant changes to the proposed language. This required the SNPA of 2006.

There were 3 key changes in the SNPA. 1. In the NPA the wording related to minimum retroreflectivity was worded as a SHOULD condition. In the SNPA it was changed to a SHALL. 2. In the NPA the table of minimum retro levels was proposed in a reference document. In the SNPA it was proposed in the MUTCD. 3. There was ambiguity in the compliance periods proposed in the NPA. They were clarified in the SNPA.

The SNPA generated 121 letters totaling about 550 comments. The FHWA responses are documented in the Final Rule, which I'll describe in the next series of slides.

# Background

## 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."



In 1992, a Congressional Directive driving minimum retro work and new MUTCD regs. was published. The directive includes some key points. First, it includes the MUTCD. It also says that a "standard" is needed for signs and pavement markings. These are key concepts that have driven the MUTCD min retro language I will be discussing shortly.

# MUTCD Changes

Introduction

- Compliance dates

Part 1

- 1A.11 - relation to other publications

Chapter 2A

- 2A.09 - minimum sign retroreflectivity ⬅ **Key element of revision**
- 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.

# Summary of New Language

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"

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.

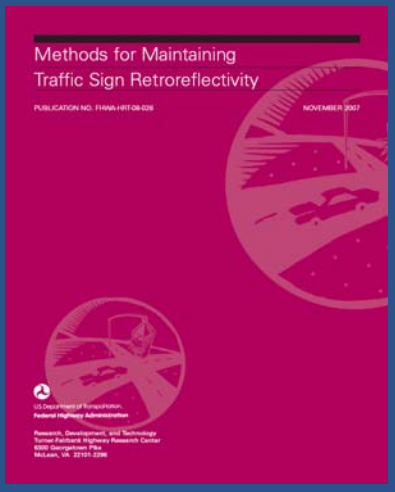
# MUTCD Maintenance Methods

How to be in Compliance with new Retroreflectivity Maintenance Requirements

# Can we decide to replace signs based on daytime inspections?

# MUTCD Methods

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




www.fhwa.dot.gov/retro

# Method 1: Visual Assessment

Trained inspector

Visual inspection at night

Need to tie to minimum values by using

- Calibration signs procedure, or
- Comparison panels procedure, or
- Consistent parameters


# Method 1: Visual Assessment

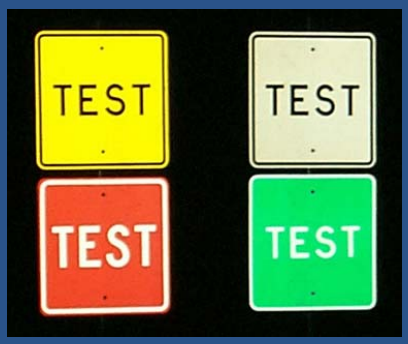
Common elements of all visual assessment techniques

- Aim inspection vehicle headlamps
- Two-person crew works best
- Having an inventory is ideal
- Use low-beam headlamps
- Have evaluation form and criteria
- Conduct evaluations at roadway speed

# Method 1: Visual Assessment

Tie to minimum values with calibration signs

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



# Method 1: Visual Assessment

Tie to minimum values with comparison panels

- Panels are near desired retro
- Clipped to sign - viewed from distance
- Evaluate signs compared to panels

# Method 1: Visual Assessment

Tie to minimum values by using same parameters used to develop the minimums

- Inspector – older driver (60+)
- SUV type vehicle
- Cutoff headlamps
  - (properly aimed)

# Method 2: Measure Sign Retro

Use a portable instrument

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





Sign age on front of sign

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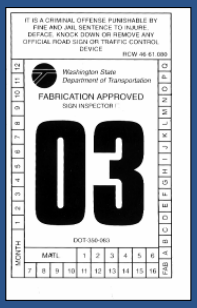
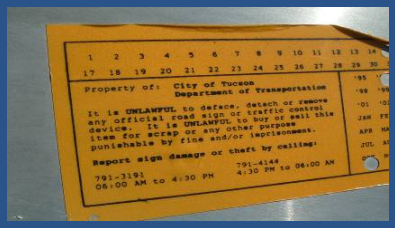
# Indicating Sign Age

Stickers on front or back of sign to show when fabricated or installed







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Sign age on back of sign

# Warranty Information

Predicted sign age could be provided in a warranty by sheeting manufacturers.

Typical warranties:

| ASTM D4956 | Years* |
|---|---|
| I and II | 7 |
| III and IV | 10 |
| VII, VIII, IX, X | 12 |
| * May be different for fluorescent materials | |

# Method 4: Blanket Replacement

- All signs in an area/corridor are replaced at the same time at specified intervals
- Specified intervals could be set based on expected sign life
- Some existing blanket sign replacement policies exist using 10-12 years for Beaded High-Intensity sheeting signs

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# Blanket Replacement Method

- Divide agency into areas/corridors
- Relate number of areas to replacement cycle (based on service life)
- Replace all signs in an area/ corridor each replacement cycle
  - 10 yr life, ➔ 10 areas
  - Annual replacement in each area


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This method is very similar to the Expected Sign Life Method, except that this method treats all signs in an area as the same, instead of managing every individual sign. **City of Mesa AZ Maintenance Zones**

# Method 5: Control Signs

- Sign life is estimated using a subset of 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 of all their signs.
- Periodically measure retroreflectivity 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

# Combining Methods

Use one or more of the methods together

- Support and reinforce each other
- Use one as quality control of another

Possibilities

- Visual inspection to identify signs to be measured
- Measured retro of control signs

# Summary: Methods Allowed

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

# 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,)

# Clarification

Fluorescent colors

- fluorescent yellow -- > yellow
- fluorescent yellow-green -- > yellow
- fluorescent orange -- > orange

# 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)

# What Should Be Done Next?

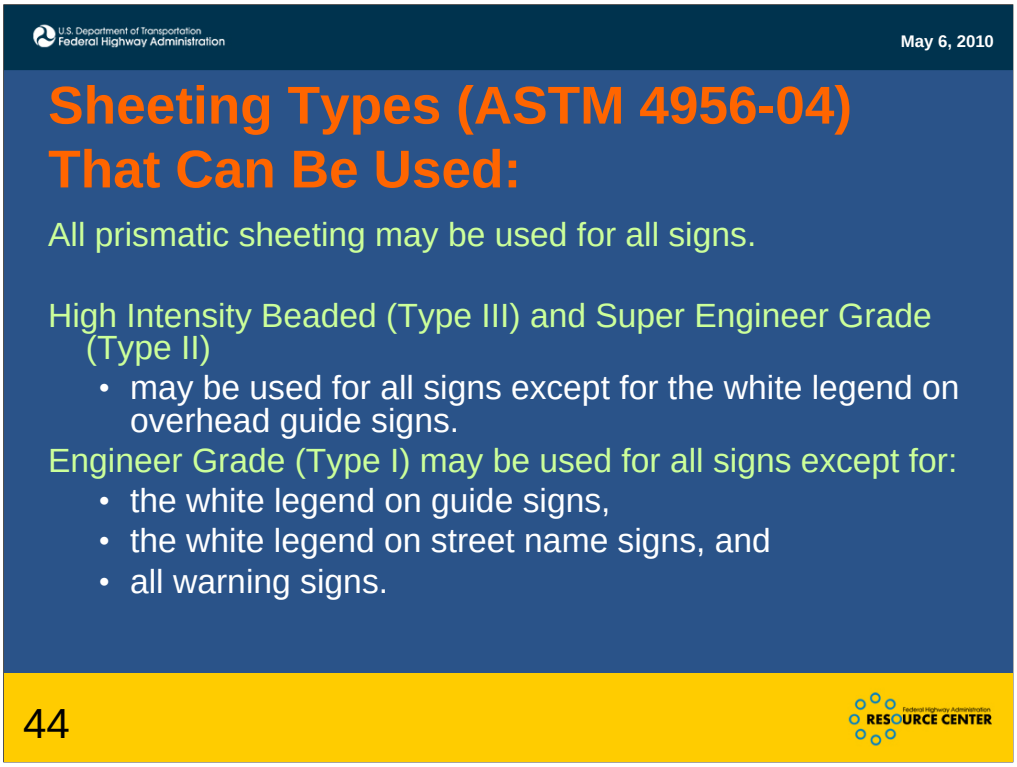
# What Should Be Done Next?

Select assessment method(s)
Budget for necessary effort
Train inspectors
Implement assessment method(s)
Decide on sheeting types
Budget for the future
Replace signs

# Decide on Sheeting Types

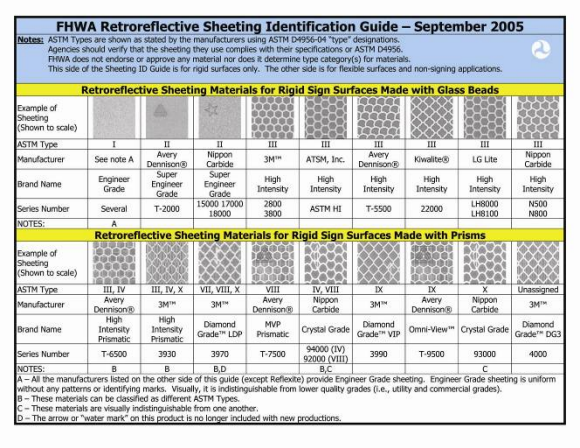
Consider

- Initial cost of sheeting and labor
- Life expectancy of sheeting
- Life/cycle cost
- Potential hazards to sign crews




Here is a summary of what sheeting types are allowed for new signs.

# Sign Sheeting ID Guide



**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**

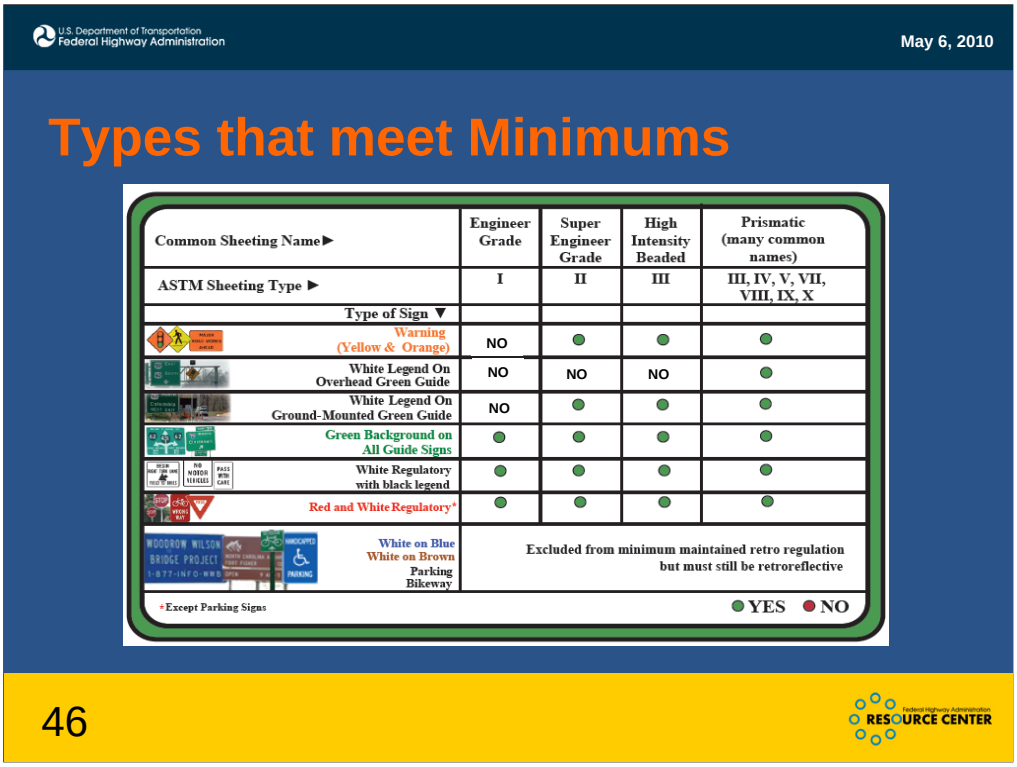
| Example of Sheeting (Shown to scale) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ASTM Type | III, IV | III, IV, X | VII, VIII, X | VIII | IV, VIII | IX | IX | X | Unassigned |
| Manufacturer | Avery Dennison® | 3M™ | 3M™ | Avery Dennison® | Nippon Carbide | 3M™ | Avery Dennison® | 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.

**http://safety.fhwa.dot.gov/roadway_dept/night_visib/sign_visib/sheetguide_sept05/**



This is a sheeting ID Guide that is available on the web site. It helps you figure out what type of sheeting is on your signs in the field.




All prismatics currently on the market may be used for all signs.

High-Intensity Beaded and Super Engineering Grade may be used for all signs except white legend on overhead guide signs.

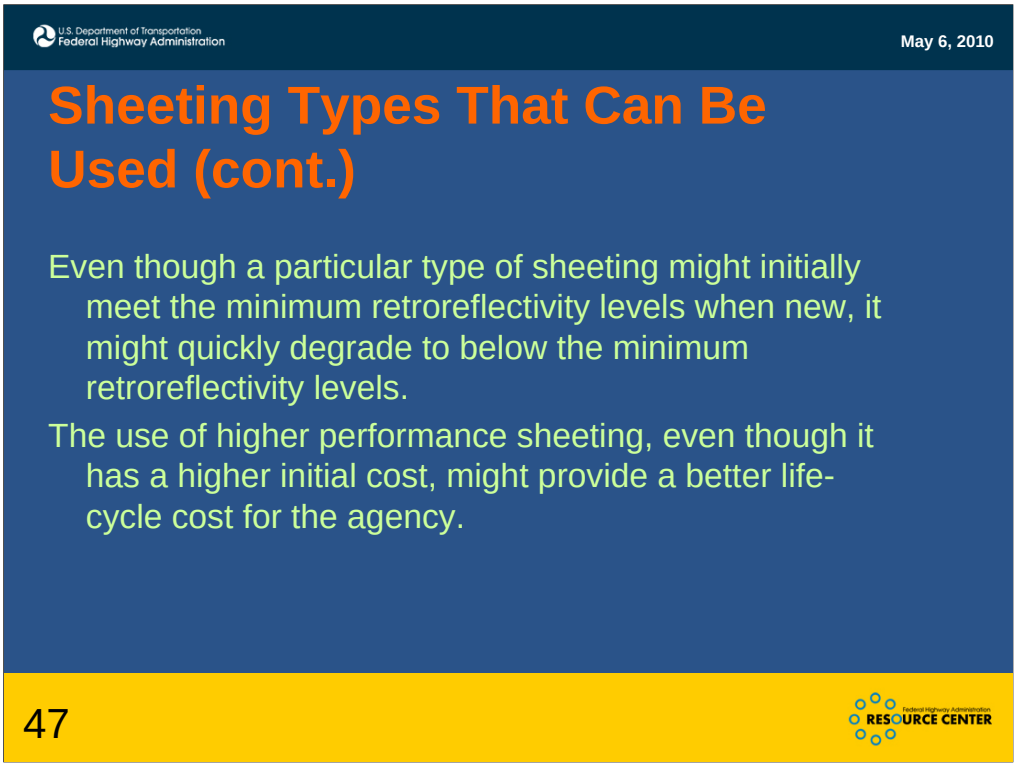
Engineer Grade may be used for all signs except for:

White legend on guide signs

White legend on street name signs

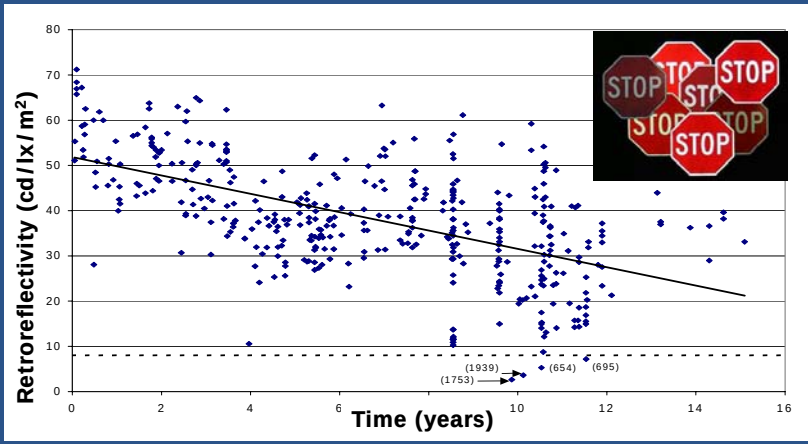
All warning signs

Even though a particular type of sheeting might initially meet the minimum retro level when it is new, it might quickly degrade to below the minimum, thus losing its effectiveness at night and requiring replacement during next assessment. The use of higher performance sheeting, even though it has a higher initial cost, might provide a better life-cycle cost for the agency.




This is a very important item to remember.

# Retroreflectivity Fades






The problem we have with providing driver cues, and critical information, to drivers at night is that retroreflective devices fade over time. But when should we replace our signs due to faded retroreflectivity. When do the signs no longer meet the needs of the older driver?

# Summary

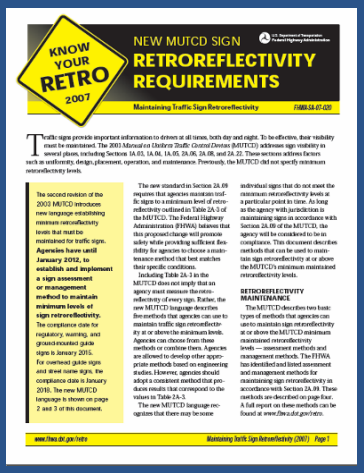
New regulation in place

Must use an assessment or management method in MUTCD

Must begin to make decisions now in order to meet compliance dates

Consider life-cycle costs, not just initial costs, when replacing signs

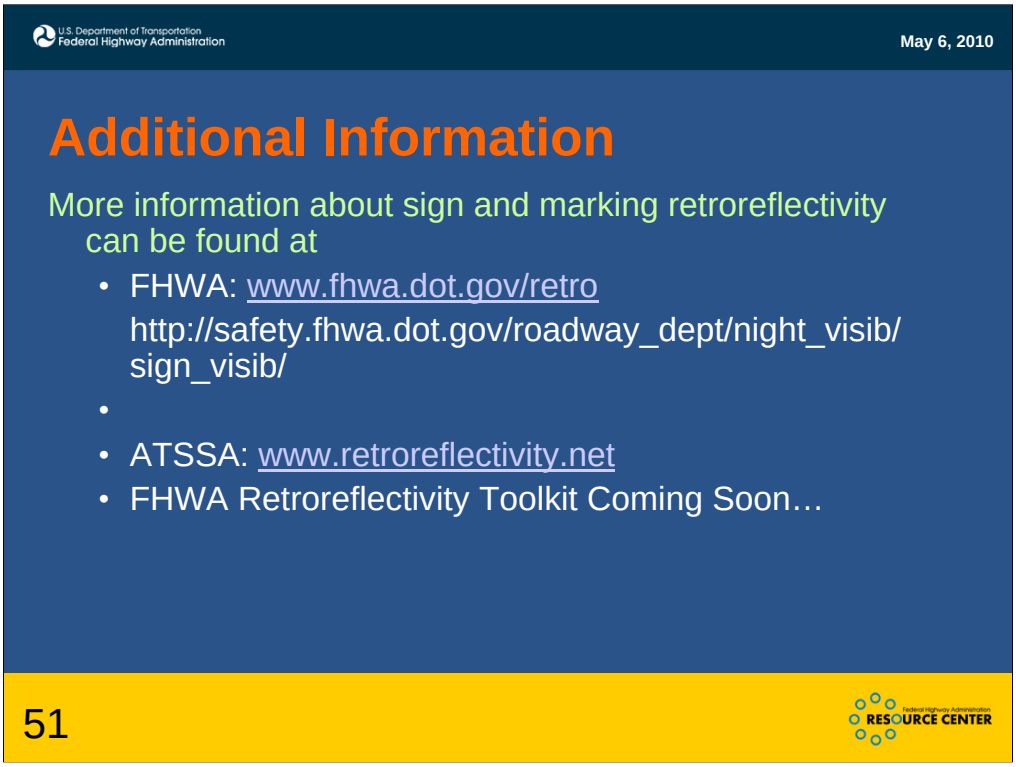
# FHWA Supporting Material



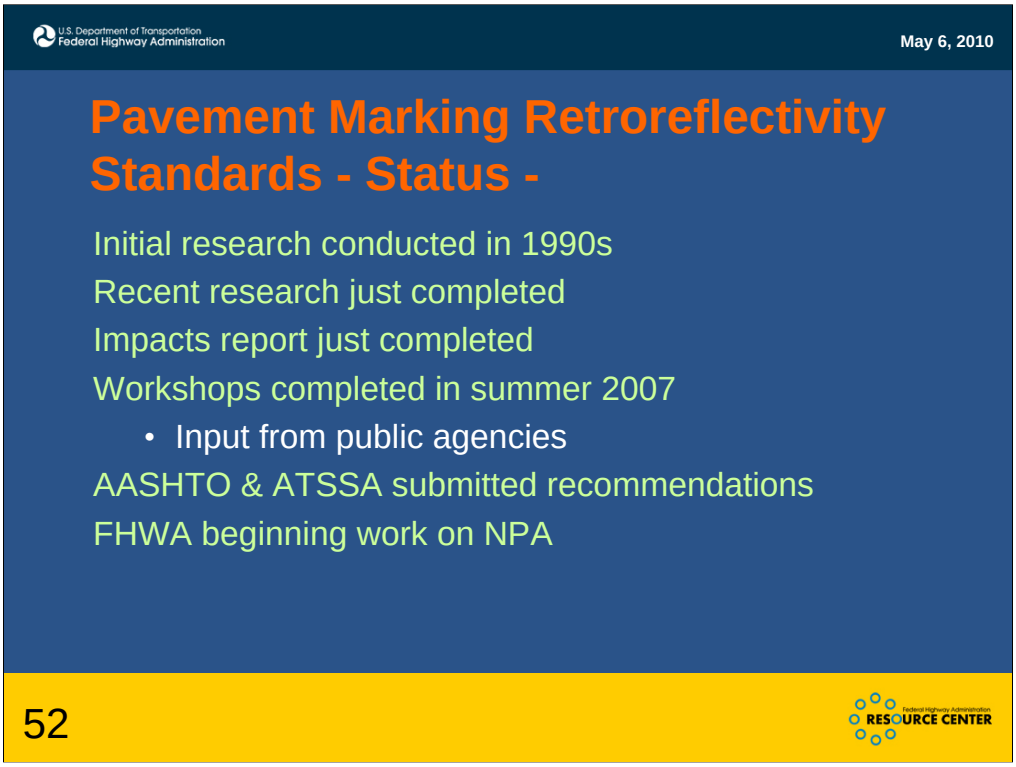

FHWA has developed a variety of material to explain the final rule. A good reference site for research reports and all other information related to the minimum retroreflectivity efforts is the web site shown here. An example of the material on this web site is this 4-page summary that I mentioned earlier. This is the document that is referenced in the MUTCD language. The front page is shown on this slide. Copies of this brochure are available in the FHWA Report Center.

Another key feature of the web site is the FAQ section. A lot of the incoming questions (and answers) related to the new retroreflectivity requirement are posted here.




Thank you for your time and attention. Here is additional information you may want to jot down for future reference.

FHWA is not responsible for what ATSSA posts on their site, but they do a pretty good job. Some other sites on the web have misinformation.




The Congressional Directive did require MUTCD standard for both signs and pavement markings. Now that the sign requirement has been fulfilled, the FHWA has moved their focus to the pavement markings. However, work has been underway since the mid 1990s when the first research was completed. Since then, a fresh look at the minimums for pavement markings has been completed and in the summer of 2007, the FHWA hosted two national workshops to solicit public agency input regarding the minimum retro levels for pavement markings.

The FHWA has started to begin their work to prepare MUTCD language and an NPA to add minimum pavement marking retroreflectivity the MUTCD. The NPA may be out as early as the end of 2008 but no timeline has been set. As usually, whenever the NPA is out, and the comment period ends, the FHWA will consider the comments and move to the appropriate next step. There will be many tough decisions and lots of discussions. In many ways, developing minimum pavement marking retroreflectivity levels will be more challenging than it has been for minimum sign retroreflectivity levels --- and that rule-making effort took about 4 years once the NPA went out.


That being said, here are some important reminders to review as we move forward.

# Additional Information

Worker Visibility Rule

- ANSI Class 2 on Federal Highways
- November 24, 2008

Breakaway Signpost

- >50 MPH, Within Clearzone
- January, 2013


New provisions are being incorporated into the MUTCD that require the use of high-visibility safety apparel by all workers (including flaggers) within the public right-of-ways of all federal-aid and non-federal-aid streets and highways. This is an expansion of recent 23 CFR revisions, to extend the applicability from just federal-aid highways to all roads open to public travel. A new option is being added that allows first responders and law enforcement personnel to use safety apparel meeting a newly-developed ANSI standard for "public safety vests" because this type of vest will better meet the special needs of these personnel. Also, a recommendation is being added that all on-scene responders and news media personnel in traffic incident areas should wear high-visibility apparel

**How Will This Be Implemented?**

**FHWA realizes that no agency can inventory, inspect, design, and replace non-breakaway sign supports overnight.** The easiest way to accomplish this is to begin using breakaway supports when installing new signs or replacing damaged supports. All non-breakaway sign supports within the clear zone of roads posted at 50 mph or greater shall be replaced by January 2013.

The retroreflective material on traffic signs has a limited life span. It is recommended that this retroreflective sheeting be upgraded over a seven to ten year span. Costs can be minimized by coordinating the replacement of sign supports with the upgrading of the retroreflective sheeting of signs.

**Safer Sign Supports: Are Yours Breakaway Yet?**

**Where can I get more information?**

Manual on Uniform Traffic Control Devices:

http://mutcd.fhwa.dot.gov

A Guide to Small Sign Support Hardware by AASHTO/AGC/ARTBA Task Force 13, 1998. This guide may be purchased from the AASHTO web site bookstore, Code GSSSH-1:

https://bookstore.transportation.org/

AASHTO Roadside Design Guide, 2002. This guide may be purchased at the AASHTO web site bookstore, Code RSDG-3-M:

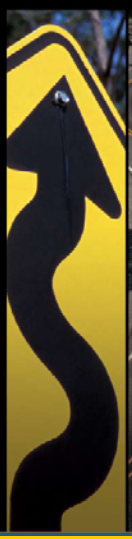
https://bookstore.transportation.org/

Additional information on crashworthy sign supports and other highway safety topics can be found at:

http://safety.fhwa.dot.gov/

FHWA-SA-06-14

**Safer Sign Supports: Are Yours Breakaway Yet?**



U.S. Department of Transportation
Federal Highway Administration

# Questions?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