Traffic Sign Retroreflectivity

- Rule
- Requirements
- Sign Maintenance Methods
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.
Nighttime Driving

**Daytime**
- Many cues available
- Driver task relatively easy

**Nighttime**
- Few cues remain
- Task more difficult

*Retroreflectivity provides nighttime guidance*
Night Travel and Crashes

Source: National Safety Council
Why Create Minimums?

Daytime

Nighttime
Retroreflectivity

When do we replace the sign?

Retroreflectivity Degrades Over Time
Typical Outdoor Durability Testing

45 degree south facing

Retroreflectivity

Age (months)

Type III
Type II
Type I

0 10 20 30 40 50 60 70 80
“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**

<table>
<thead>
<tr>
<th>SHEETING TYPE (ASTM D4956-04)</th>
<th>Prismatic Sheet (III, IV, VI, VII, VIII, IX, X)</th>
<th>ADDITIONAL CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SIGN COLOR</strong></td>
<td><strong>I</strong></td>
<td><strong>II</strong></td>
</tr>
<tr>
<td>White on Green</td>
<td>W ≥ 7</td>
<td>W ≥ 15</td>
</tr>
<tr>
<td>Black on Yellow or Black on Orange</td>
<td>Y ≥ G ≥ 7</td>
<td>Y ≥ 50; O ≥ 50</td>
</tr>
<tr>
<td>White on Red</td>
<td>W ≥ 35; R ≥ 7</td>
<td></td>
</tr>
<tr>
<td>Black on White</td>
<td>W ≥ 30</td>
<td></td>
</tr>
</tbody>
</table>

* The minimum maintained retroreflectivity levels shown in this table are in units of cd/lm/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 1000 mm (40 in) and for all sizes of bold symbol signs

* For text and fine symbol signs measuring less than 1000 mm (40 in)

* 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**

- W1-1, 2 - Turn and Curve
- W1-3, 4 - Reverse Turn and Curve
- W1-5 - Windshield
- 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, 7 - Circular Intersection
- 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 Roundabout
- W5-1, 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
- 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 Arrows
- W16-5, 6, 7 - Pointing Arrow Plaques
- W20-7 - Flagger
- W21-4 - Worker

**FINE SYMBOL SIGNS – Symbol Signs Not Listed As Bold Symbol Signs**

- 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 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

<table>
<thead>
<tr>
<th>Common Sheeting Name</th>
<th>Engineer Grade</th>
<th>Super Engineer Grade</th>
<th>High Intensity Beaded</th>
<th>Prismatic (many common names)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASTM Sheeting Type ▶</td>
<td>I</td>
<td>II</td>
<td>III</td>
<td>III, IV, V, VII, VIII, IX, X</td>
</tr>
<tr>
<td>Type of Sign ▼</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Warning (Yellow &amp; Orange)</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>White Legend On Overhead Green Guide</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>White Legend On Ground-Mounted Green Guide</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Green Background on All Guide Signs</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>White Regulatory with black legend</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Red and White Regulatory*</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

- Excluded from minimum maintained retro regulation but must still be retroreflective

*Except Parking Signs
### 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

<table>
<thead>
<tr>
<th>Example of Sheeting (Shown to scale)</th>
<th>ASTM Type</th>
<th>Manufacturer</th>
<th>Brand Name</th>
<th>Series Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>See note A</td>
<td>Engineer Grade</td>
<td>Several 15000 17000 18000 2800 3800 ASTM HI T-5500 22000 LH8000 LH8100 N500 N800</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Avery Dennison®</td>
<td>Super Engineer Grade</td>
<td>High Intensity</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Nippon Carbide</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>3M™</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>ATSM, Inc.</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Avery Dennison®</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Kwalite®</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>LG Lite</td>
<td>High Intensity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Nippon Carbide</td>
<td>High Intensity</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

A

#### Retroreflective Sheeting Materials for Rigid Sign Surfaces Made with Prisms

<table>
<thead>
<tr>
<th>Example of Sheeting (Shown to scale)</th>
<th>ASTM Type</th>
<th>Manufacturer</th>
<th>Brand Name</th>
<th>Series Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>III, IV</td>
<td>III, IV, X</td>
<td>Avery Dennison®</td>
<td>High Intensity Prismatic</td>
<td>T-6500 3930 3970 T-7500 94000 (IV) 92000 (VIII) 3990 T-9500 93000 4000</td>
</tr>
<tr>
<td>III, IV, X</td>
<td>III, IV, X</td>
<td>3M™</td>
<td>High Intensity Prismatic</td>
<td></td>
</tr>
<tr>
<td>VII, VIII, X</td>
<td>VII, VIII, X</td>
<td>3M™</td>
<td>Diamond Grade™ LDP</td>
<td></td>
</tr>
<tr>
<td>VIII</td>
<td>VIII</td>
<td>3M™</td>
<td>MVP Prismatic</td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>IX</td>
<td>Avery Dennison®</td>
<td>Crystal Grade</td>
<td></td>
</tr>
<tr>
<td>IX</td>
<td>IX</td>
<td>Nippon Carbide</td>
<td>Diamond Grade™ VIP</td>
<td></td>
</tr>
<tr>
<td>X</td>
<td>X</td>
<td>Avery Dennison®</td>
<td>Omni-View™</td>
<td></td>
</tr>
<tr>
<td>Unassigned</td>
<td>Unassigned</td>
<td>Nippon Carbide</td>
<td>Crystal Grade</td>
<td></td>
</tr>
<tr>
<td>Unassigned</td>
<td>Unassigned</td>
<td>3M™</td>
<td>Diamond Grade™ DGC</td>
<td></td>
</tr>
</tbody>
</table>

**NOTES:**

B – 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.
Traffic Sign Inspection Sheet – SAMPLE 1

Date Surveyed ____________

Zone _____ Roadway ________________________ Location/Direction ____________

From ____________________ To ____________________

| Milepoint | Direction | Sign Type | MUTCD Number | Sign Size | Sign Message | Reflectivity | OK | Remove Sign | Replace Sign | Adjust Height | Steel Post | Wood Post | New Post | Level Post | Remarks |
|-----------|-----------|-----------|---------------|-----------|--------------|--------------|----|-------------|--------------|--------------|------------|-----------|----------|----------|-----------|---------|
|           |           |           |               |           |              |              |    |             |              |              |            |           |          |          |          |         |
|           |           |           |               |           |              |              |    |             |              |              |            |           |          |          |          |         |
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, \( \Rightarrow \) 10 areas
  - Annual replacement in each area

Example:

- Replace all signs in this area during 1st year
- 7th year
- 3rd year
- 5th year
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 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

<table>
<thead>
<tr>
<th>Date</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 22, 2012</td>
<td>Identify and begin using method(s)</td>
</tr>
<tr>
<td>Jan 22, 2015</td>
<td>Replace identified regulatory, warning, and ground-mounted guide signs (except street-name)</td>
</tr>
<tr>
<td>Jan 22, 2018</td>
<td>Replace identified street name and overhead guide signs</td>
</tr>
</tbody>
</table>
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 = \( \frac{65}{7} = $9.29/\text{yr} \)
  - Super Engineer Grade = \( \frac{67}{10} = $6.68/\text{yr} \)
  - High Intensity Beaded = \( \frac{68}{12} = $5.68/\text{yr} \)
  - High Intensity Prismatic = \( \frac{71}{12} = $5.94/\text{yr} \)
  - Other Prismatic = \( \frac{87}{16} = $5.80/\text{yr} \)

Now what if you have 2000 warning signs?
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
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

U.S. Department of Transportation
Federal Highway Administration
Indiana LPA Sign Review

- Visited 10 local agencies
  - Counties
  - Towns
- Talked with agency representative
- Driving tour observing signs
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
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
What Should Be Done Next?

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