Retroreflectivity
It’s Required

• Manual on Uniform Traffic Control Devices
• 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).

• 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, maintenance, and uniformity of traffic control devices shall rest with the public agency or the official having jurisdiction.
Compliance Times

• The FHWA final ruling on Retroreflectivity, Section 2A.09 of the MUTCD, went into effect January, 2008
• Agencies have until January, 2012 to establish and implement one of the methods laid out by the FHWA
• The compliance date on all regulatory, warning, and ground mounted guide signs is January, 2015
• Overhead guide signs and street ID signs have until January 2018
Methods of Maintaining or Managing Retroreflectivity

6 Ways
The Methods

• I Visual Night Time Inspection
• II Measured by Sign Retroreflectivity
• III Expected Sign Life
• IV Blanket Replacement
• V Control Signs
• VI Other Method – Engineering Study

• Combined methods
• All methods must meet or exceed the levels defined by the chart 2A-3
## Chart 2A-3

### New MUTCD Table 2A-3. Minimum Maintained Retroreflectivity Levels

<table>
<thead>
<tr>
<th>SIGN COLOR</th>
<th>SHEETING TYPE (ASTM D4956-04)</th>
<th></th>
<th></th>
<th></th>
<th>ADDITIONAL CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beaded Sheeting</td>
<td>Prismatic Sheeting</td>
<td>III, IV, VI, VII, VIII, IX, X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White on Green</td>
<td>W*; G ≥ 7</td>
<td>W*; G ≥ 15</td>
<td>W*; G ≥ 25</td>
<td>W ≥ 250; G ≥ 25</td>
<td>Overhead</td>
</tr>
<tr>
<td></td>
<td>W*; G ≥ 7</td>
<td>W ≥ 120; G ≥ 15</td>
<td></td>
<td>Ground-mounted</td>
<td></td>
</tr>
<tr>
<td>Black on Yellow or Black on Orange</td>
<td>Y*; O*</td>
<td>Y ≥ 50; O ≥ 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Y*; O*</td>
<td>Y ≥ 75; O ≥ 75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White on Red</td>
<td>W ≥ 35; R ≥ 7</td>
<td>W ≥ 50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black on White</td>
<td>W ≥ 50</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m² measured at an observation angle of 0.2° and an entrance angle of -4.0°.
2. For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs
3. For text and fine symbol signs measuring less than 1200 mm (48 in)
4. Minimum Sign Contrast Ratio ≥ 3:1 (white retroreflectivity + red retroreflectivity)

* This sheeting type should not be used for this color for this application.
I Visual Night Time Inspection

- The retroreflectivity of an existing sign is assessed by a trained sign inspector conducting a visual inspection from a moving vehicle during nighttime conditions. Signs that are visually identified by the inspector to have retroreflectivity below the minimum levels should be replaced.
II Measured by Sign Retroreflectivity

• Retroreflectivity is measured using a retroreflectometer. Signs with retroreflectivity below the minimum levels should be replaced.
III Expected Sign Life

• When signs are installed, the installation date is labeled or recorded so that the age of a sign is known. The age of the sign is compared to the expected sign life. The expected sign life is based on the experience of sign retro-reflectivity degradation in a geographic area compared to the minimum levels. Signs older than the expected life should be replaced.
IV Blanket Replacement

• All signs in an area/corridor, or of a given type, should be replaced at specified intervals. This eliminates the need to assess retroreflectivity or track the life of individual signs. The replacement interval is based on the expected sign life, compared to the minimum levels, for the shortest-life material used on the affected signs.
V Control Signs

• Replacement of signs in the field is based on the performance of a sample of control signs. The control signs might be a small sample located in a maintenance yard or a sample of signs in the field. The control signs are monitored to determine the end of retro-reflective life for the associated signs. All field signs represented by the control sample should be replaced before the retroreflectivity levels of the control sample reach the minimum levels.
VI Other Method

• Other methods developed based on engineering studies can be used.
RETROREFLECTOMETERS
Available

- Chehalis, Spokane, Yakama, and Siletz Tribes are in process of purchasing four Retroreflectometers (with GPS), sign management programs and sign bar code readers that will be available to all Tribes.
- The Regional Office currently owns one Retroreflectometer.
- All five are the same manufacture - Delta.
RETROREFLECTOMETER

DELTA
Retrosign GR3
Retroreflectometer
DELTA RetroSign GR3

- Retroreflectometer
- GPS
- RFID Tag Reader
The GR3 has an extension pole option to assist with taking readings on signs that are too high to reach easily from the ground.

The extension pole comes equipped with a larger flange to assist in selecting reading locations and stability while the GR3 is on top of the pole.
This display confirms that the ASTM Geometry is the setting in use on the device.
Current FHWA requirements for handheld Retroreflectometer readings as defined by the ASTM standard E1709 require an entrance angle of -4° with an observation angle of .2°.
What Does a Reading Represent

This sample reading for the GR3 indicates the brightness of a sign at different Observation Angles. Only the .2° Reading is currently required.

This value is referred to as the $R_A$ which is defined by the formula

$$\frac{cd}{lx/m^2}$$
cd / lx / m²

How does this translate?

cd : candela – The intensity of the light source
  (how much light is sent to the sign surface)

lx : lux – Illumination, or light falling on a unit area
  (how much light is reflecting from the sign surface)

m² : Distance in meters squared
Calibration

It is essential to calibrate the device before the days use.

Calibration is done by comparing the values printed on the calibration plate to the reading of the same plate.
Taking Readings – Mean Calculation

The ASTM standard accepted by the FHWA requires that no less than *four* readings need to be taken for each retroreflective color. To accomplish this, the GR3’s Mean Calculation feature should be turned on through the menu or via the software connection.

The *Mean Calculation* symbol will display on the LCD whenever it is active.
Taking Readings
Proper Technique

Improper use of a handheld retroreflectometer could allow it to pass.

No one would pass a sign in this condition.
Proper handling will resolve this.

In any event, this sign would be failed by the operator regardless of the results of the readings.
Evaluation

Signs are evaluated against the published values on chart 2A-3.

### New MUTCD Table 2A-3. Minimum Maintained Retroreflectivity Levels

<table>
<thead>
<tr>
<th>SIGN COLOR</th>
<th>SHEETING TYPE (ASTM D4956-04)</th>
<th>ADDITIONAL CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Beaded Sheet</td>
<td>Prismatic Sheet</td>
</tr>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>White on Green</td>
<td>W*; G ≥ 7</td>
<td>W*; G ≥ 15</td>
</tr>
<tr>
<td>Black on Yellow or Black on Orange</td>
<td>Y*; O*</td>
<td>Y ≥ 50; O ≥ 50</td>
</tr>
<tr>
<td>White on Red</td>
<td></td>
<td>W ≥ 35; R ≥ 7</td>
</tr>
<tr>
<td>Black on White</td>
<td></td>
<td>W ≥ 50</td>
</tr>
</tbody>
</table>

- The minimum maintained retroreflectivity levels shown in this table are in units of cd/lux/m² measured at an observation angle of 0.2° and an entrance angle of ±0.5°.
- 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)
- This sheeting type should not be used for this color for this application.
Contrast Ratio

Contrast Ratio for White on Red Signs

3:1

Sample Readings

White $R_A = 100$  
Red $R_A = 50$

50 x 3 = 150  
150 > 100  
FAILED

Sample Readings

White $R_A = 265$  
Red $R_A = 35$

35 x 3 = 105  
105 < 265  
PASSED
Electronic Evaluation

The Retroreflectometers currently on the market are simply recording devices.

They cannot evaluate the RA values or contrast Ratios by themselves.

This task is typically handled either by manually evaluating the data, or by the use of software.
TAPCO
SignIT and Datalink

SignIT and Datalink are designed to assist in that process.
Datalink is used to gather information on Retroreflectivity, GPS Location and Sign ID on site.
Datalink is used to gather information on Retroreflectivity, GPS Location and Sign ID on site.
• FHWA Signs are selectable and sorted by code or color and are available for selection
Readings

- Rules for evaluating $R_A$ values are already attached to the sign images.
Send Datalink to SignIT

Readings are stored in Datalink until connected to SignIT and are then transmitted to SignIT to be sorted and stored with the proper record.
SignIT is the main database maintaining records on signs, assemblies, inventory, and work assignments.
SignIt

- Items Needing Maintenance:
  - Location: RS-1 @ Wall St & Professional Bldg 7/9
  - Assembly @ Wall St & Rail Crossing 6/12
  - Assembly @ Wall St & Rail Crossing 6/12
  - Assembly @ Wall St & The Grove in L 6/16
  - Assembly @ Wall St & Bridge B-67-13 6/10
  - Assembly @ Wall St & Bridge A-67-11 6/10
  - Assembly @ Wall St & Bridge A-67-15 6/10
  - Assembly @ Wall St Bridge B-67-13 7/9
  - Assembly @ Wall St & The Grove Lot 7/9
  - Assembly @ Wall St & West of the G 7/9

- Low Inventory:
  - Item: 27-42: Carriage Head Bolt 5/16" x 2 1/2" 398 (500)
  - Item: 35-1b: Bolt, 5/16 stainless hex head 53 (100)
  - Item: 37-91: Nut 5/16" Hex Head 464 (900)
  - Item: 37b-99: 1/2" Bolt, Nut, Washer Set 77 (100)
  - Item: 37z-45: Post, 10" x 2 3/8" OD Round, 3 3/4" 135 (150)
  - Item: 41-2-36: High Yield 0 (0)
  - Item: 37-211: Cross Piece 31 (40)
  - Item: 27-6: NO PARKING LOADING ZONE 2 (8)
  - Item: 22-90: Block, Sidewalk and Access 24 (30)
  - Item: 22-82-1: 24x20 25MPH 24x20 0 (6)
  - Item: 27-4: NPTEOS: No Parking This Side Of... 0 (6)
  - Item: 27-4: NPTOS: Exit Only - Special 0 (6)

- Open Work Orders:
  - #: WR000000010
  - Due Date: 8/1

- Requisitions:
  - #
  - Vendor
  - Date
SignIt - Alert Screen

- Items Needing Maintenance:
  - Location:
    - R5-1 @ Wall St & Professional Bldg: 7/9
    - Assembly @ Wall St & Rail Crossing...: 6/12
    - Assembly @ Wall St & Rail Crossing...: 6/12
    - Assembly @ Wall St & The Grove in T...: 6/16
    - Assembly @ Wall St & Bridge B-67-13: 6/30
    - Assembly @ Wall St & Bridge B-67-13: 6/30
    - Assembly @ Wall St & Bridge B-67-13: 6/30
    - Assembly @ Wall St & Bridge B-67-13: 7/9
    - Assembly @ Wall St & The Grove Lot: 7/9
    - Assembly @ Wall St & West of the G...: 7/9

- Low Inventory:
  - Item:
    - 37-62: Carriage Head Bolt 5/16" x 2 1/2": 398 (500)
    - 35-10: Bolt, 5/16 stainless hex head: 52 (100)
    - 37-97: Nut 5/16" Hex Head: 464 (500)
    - 373-69: 2 1/2 in Bolt, Nut, Washer Set: 77 (100)
    - 372-4: Post, 10" x 2 3/8" OD Round: 135 (150)
    - 5F-454: VDC Post, 4xSquare Wooden...: 4 (10)
    - R1-2.36 HP: Yield: 0 (10)
    - 37-24: Cross Piece: 31 (40)
    - R7-6: NO PARKING LOADING ZONE: 2 (8)
    - 23-VR2: VLock, Rd Post, Earth and As...: 24 (30)
    - R2-1: 24x30 25MPH: 0 (6)
    - R7-5: PDTS: No Parking This Side Of...: 0 (6)
    - SPEXIT24: Exit Only - Special: 0 (6)

- Open Work Orders:
  - #: WR000000010
  - Due Date: 5/1

- Requisitions:
  - Vendor
  - Date
Alert Screen - Maintenance

Show a list of all signs and assemblies that are due, close to due, or over due for scheduled maintenance.

<table>
<thead>
<tr>
<th>Location</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5-1 @ Wall St &amp; Professional Bldg</td>
<td>7/9</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; Rail Crossing 3...</td>
<td>6/12</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; Rail Crossing 3...</td>
<td>6/12</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; The Grove in t...</td>
<td>6/16</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; Bridge B-67-13</td>
<td>6/30</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; Bridge B-67-13</td>
<td>6/30</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; Bridge B-67-13</td>
<td>6/30</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; Bridge B-67-13</td>
<td>7/9</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; The Grove Lot</td>
<td>7/9</td>
</tr>
<tr>
<td>Assembly @ Wall St &amp; West of the G...</td>
<td>7/9</td>
</tr>
</tbody>
</table>
Alert Screen - Inventory

Show a list of all Inventory Items that are at or below their assigned reorder level.
Alert Screen – Work Orders

Show a list of all Work Orders that are open and pending.
Alert Screen - Requisitions

Show a list of all requisitions for inventory items that are pending.
SignIt - Inventory

Signit will maintain a list of all related hardware and equipment maintained or stored by the shop.

This can be as limited as signs and post, or as detailed as individual nuts and bolts, as is needed.
<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Qty</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>203-10</td>
<td>Dome Cap Roun...</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>203-11</td>
<td>Round Pole, 12'...</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>2180-</td>
<td>Blinker Stop R1...</td>
<td>-3</td>
<td>2</td>
</tr>
<tr>
<td>2180-</td>
<td>Blinker Stop 36...</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>23-VR2</td>
<td>VLock, Rnd Post...</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>267-2</td>
<td>Crossover, SNS...</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3177-16</td>
<td>Vandal Proof W...</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>3177-17</td>
<td>Anti Vandal Nut</td>
<td>105</td>
<td>100</td>
</tr>
<tr>
<td>34-4</td>
<td>Wedge</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>35-10</td>
<td>Bolt, 5/16 stainle...</td>
<td>53</td>
<td>100</td>
</tr>
<tr>
<td>35-8</td>
<td>Flared Leg Bracket</td>
<td>198</td>
<td>150</td>
</tr>
<tr>
<td>37-16</td>
<td>Stainless Snap L...</td>
<td>184</td>
<td>150</td>
</tr>
<tr>
<td>37-21</td>
<td>Cross Piece</td>
<td>31</td>
<td>40</td>
</tr>
<tr>
<td>37-22</td>
<td>Bracket for Rou...</td>
<td>45</td>
<td>40</td>
</tr>
</tbody>
</table>
Inventory Details

Inventory Details

Inventory ID: 269
Inventory Code: R1-2 30 HIP
Inventory Barcode:
Item Name: Yield
Reorder Quantity: 10
Initial Cost: 84.55
Category: Completed Sign
Description: R1-2 Yield on HIP

Sign Specs
Size: 36x36
FHWA Sign Code: R1-2
Legend(s):
Discontinued: None

On Hand: 0
In Use: 0
Retired: 0
Last Vendor
Sign Library Reference

Samples of the FHWA Standard Highway Signs Manual signs are accessible from the help menu as well as several other locations within both applications.
SignIt – Barcode Inventory

Signit supports barcode based inventory control as an optional add on.

Barcode labels can be produced in type 39 format from within the software or from other sources.

Barcode scanning is supported with the Unitech HT580 barcode scanner.
SignIt - Assemblies

The assembly section of the software tracks all of the signs attached to any given assembly tracked in the system.
Additionally, individual components and the estimated replacement costs of each assembly tracked to each individual piece of hardware.
SignIt - Signs

Individual signs, along with their maintenance and retroreflectivity histories are maintained separately. These histories stay with the sign even if it is recycled to a new location.
Sign Inspection History

Shows a history of the signs previous Retroreflectivity readings - both electronic and visual inspection.
SignIt - Streets

Streets and other landmark locations can be easily added individually or imported through text files to rapidly populate the software's lists of searchable locations.
### SignIt - Employees

Employees can be maintained in the list to allow log in and different levels of access to the software, and to maintain a history of the work done by different individuals.

<table>
<thead>
<tr>
<th>Name</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jefferson, Tom</td>
<td>Manager</td>
</tr>
<tr>
<td>Pierce, Frank</td>
<td>User</td>
</tr>
<tr>
<td>Polk, Jimmy</td>
<td>Manager</td>
</tr>
<tr>
<td>Tyler, Jack</td>
<td>User</td>
</tr>
<tr>
<td>Van Buren, Marty</td>
<td>User</td>
</tr>
</tbody>
</table>
Levels of Access

Different levels of access are assigned to different users to control and secure the data in the software.
SignIt - Retroreflectivity
Work Order Entry

Work Order entry and tracking, includes:

- listing of all parts at the location
- Permits that were acquired for the work if needed.
- Information related to the job and crew assignments.
SignIt - Requisitions

The Requisition area tracks all requests for purchases on all inventory items and assists in maintaining the current costs on all materials in inventory.
Printing Requisitions

- Requisitions can be configured with the organizational logos, and formatted to be consistent with existing purchase order or requisition number sequences.
SignIt - Reports

- Reports can be configured with various parameters to limit or expand the information to be displayed either on screen in a preview format, to export for use in a spreadsheet or other document, or for output to any printer.
SignIt - Mapping

• Mapping functions are a separate add on to the software. Requires the use of Microsoft MapPoint software.
• Shows the location and lists of related hardware on the map based on GPS positioning.
• Allows for access to mapping functions without an internet connection.
Mapping
Thank You