

Guidelines for Conducting Retroreflective Measurements of Traffic Signs

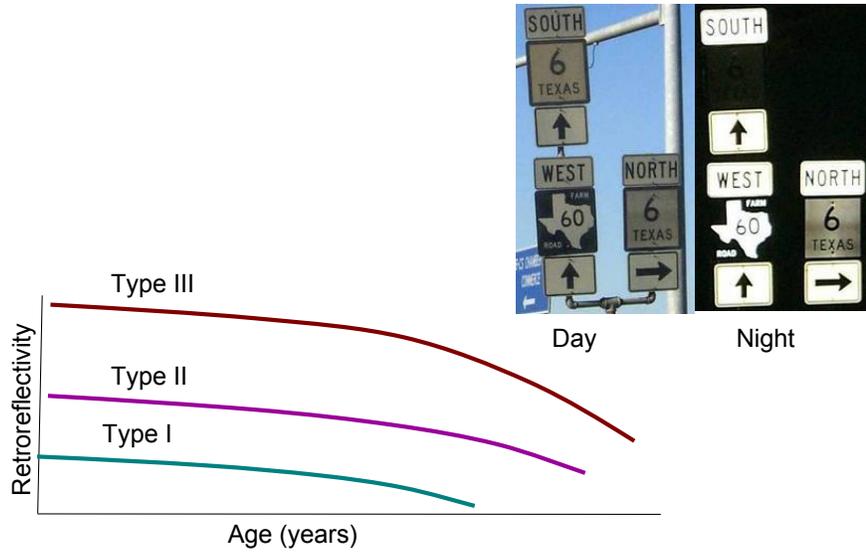
This information is intended to help you implement a sign retroreflectivity measurement method that satisfies the new MUTCD rules are in place regarding the maintenance of sign retroreflectivity.

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)**

Ask the audience why the measurements would need to be repeated annually (or some other set interval).

Sign Sheeting Degrades over Time



Retroreflectivity degrades over time and needs to be evaluated ever so often, regardless of the method of inspection.

Devices Available in the US

* as of October 2008



Model 922
by Road Vista
<http://www.roadvista.com>



Model GR3
by Delta
<http://www.tapconet.com/digital>

* FHWA does not endorse specific products

These are the two most common retroreflectivity measurements devices available in the US. They are both hand held devices and essentially produce the same information. The web sites for these instruments are shown on this slide for your reference. The devices are approx \$10,000 each.

Available Features



- **RoadVista Model 922**

- **Annular Device** (one measurement on prismatic)
- 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 prismatic 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

Costs are \$10,000 to \$12,000 as of **June** 2008. The info on this slide is only meant to be a quick reference for those interested in purchasing a device.

<This slide is not meant to take a lot of time>.

Important Common Features

- Measurements are provided at standard geometry (defined by ASTM)
 - 0.2 degree observation angle
 - -4.0 degree entrance angle
- Ability to store data
- Easy to use
- Rechargeable batteries

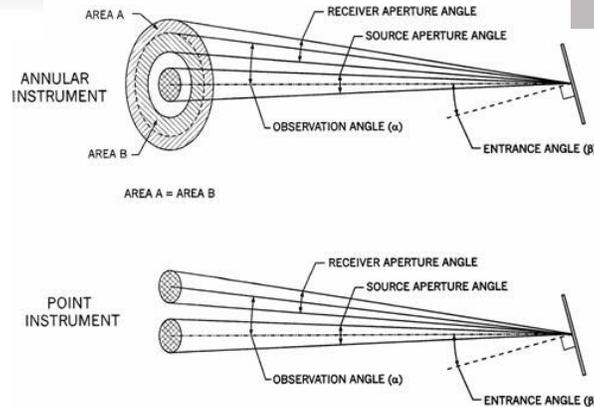
Both devices provide measurements at the standard geometry of 0.2 degree observation angle and 4 degree entrance angle. This is the same as the minimum retroreflectivity levels in the MUTCD. Measurements at other geometries cannot be used with the minimum retroreflectivity levels in the MUTCD table.

Important Distinctions

- **RoadVista Model 922**
– Annular Device



- **Delta RetroSign GR3**
– Point Device



If you measure the same point on the same sign, you may get different readings with these devices. This is why...

The instruments are either a "point instrument" or an "annular instrument," depending on the shape of the receiver aperture. You will need to know which kind you have because you will get different readings with them. Be sure to refer to the owner's manual and ask the seller for training on how to measure signs near the minimum retroreflectivity levels.

Practical Differences

- Sign sheeting materials made with glass beads - **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

Glass bead sheeting materials tend to be rotationally insensitive. Therefore, point and annular instruments should produce similar RA values for these materials. The RA values for prismatic sheeting, however, are rotationally sensitive, and the RA values produced by point and annular instruments can differ on the order of 10 percent, with differences of up to 25 percent possible. Annular instruments cannot accurately gauge how the RA of prismatic sheeting varies with rotation angle.

Measurement Rotation Example

- 0 degree rotation



Here is a measurement of the Stop sign with the retroreflectometer held at 0 degrees. The reading at 0.2 degrees is 179.

Measurement Rotation Example

- 45 degree rotation



Let's measure the same Stop sign but rotating the instrument 45 degrees. Now the reading at 0.2 degrees is 109.

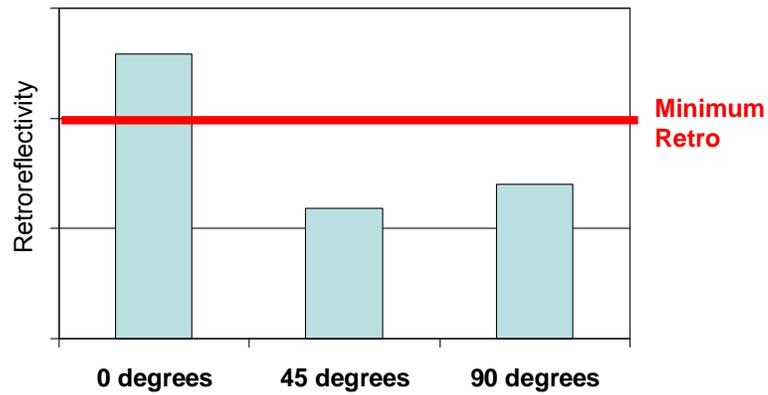
Measurement Rotation Example

- 90 degree rotation



OK. Once again, let's measure the same Stop sign but rotating the instrument to 90 degrees. Now the reading at 0.2 degrees is 120.

Measurement Rotation Example Results (Observation = 0.2°)



These differences are why you have to be consistent when using a point device. Imagine if the min retro was 150 in this case. There could be confusion on whether the sign passed minimum retro levels or not.

Always make measurements with devices held at the same orientation

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 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.

If you do not know the type of sheeting on your sign, use this reference to identify the specific type of material.

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

Avoid taking msmts where there are bullet holes, paint ball marks, graffiti, or other damage not representative of most of the sign's condition.

Always hold the retroreflectometer at the same orientation.

New MUTCD Table 2A.3 Minimum Maintained Retroreflectivity Levels

Sign Color	Sheeting Type (ASTM D4956-04) ①				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting	
	I	II	III	III, IV, VI, VII, VIII, IX, X	
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/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.

For Stop signs, we would compare to the average retroreflectivity levels to the numbers in the red box.

Now let's look at this "additional criteria for white on red signs (the number 4 in the circle)

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Maintaining a contrast ratio helps ensure that the sign is recognizable and legible at night.

Contrast Ratio



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

- Contrast ratio equals:

$$\frac{\text{Average of white measurements}}{\text{Average of red measurements}}$$

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

A contrast ratio of at least 3:1 is needed. The contrast ratio is computed by dividing the white retroreflectivity value by the red retroreflectivity value.

Most stop signs are made using a silk screening process. Over time, the red ink fades and even though the color begins to look bad, what happens is the retroreflectivity of the red increases (because of the faded ink). This lowers the contrast ratio of the sign.

Measuring Letters



Letters on street name signs and other similar signs where the letters are retroreflective create an issue in that the dimension of the letter is usually less than the dimension of the aperture of the retroreflectometer. In this case, you will need to use reducer cap, which requires recalibrating the retroreflectometer.

Measuring Letters

The reduction cap decreases the aperture size to 0.5 inch



After installing the reducer cap, the device will need to be recalibrated. And if you take the reduced cap off, the device will need to be recalibrated.

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



One concern, cannot tell orientation of sheeting when using extension pole

Orientation of Sign Sheeting



Not only is it important to measure signs with consistent device orientation, but it is also important to note the direction of the material on the sign. Here are some signs with materials installed at various orientations.

One thing to remember is to always hold the device up and down when making measurements.

Checklist

- Handheld retroreflector fully charged
- Ladder, extension pole, or bucket truck
- Proper safety gear
- Data entry form or use of device memory capability
- Some signs may be excessively dirty. A quick clean up can provide higher retroreflectivity and several more years of useful life. Therefore, may want to have water and rags available.

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



Increase safety
Increase nighttime visibility