



Proposed Specification Changes for Retroreflective Sheeting and Temporary Pavement Markings

☞ Fall - 2009 ☞

Challenge – Older Motorists

- VDOT has, as one of its goals, the reduction of crashes, injuries and fatalities involving older drivers.
- Commissioner Ekern challenged the agency to improve markings, sign sheeting, and channelization; improving visibility for older drivers in an attempt to reduce their crashes.
- The FHWA, echoing other Federal actions, has also asked states to enhance their traffic control programs to improve guidance for older drivers.



Challenges Being Met Older Motorists

What has been done already:

1. Larger traffic signals than required to increase their target value and color contrast;
2. More signals per approach than required on facilities having three or more through lanes;
3. More overhead signs (better target value and sight distance) than required;
4. A more highly retroreflective sign sheeting material than required;
5. Florescent signs in work zones to give motorists greater sight impact;



Challenges Being Met Older Motorists

6. Larger channelizing devices to delineate work zones;
7. Highly reflective material for pavement markings and reflective markers on high volume/high-speed roadways;
8. A higher standard for road markings than required; and
9. Use of wider markings for high volume and high-speed roadways



Even though we have taken these steps. Our crash numbers for motorist over 40 years old are still too high...

2005-'08 Summary

On average, during the last four years:
38.1% of all roadway crashes and;
36.4% of all injuries and;
45.6% of all fatalities in motor vehicle
crashes occurred to motorist over 40
years old.



Federal Legislation now Introduced

Congressman Jason Altmire (D-Pa) introduced H.R. 3355 – the “Older Driver and Pedestrian Safety and Roadway Enhancement Act of 2009” – which would direct the Secretary of Transportation to carry out a program to improve roadway safety infrastructure in all States to enhance the safety of older drivers and pedestrians.

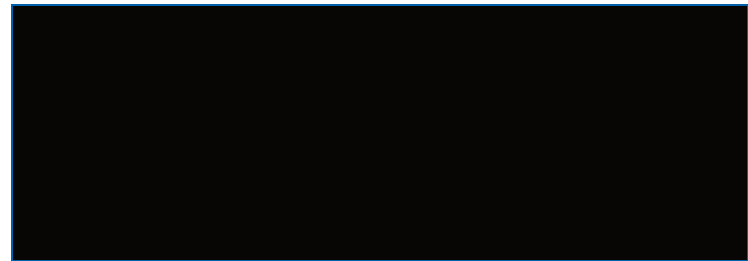


Congressman
Jason Altmire (D-Pa)

Federal Legislation now Introduced

In early October, Congressman Altmire delivered a floor speech in which he encouraged support of the bill, citing low-cost safety solutions including “signs with more legible font, retro-reflective sheeting and retro-reflective pavement markings, left turn lanes at intersections and improved sign placement to ensure that drivers have adequate time to make informed decisions on the road.” Several Cosponsors have now signed on.

To activate a video of Congressman Altmire’s address, click in the black box.



Night Driving

One Of The Larger Challenges In Our Quest To Improve The Motorist's Ability

VDOT is striving to make better the ability to see and perceive our Traffic Control Devices by both day and night, as will be seen through this presentation. However, we realize that the challenge of night driving is marked by the inability to see and perceive the entire driving environment, making the Traffic Control Device even more critical at night.

While volumes and perhaps speed are higher during the day lighted hours and while many advanced seniors choose not to drive after sun-set, the issues with diminished eye-sight capabilities during darkness is quite concerning, even for the 50 something and 60 something motorists, as the information on the following three pages demonstrates.

Vision of Older Drivers

According to the FHWA, “Maintaining minimum levels of sign retroreflectivity on the nation's roads is becoming increasingly important as the driving population ages. Older drivers have diminished visual capabilities that are most apparent under dark conditions. By 2010 an estimated 33.7 million drivers will be 65 or older. Traffic signs that are easier to see and read can help this growing segment of drivers as well as provide benefits to all drivers (not just the elderly) at night. The FHWA believes that the benefits associated with this rule-making will far out weight the costs.”

Vision of Older Drivers

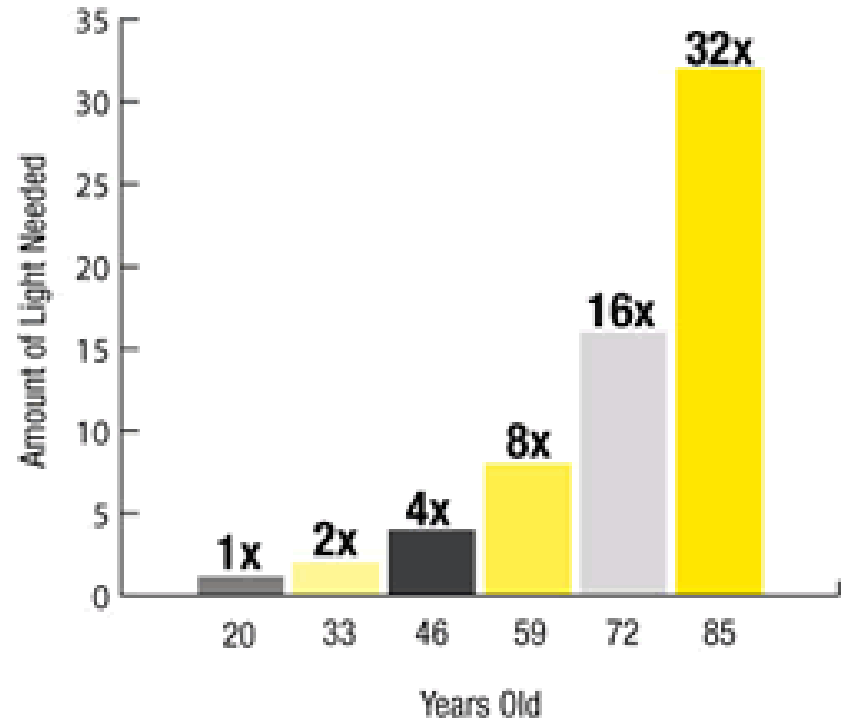
In support, FHWA goes on to say that, “Studies show that starting at age 20, the amount of light needed to see doubles every 13 years.” This means that a 59 year-old driver needs 8 times more light than a 20 year-old to see the same object while driving. See Figure 7. “By 2020, about one-fifth of the 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 can help older drivers retain their freedom of mobility, remain independent, and reduce their likelihood of being involved in traffic crashes.”

From: U.S. Department of Transportation – Federal Highway Administration Safety (Frequently Asked Questions)

http://safety.fhwa.dot.gov/roadway_dept/retro/sign/sign_faq.htm



Vision Bar Graph: With every 13 years we age beginning at 20, we need double of the amount of light to properly see in the dark.

The following section addresses pending changes to the retroreflective sheeting used by VDOT on most highway signs

To skip this section, advance to slide 30

Road and Bridge Specification Retroreflective Sheeting Changes

Prismatic Lens Sheeting for Permanent Signs



Road and Bridge Specification Retroreflective Sheeting Changes

Moving from Encapsulated Lens Sheeting to Prismatic Lens Sheeting for Permanent Signs, what are the reasons, and is now the time?

As Observed from an SUV, 100 Ft. away and looking straight towards the signs:

**On the top –
Encapsulated Lens**

**On the bottom –
Prismatic Lens**





INTERNAL EVALUATION:

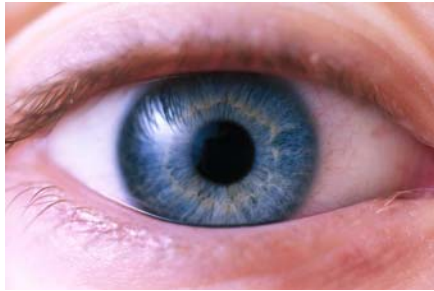
VDOT performed an internal evaluation of sheeting types using staff from our Traffic Engineering teams, our Materials engineers, our Field Forces and Sign Shop leaders, our Maintenance office and our Administrative planners.

A RENEWED FOCUS:

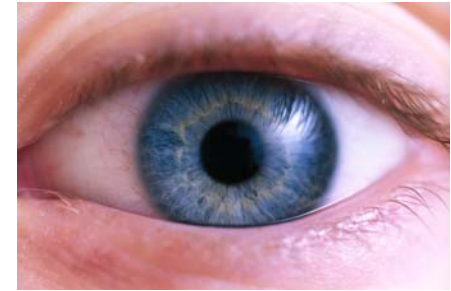
After much discussion and debate, The Materials Engineer was called on to present a pictorial review of the benefits of using a higher caliber of material. The following slides have been excerpted from that presentation. The presentation was key in an overwhelming agreement that higher grade prismatic sheeting is the product that VDOT should be focused on.

Sign Visibility

Basics of Sign Visibility



- Sign detection
- Sign legibility
- Sign contrast



Note: In the following slides, HI is a reference to Encapsulated Lens sheeting and Type IX and Type XI are references to higher quality types of Prismatic Lens sheeting.

Sign Legibility

Factors affecting sign legibility:

Contrast of Legend vs. Background

Font size and type

Stroke width-to-height ratio

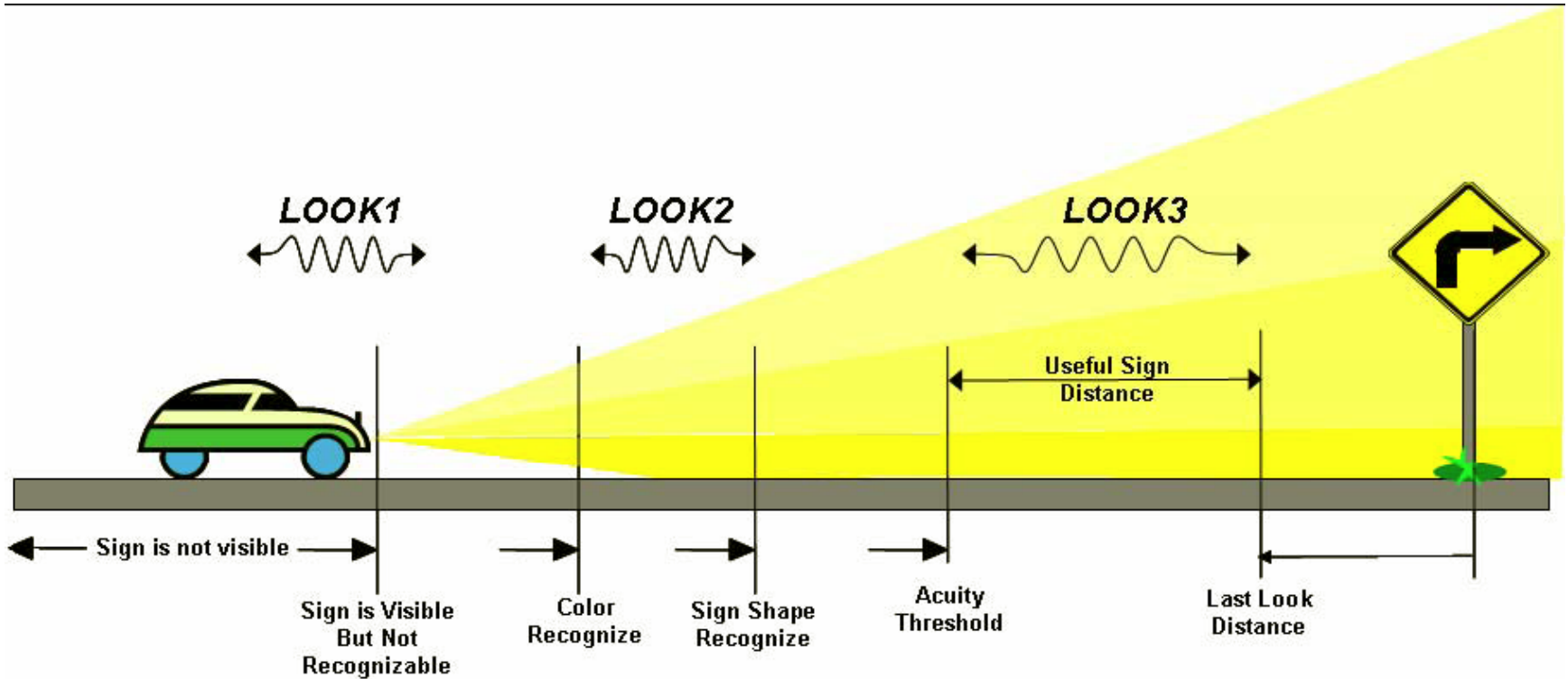
Word spacing, Letter spacing

Uppercase vs. Lowercase

Text vs. Symbols

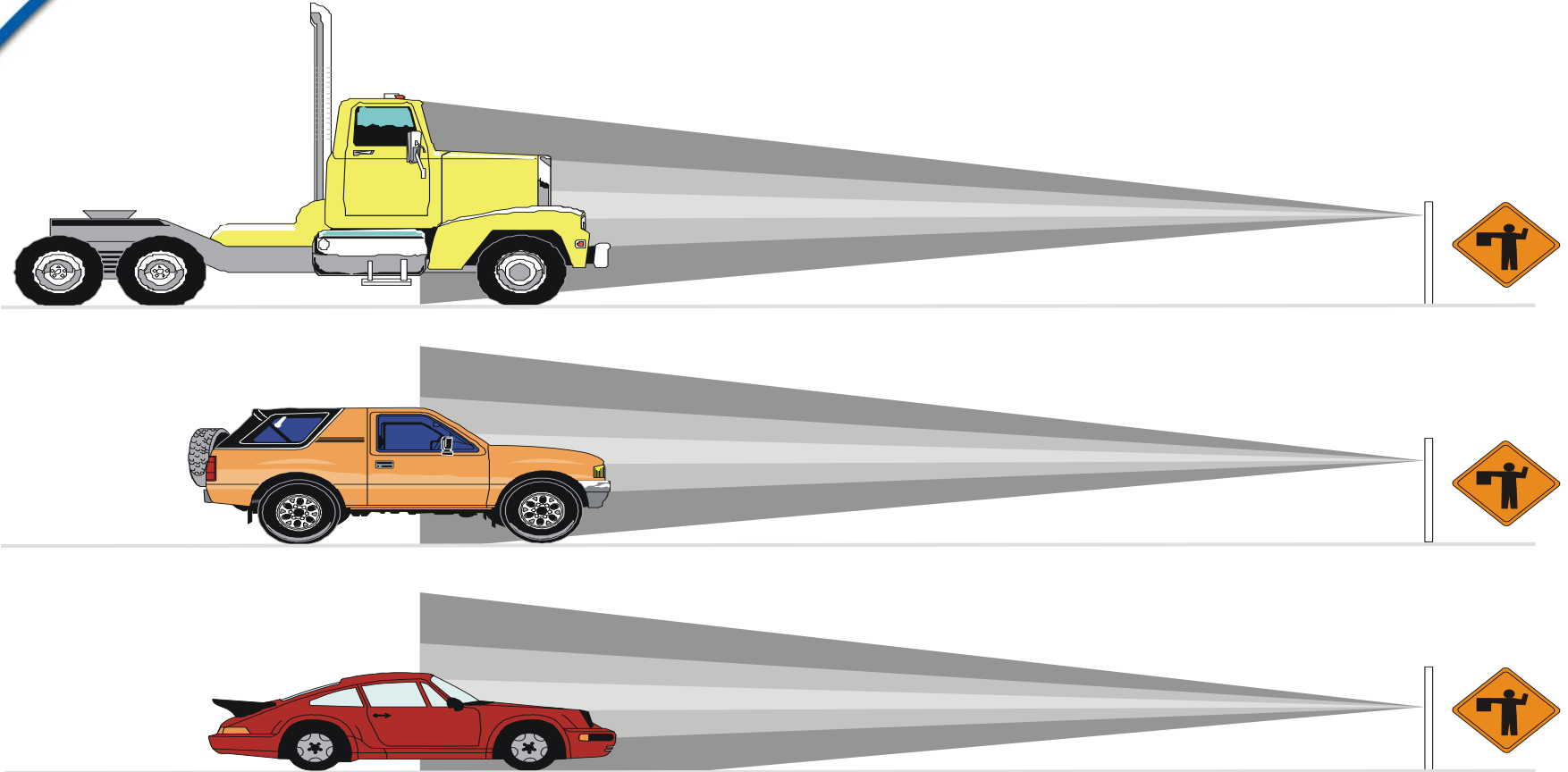


Model for Seeing Signs



Seeing signs in a dynamic fashion

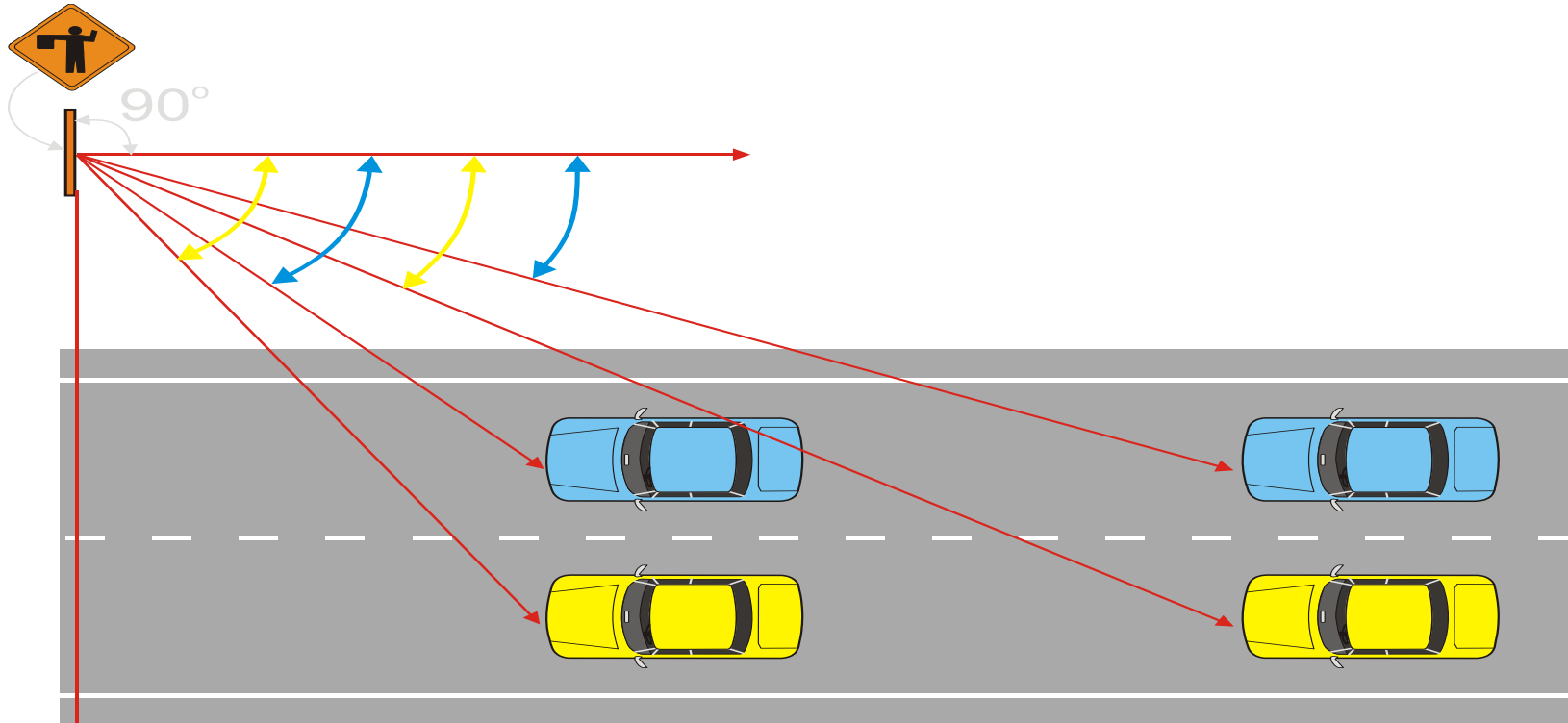
Observation Angles of Vehicles



Note that the driver's eye position relative to the light source (headlamp) is quite different between these vehicle types.

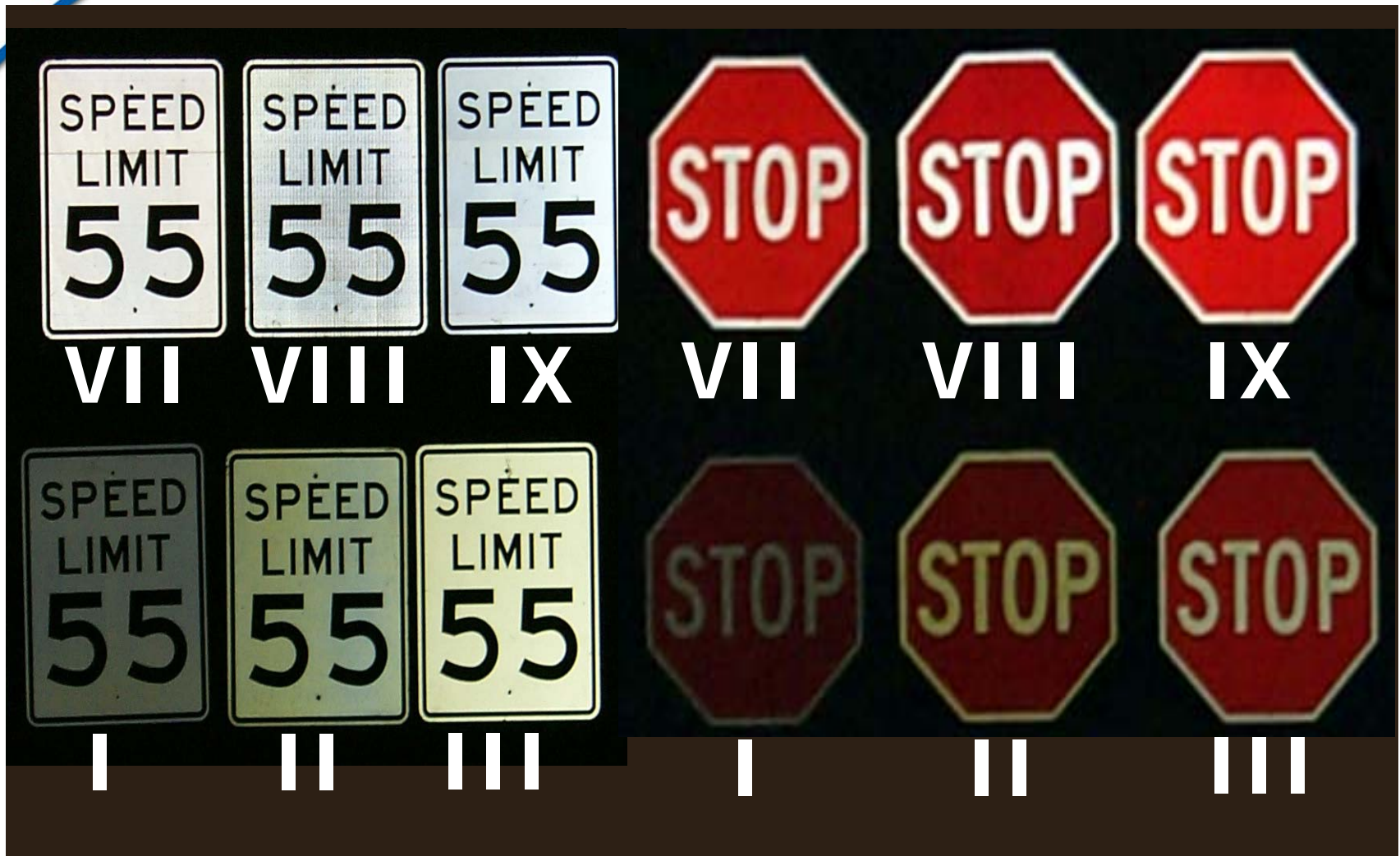
Entrance Angle

Dependent on Vehicle, Distance and Sign Orientation



The retroreflective qualities of any sign must be such that light is returned to vehicles over an endless array of observation positions. This is even more dramatic for roads having three or four approach lanes.

Sheeting Types



Types I and II are non-encapsulated and non-prismatic sheeting types, while Type III is encapsulated lens and Types VII, VIII and IX are prismatic lens

White on Green Sign (Positive Contrast)

Sign Recognition Distance Approx. 1000 Ft.

Low Observation angle (0.2 Deg.)



Sign recognition distance is the point at which a motorist might recognize the fact that a sign is coming into view and therefore can prepare to read the message.

Sign Legibility Distance Approx.250 Ft.

Notice differences in sheeting luminance and contrast.

Bkg=HI



HI

Type XI

Type IX

Sign legibility distance is the point at which a motorist might read the message and begin to prepare for any action needed.

Close to Sign (50 Ft.) High Observation Angle (1.0 Deg)

Notice sheeting luminance differences.

Bkg = HI



HI

Type XI

Type IX

At this distance, the motorists has their last chance to re-read the sign for assurance that it has been read correctly.

SUV 100 Ft. Straight Towards Signs



HI

Prismatic

SUV 100 Ft. Turned 30 Deg. to left



It should be noted that these depictions are from the camera's eye and that the human eye might well see more light being returned (thus better legibility) from both signs. However, the ratio of returned light being seen from each sign is the same for the camera's eye and the human eye; that is to say, the prismatic signs will appear much brighter to the human eye than the HI sign just as it has here, to the camera's eye.



Now that we had concluded that we can do more with our signs in terms of better delivery of the needed information to the motorist, (motorists of all ages, but particularly the older motorists) the questions then became;

- **Can we afford it, and**
- **How do we move the change to the field?**

Can we afford it?

Yes, while this change represents a 15% increase in the cost of the sheeting material, the increased cost for a manufactured sign installed in the field is projected to be less than 5% as the cost of the sign sub-straight, the post and the mobilization and erecting will remain static. Further, as many signs are installed as a part of a larger construction or maintenance project, the impact to each of those projects will be diluted to the point of being negligible.

How do we move the change to the field?

By requiring prismatic sheet be used in both construction and maintenance projects and be used on sign produced in the VDOT Sign Shop, all new sign will be prismatic. Existing signs that are not prismatic will be allowed to remain for their service life, which could be as much as ten to twelve years for those most recently installed.

However, for the more critical signs that happen to be place in a less desirable location (in curves where headlamps don't align optimally, etc.), engineering evaluations may lead to a sign being upgrade to prismatic sheet before the sign's end-of-life is reached.

All-in-all, to keep expenses to a minimum, the total change-over will be spread out over a period of up to twelve years.

The following section addresses pending changes to the retroreflective sheeting used by VDOT on Drums and Temporary Sand Barrels

To skip this section, advance to slide 45

Road and Bridge Specification Changes

Drum and Temporary Sand Barrels Sheeting



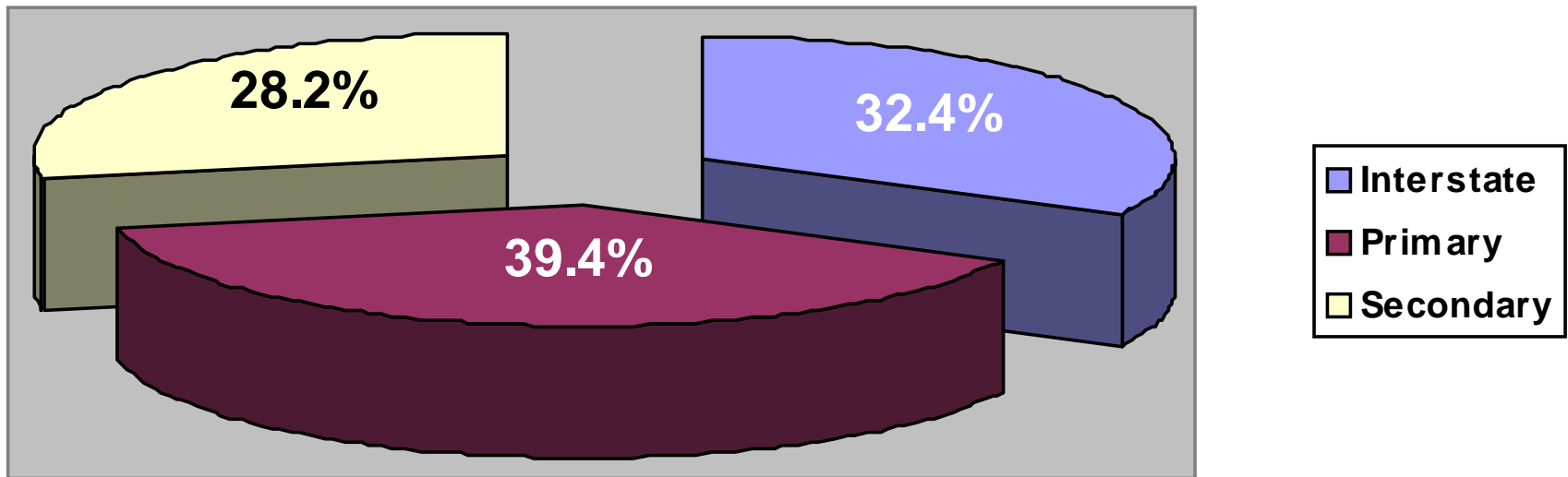
Drum and Sand Barrel Sheeting

Older driver errors are even more pronounced in work zone applications.



Crashes by State Roadway System:

- 653 occurred on the Interstate System (32.4%)
- 793 occurred on the Primary Route System (39.4%)
- 567 occurred on the Secondary Route System (28.2%)

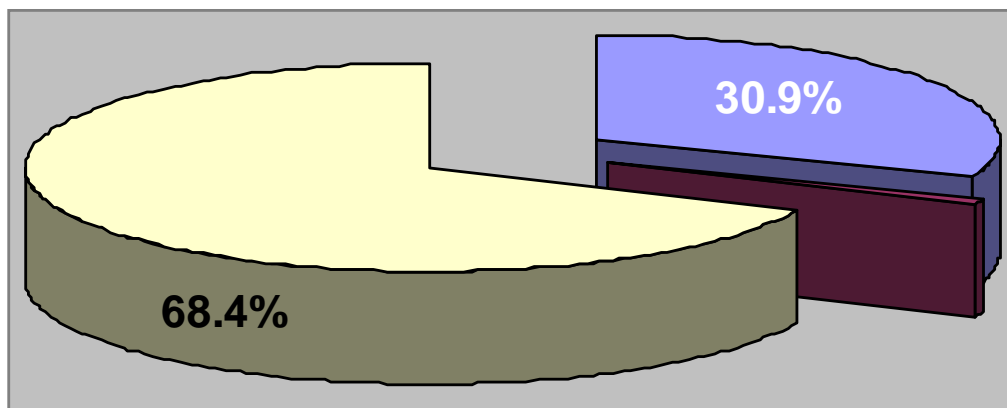


2008 Work Zone Crashes by State Roadway System

2008 Lighting Condition During WZ Crashes

Lighting Condition During Crash

Daylight	Dawn/Dusk	Darkness w/Roadway Lights	Darkness – no Roadway Lights	Unknown
1377	105	222	295	14



New Sheeting Requirement for Drums and Sand Barrels

VDOT recognizes a need for Increased visibility of channelizing devices during daylight and dawn/dusk hours.

The use of florescent properties in prismatic lens sheeting makes the sheeting twice as visible as encapsulated lens sheeting during these hours. Though the florescent properties make no recognizable difference during darkness, the use of prismatic lens in the sheeting in lieu of encapsulated lens sheeting does; thus, changing to a florescent prismatic lens sheeting will produce benefits both during the day and the night.



Short wavelength light which is not visible to the human eye is absorbed by sign.

Ordinary Sheeting Material

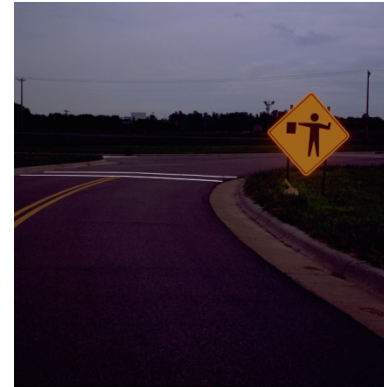


Short wavelength light is reemitted as longer and visible wavelength light.

Fluorescent Sheeting Material



Fluorescent Orange



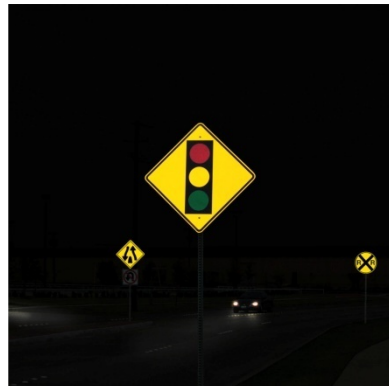
Standard Orange

Fluorescent Yellow-Green



Standard Yellow

Fluorescent Yellow



Standard Yellow

Human Factors Studies on Fluorescent Traffic Control Devices

Zwahlen, Schnell, “*Visual Detection and Recognition of Fluorescent Color Targets versus Non-fluorescent Color Targets as a Function of Peripheral Viewing Angle and Target Size*”, Transportation Research Record No. 1605, p. 28-40, 1997

Conclusion: The results of this study indicate that the fluorescent color targets (especially the fluorescent yellow-green) were considerably better-detected peripherally than their non-fluorescent counterparts.

Schnell, Bentley, Hayes, Rick, “*Legibility Distances of Fluorescent Traffic Signs and Their Normal Color Counterparts*”, Transportation Research Record No. 1754, p. 31-41, 2001

Conclusion: Fluorescence increased legibility distances statistically significantly. Legibility distances for fluorescent signs 5.3 to 15.9% longer than their normal color counterparts.

Non-Fluorescent Orange Sheeting vs. Fluorescent Orange Sheeting

In this example, an encapsulated non-fluorescent sheeting is compared to a prismatic and fluorescent sheeting material during low light conditions. The difference is very eye catching.



New Sheeting Requirement for Drums and Sand Barrels

Improved Consistency – Florescent Prismatic Lens sheeting drums are now required in both Maryland and West Virginia.

Contractors who also work in those states, are beginning to deploy Florescent Prismatic Lens sheeting drums in work zones in VA.



New Sheeting Requirement for Drums and Sand Barrels

- To move to a requirement for florescent prismatic sheeting for the orange band and a prismatic white band on drums and temporary sand barrels, VDOT will experience an cost increase of about 30%, to a price of about \$85 each.
- By moving to a requirement for florescent prismatic orange sheeting and prismatic white sheeting on drums and temporary barrels, motorists will gain additional sight recognition of these features when approaching them, as well as additional peripheral awareness as they pass through the work zone.
- VDOT believes that with these gained defensive driving cues, the crash rate in work zones will decrease, avoiding property damage, injury and perhaps saving lives.
- To lessen the impact on contracting companies that have stock piles of drums and temporary barrels meeting the current specification, VDOT has planned a staged transition.

New Sheeting Requirement for Drums and Sand Barrels

Implementation – Due to contractor logistical concerns, the implementation of Prismatic Lens sheeting will be phased in as follows:

- **Projects advertised on limited access highways beginning 01/01/11;**
- **Projects advertised on all other roadways beginning 01/01/12;**
- **Regardless of project advertisement, all drums converted to meet new spec. beginning 01/01/14. For existing contracts prior to 01/01/11 advertisement, change will be by work order.**

New Sheeting Requirement for Drums and Sand Barrels

Implementation – drums meeting the new specification may be used immediately as an “equal to or better than” substitution, at no additional cost to VDOT, however . .

Mixing of drums/barrels with fluorescent materials and those without fluorescent properties on the same project **will not be allowed.**

New Sheeting Requirement for Drums and Sand Barrels

Other changes in this specification will allow two manufacturers to provide the sheeting instead of the current one manufacturer.

The following section addresses pending changes to the retroreflective sheeting used by VDOT in Roll-Up signs

To skip this section, advance to slide 49

Road and Bridge Specification Changes

Roll-up Sign Sheeting



Road and Bridge Specification Changes

- VDOT has evaluated research and development works performed by those other than the manufacturing industry regarding the performance parameters of flexible sheeting used in temporary work zone signs.
- VDOT noted that slight adjustments in our specification (based in these studies) could allow for competing manufacturer's materials to be used. Currently, only one manufacturer's material meets the specification.
- To realize the advantages of competitive bidding while still serving the public's need, VDOT is proposing a specification based in the referenced research.

Road and Bridge Specification Changes

In that the proposed change to the roll-up sign sheeting material specification will not impact contractors in a negative manner, i.e., they may continue to use any sign now in their inventory and may continue to purchase signs of the same material; and,

In that this proposed change may benefit the contractor by providing them with multiple sources of supply, which could result in better delivery times and lower cost;

This change in the specification will be introduced with no staging or delay.

The following section addresses pending changes to the Pavement Marking Specification used by VDOT for Temporary Markings

Road and Bridge Specification Changes

Temporary Pavement Marking



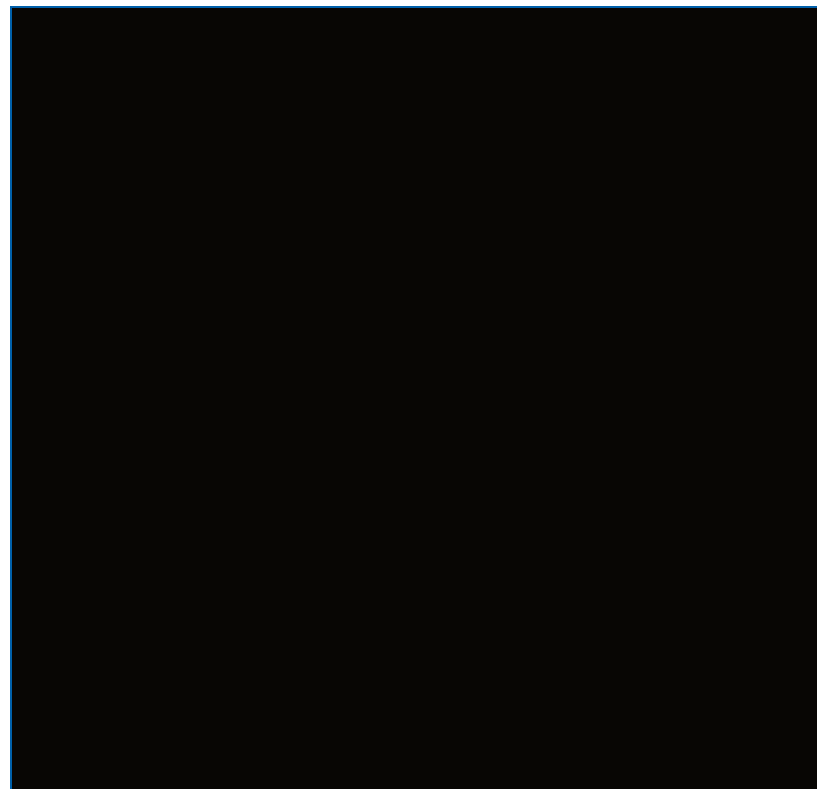
Pavement Markings Wet Night Visibility

- A 1997 VDOT survey of 3,000 Virginians identified roadway “night-time visibility, especially during wet conditions” as a great concern.
- Pavement markings are an essential component of highway safety in reducing crashes – providing information on lane alignments & reinforcing the messages of other traffic devices.
- AASHTO reported every 21 minutes a highway death occurs as a result of a lane departure. This equals to 25,000 deaths or 60% of all highway fatalities annually.
- As traffic accidents are three times more likely to occur in wet, rainy conditions, VDOT is committed to maintaining the effectiveness of pavement marking system during adverse weather, particularly at night and in Work Zone areas.
- Recent advancement in marking technologies introduced Wet Reflective products to improve Wet Night Visibility.

Wet Reflective Pavement Marking Demo

Click in the black box to view

This video was recorded by representatives of the 3M Company and compares their Stamark, Wet Reflective, Removable Tape, Series 780 to non-wet reflective painted lines.



Road and Bridge Specification Changes

Phase 1 of VDOT Wet Reflective Marking Enhancement Efforts – Revised Specification for Temporary Wet-Reflective Pavement Markings & Messages.

Temporary Pavement Markings & Messages Revisions

Our Specification has been revised and now includes a provision for Type D, Class III Temporary Pavement Marking & Message.

- This type of marking is visible during wet, adverse weather conditions, providing the greatest guidance to motorists at night, in a challenging environment.
- Retro Luminance (RL): White = 200, Yellow = 100, Dry & Cont. Wet.

Road and Bridge Specification Changes

Implementation Phasing:

Immediate - Products meeting the new spec. may be used immediately as an “equal to or better than” substitution, at no additional cost to VDOT

March 2010 Advertisements - Only NHS Routes projects will need to comply with new specification. (*Contract documents identify if NHS routes apply*)

March 2011 or after Advertisements - All projects advertised on or after March 2011 will need to comply with new specification.

This concludes our presentation. Should you have questions or want to make comments, we will gladly accept them and we will respond as needed.

Please follow the instructions on the next screen for submitting these questions and comments.

Thank you.

Our thanks go out to the 3M Company for giving us permission to use several of their presentation tools in this presentation.

Road and Bridge Specification Changes

Questions and Comments concerning VDOT's proposed changes to specification regarding:

- **Retroreflective Sign Sheeting Materials use**
 - **On Permanent signs**
 - **On Drums and Temporary Sand Barrels**
 - **For Roll-up signs**

- **Wet Reflective Temporary Pavement Markings**

Should be submitted prior to April 3, 2010 in the form of an e-mail directed to: Traffic.Eng.Spe.Change@VDOT.Virginia.gov

Question and comments regarding any other topic should be directed to: Helpdesk@VDOT.Virginia.gov