



## Diamonds are Forever – Pavement Markings Are Not

by Matt Cate, Technical Assistance Coordinator

If you ask the average driver to name a traffic control device (TCD), the first thing that comes to mind is likely to be a stop sign or a traffic signal. After all, these are the devices that really matter, aren't they? How else would we maintain order at an intersection without some way to assign right-of-way to entering vehicles? Even roundabouts utilize yield control for entering vehicles. It really is common sense – when two vehicles want to occupy the same space, someone gets to go first and the other has to wait its turn. While we might be able to let individual drivers sort the order out in some situations, it is much simpler to use a traffic control device to assign this order to drivers.

Everyone would agree that

these traffic control devices play a vital role in the safe and efficient operation of our roadways. They are so important that signal technicians replace traffic signal bulbs immediately if they burn out, even if there is a redundant bulb relaying the same information to

the same drivers from an adjacent signal head. Public works crews rush to replace stop signs the moment that they receive a report of damage or theft. Transportation officials assign a similar level of importance to other TCDs: curve warning signs, speed limit signs, and yield signs.

In most cases it isn't enough for the TCD to simply be present. The device has to perform well in all conditions, whether in daylight or total darkness, in wet or dry conditions, in rain, snow, or fog. Traffic signs utilize retroreflective sheeting to ensure adequate



The freeway off-ramp edgeline pictured above is clearly showing the effects of years of damage caused by traffic, weather, and plowing.

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RoadTalk is a publication of the Tennessee Transportation Assistance Program (TTAP). TTAP is part of a nationwide Local Technical Assistance Program (LTAP) financed jointly by the Federal Highway Administration (FHWA) and Tennessee Department of Transportation (TDOT). Its purpose is to translate into understandable terms the latest state-of-the-art technologies in the areas of roads, bridges, and public transportation to local highway and transportation personnel.

The views, opinions, and recommendations contained within this newsletter are those of the authors and do not necessarily reflect the views of FHWA and TDOT.

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## From the Director

I hope that everyone is having a productive and safe fall season. I'm sure you all have been busy. We sure have here at TTAP.

We continue to work with TDOT staff to get the Sign Grant program revitalized. We should be getting started early in 2008. Speaking of signs, FHWA is posed to issue the final retroreflectivity rule any day now. This will require some changes in the way in which we specify and maintain our signs. Matt Cate discusses this in more detail in this issue of *RoadTalk*. We want to add a sign retroreflectometer to our toolkit so that we can help you evaluate the retroreflective performance of your signs. Keep an eye on *RoadTalk* and we'll let you know when and if we get this device. We're hoping Santa is good to us this year!

Fall has been very busy with our training activities. Frank Brewer is on the road almost full time, it seems, either facilitating classes or presenting his work zone programs. Among the classes we've offered is the TDOT sponsored Management of Funded Transportation Projects. As a reminder, any local agency planning to manage state or federally funded transportation projects must have project staff attend this class. TTAP offers this class several times each year at locations across the state. Be sure to enroll. It will help you avoid a great many potential problems!

I'll close with my traditional comment about the weather. It's DRY—the perfect time to get all your drainage systems cleaned and in good order, seal those pavement cracks, and do other outdoor work to get ready for what we sure do hope are some good winter rains. My pond is drying up!

On behalf of all of us here at TTAP, I wish you a merry holiday season and a happy new year! As always, please feel free to contact TTAP for technical assistance, training, or information. We look forward to serving you.



performance in all conditions. If a sign becomes weathered and worn to the point that its nighttime visibility is drastically reduced, then it is replaced. Maintenance crews trim tree limbs and other vegetation to ensure that drivers can see signs and signals on the road ahead. All of these activities ensure that TCDs perform their intended function at all times.

Let's ask the average driver a similar question: what is the most prevalent traffic control device? The odds are good that you will get a response similar to our first question – stop signs and traffic signals. Good guess, but incorrect. "What?" you say. "How could this be? What am I missing?" Maybe the title of our article gave it away. Pavement markings are just a given on most collector and arterial roadways. They have been there from day one, keeping watch on the roadway. Teenagers cannot steal pavement markings and hang them on their bedroom walls, and it takes too much effort to vandalize them. Why would we worry about pavement markings? When the road is repaved, replace the markings. It really is that simple – or is it?

Pavement markings provide drivers with valuable information. Yellow centerline markings separate traffic flowing in opposite directions, guarding against head-on collisions. White edge lines delineate the outside edge of the traveled way, preventing drivers from inadvertently straying onto the shoulder or into a ditch. Broken white lines separate lanes of travel in the same direction. Do you remember the *Seinfeld* episode where Kramer adopts a section of highway, then removes half of the lane lines to make "roomy"



*A close-up of the same line shows that as much as half of the original area of the marking has been lost, reducing the available amount of retroreflective material by the same amount.*

lanes? It was hilarious, but we would not want to see it happen on our own roads. Transverse markings also provide drivers with needed information, indicating the location of crosswalks, delineating the proper point to stop or yield, and defining parking spaces.

Everyone would agree that pavement markings provide crucial information. Separation of traffic flowing in different lanes, whether in opposing directions or the same direction, must be accomplished via pavement markings on any roadway where there are three or more travel lanes. Pavement markings are important even on two lane roadways as widths and traffic volumes increase. At best, the absence of these markings would inconvenience drivers. At worst, drivers would face greatly increased risk for sideswipe and head-on collisions. With the importance of pavement markings clearly established, it follows that we must establish the location, color, and pattern of these markings at all times. Allow me to ask one final question: is our treatment of pavement markings representative of their importance in roadway safety and operations?

As with traffic signs, retroreflectivity plays a key role in the all-weather performance of pavement markings. Some markings are barely visible during the daytime, much less under dark or wet conditions. The reasons for limited visibility are readily apparent in cases where exposure to traffic has largely worn away the marking over the years. The ravages of traffic, exposure to the sun, and snowplows leave many markings chipped and thin. In other locations, the markings may have faded to the point where they are barely distinguishable from the aged pavement surface. However, at some locations the markings are clearly visible in the light of day but offer little assistance in nighttime driving.

We will discuss the strengths and weaknesses of many common pavement marking materials in the next issue of *RoadTalk*. In the meantime, if you would like to learn more about pavement markings and nighttime visibility, there are a number of resources available on the web. The Federal Highway Administration's *Roadway Delineation Practices Handbook* (1993) offers discussion of markings and fundamental concepts that are still helpful despite the age of the publication.

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# Safe Equipment Transporting

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Remember the saying, "There is never enough time to do it right, but always time to do it over?" If you are in the business of loading and transporting equipment, this should not be your motto.

When transporting equipment, the driver is responsible for many things including the truck and trailer, the equipment loaded on it, and most important, public safety. If equipment is loaded in an unsafe manner it can cause injury, destruction of property and even death.

It's too easy to get in a hurry and get overanxious to get the truck loaded and on its way. It's very easy to ignore the good safety practices and actual requirement of law. Sometimes to keep management happy, it is tempting to push to get to the job site. Always slow down enough to address safety correctly.

It is the responsibility of the driver to make sure the truck and trailer are safe for transporting and not loaded to exceed rated capacity. Most trailers have a stamped plate located on the frame stating the rated capacity of the trailer. You should never exceed the rated load capacity. If there is an accident resulting from equipment failure, and the load exceeds the rated capacity, you cannot claim it was due to mechanical failure. You and your department are then assuming all liability risk. Overloading will weaken or damage the trailer and can seriously affect acceleration, braking and the overall handling. Add wet or icy conditions, and an overload situation increases the danger even more.

Before loading the trailer, do a walk-around inspection. Check the tires for excess wear and proper inflation pressure. If you are in the field and a gauge is not available, at least give the tires the hammer test, which gives a good idea if a tire has low pressure. Check the lights to make sure they're all in working order, including brake and turn signals. Examine the trailer bed to make sure it is free of dirt, mud, snow and ice. This not only makes loading dangerous, but creates a hazard when traveling down the road. South Dakota Codified Law 32-15-18 states in part: ". . . No person may drive or move any vehicle on any highway unless such vehicle is so constructed or loaded as to prevent its contents from dropping, sifting, leaking or otherwise escaping therefrom." This means nothing should fall from the truck, trailer or load, including



*Safely transporting equipment is a big responsibility.*

sand, gravel or dirt chunks. Also, check the securing points on the trailer, and make sure the tie-down rings are secure and the welds are not broken.

Prior to loading equipment, make sure the trailer is on solid, level ground. Also, make sure brakes are set and/or wheels are chocked so the trailer won't move during loading operations. Loading onto a trailer during rain or simply loading over wet ramps and onto a wet deck is very dangerous. Wet steel or planks get very slippery. The piece of equipment being loaded can easily slip off of the ramps or the trailer deck and roll over. Lives have been lost in South Dakota from accidents such as this.

Next, consider the load to be transported. Walk around the piece of equipment and check for tools that may have been carelessly left on the machine, unlatched doors or chock blocks that may fall during transport.

Know the proper loading position on the trailer. There is not always someone to guide you on the trailer, but if there is the slightest doubt in your mind about the safety of loading a piece of equipment, get some qualified help. Know the safety affects of weight and balance and whether to drive or back a piece of equipment on the trailer. If in doubt, consider the operators manual for proper loading positioning. Remember, too much weight on the trailer's tongue can affect the steering and too much weight on the rear of the trailer can decrease traction and braking ability and make steering less responsive. Also, too much weight on one axle, or set of axles, is an illegal

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overload even if the gross weight is within legal limits. This will be very expensive if you get pulled onto a scale.

Only qualified operators should load and unload equipment on the trailer. The operator should be familiar with all controls of the machine. Make sure seat belts are fastened. Keep in mind the only safe place is in the Roll Over Protective Structure (ROPS) while moving a machine. If help is available, make sure hand signals are understood as this may be the only means of communication due to the noise of equipment. Good operators can judge the center of the trailer but in most instances guidance is helpful. When loading equipment such as backhoes or excavators, make sure there are no overhead power lines in the area the boom could strike when loading. Once loaded, lower all booms, buckets or attachments and remove the keys. It is wise to tape the exhaust stack opening to protect the turbo charger.

Now it's time to secure the load. Check the operator's manual for correct tie-down points on a piece of equipment being hauled for the first time. It's better to be safe than sorry. Too often statements like this are made: "Oh we are just going a little ways." Secure the load whether traveling a few feet or many miles. It is actually illegal to move a load without proper tie-downs. Safety standards require a minimum of two tie-downs no matter how small the load.

Chains and slings are the most common means of securing a load to the trailer. Chains and load binders that are legal for transport tie-down use will have a load rating and should be checked before use. Most binding applications require a transport grade 70 binder chain of adequate size. A load binder suitably matched to the size of the chain must be used.

Remember, if you're hauling it, it is your responsibility to make sure it is done right. Old chains and binders should be replaced. Ratchet binders are preferred versus snapover-center binders. It is indeed very cheap to replace chains and binders compared to the financial responsibility for an accident if the restraint fails and serious consequences result.

When securing a load, visualize pulling in opposite directions. Pull towards the front and rear simultaneously, as you pull from the sides. It is helpful to visualize chains as making a big "X" on the trailer deck.

When hauling rubber-tired equipment, secure and then check the load a few miles down the road. Tires



*Use extreme caution in loading and unloading equipment and use a helper to guide you if possible.*



*Secure tie-down of cargo cannot be emphasized enough.*

will sometimes deflect while being transported and tie-downs can loosen. When hauling steel tracked equipment such as dozers and excavators, remember you have steel against steel and it can slip and shift while being transported.

Some equipment needs to be secured with straps and not chains to avoid damaging the cargo such as generators or light plants. Again, use proper tie-down equipment.

Finally, know the height and width of your vehicle. Legal width is 102 inches and legal height is 13 feet, 6 inches. Make sure you stay within these limits. If it is not possible, you need a special permit on most highways, and you must be aware of restricted height or width conditions such as bridges and overpasses. Do a final walk-around inspection after loading. It's best to run with your headlights on when transporting.



**Education and training opportunities** are available through the University of Tennessee Center for Transportation Research (CTR), Southeast Transportation Center (STC), and Tennessee Transportation Assistance Program (TTAP). This listing of courses currently available includes both TTAP and TATE courses that are offered in conjunction with the University of Tennessee Department of Civil and Environmental Engineering and the Tennessee Section of the Institute of Transportation Engineers. Local roadway departments can benefit from all of the workshops. Because of this, we ask that you please share this listing with others who might be interested in our workshops. TTAP is always eager to meet your research and training needs. If you have a special course in mind or would like a course held on site especially for your employees, please contact Wilma Wilson at 1-800-252-ROAD.

**\*CEU and PDH credit hours available.**

## 2008 Workshop Schedule

Following is a list of workshops that will be offered in 2008. Times and locations will be announced in the next *RoadTalk*. Check our website <http://ctr.utk.edu/ttap/htm/train.htm> and look out for the brochures in the coming weeks.

2-lane Geometric Design  
Asphalt Pavement Rehabilitation  
Curb-Gutter-Sidewalk Design/ADA Compliance  
Fundamentals of Traffic Control  
GeoTech Design/Earthwork  
Highway Safety Analysis  
Innovations in Concrete  
Management of Funded Transportation Projects  
Roadway Design Principles  
Roadway Drainage  
Signs & Pavement Markings  
Tractor Loader/Back Hoe Safety  
Traffic Calming  
Traffic Flow Principles  
Traffic Measures  
Work Zone/Flagging

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### Diamonds are Forever - Pavement Markings Are Not, *continued from page 3*

Agencies interested in evaluating quantifiable performance thresholds for the replacement of pavement marking materials may find the FHWA report titled *Updates to Research on Recommended Minimum Levels for Pavement Marking Retroreflectivity to Meet Driver Night Visibility Needs* (2007) very helpful.

Finally, the UT Center for Transportation Research is working to finalize its report to TDOT evaluating the performance of several types of

pavement markings on Tennessee roadways. This report will offer unique perspective on the use of these materials as applied by local contractors in Tennessee's climate and operating conditions. The report will examine the degradation of markings over the study period, predict the useful service life for markings where sufficient data exist, and evaluate the resulting cost-effectiveness of these markings.

# FHWA Publishes Revision 2 to the 2003 MUTCD

by Matt Cate, Technical Assistance Coordinator

On December 21, 2007, the Federal Highway Administration published a Final Rule on traffic sign retroreflectivity. This rule, effective on January 22, 2008, is incorporated into the *Manual on Uniform Traffic Control Devices (MUTCD)* as Revision 2 to the 2003 Edition. The focus of this final rule is to establish minimum retroreflectivity levels by sign type and color, thus establishing a quantifiable measure of performance for nighttime sign visibility. The new rule also prohibits the use of ASTM Type I (engineer grade) sign sheeting on all yellow and orange warning signs. The compliance date for most signs under the new minimum retroreflectivity standards is January 22, 2015. For street name and overhead guide signs only, the final compliance date is January 22, 2018.

The Final Rule also establishes a new standard that requires road agencies to implement a system to ensure that all signs within their jurisdiction perform at minimum levels. Agencies can precisely measure these minimum levels, measured in units of candelas/lux/meter<sup>2</sup> (cd/lx/m<sup>2</sup>), using a sign retroreflectometer. However, the use of handheld sign retroreflectometers can be time consuming and vehicle-based systems can be prohibitively expensive. Other acceptable methods to assess sign retroreflectivity include nighttime visual inspection, replacement based on expected sign life, blanket replacement, and the use of control signs. The compliance date for agencies to adopt a sign retroreflectivity management system is January 22, 2012.

Agencies may opt to exclude the following sign types from their retroreflectivity:

- ▶▶ Parking, Standing, and Stopping signs (R7 and R8 series)
- ▶▶ Walking/Hitchhiking/Crossing signs (R9 series, R10-1 through R10-4b)

Table 2A-3. Minimum Maintained Retroreflectivity Levels<sup>1</sup>

Sign Color	Sheeting Type (ASTM D4956-04)				Additional Criteria
	Beaded Sheeting			Prismatic Sheeting III, IV, VI, VII, VIII, IX, X	
	I	II	III		
White on Green	W <sub>2</sub> ; G ? 7	W <sub>2</sub> ; G ? 15	W <sub>2</sub> ; G ? 25	W ? 250; G ? 25	Overhead
	W <sub>2</sub> ; G ? 7	W ? 120; G ? 15			Ground-mounted
Black on Yellow or Black on Orange	Y <sub>2</sub> ; O <sub>2</sub>	Y ? 50; O ? 50		Y ? 75; O ? 75	2
	Y <sub>2</sub> ; O <sub>2</sub>	Y ? 75; O ? 75			3
White on Red	W ? 35; R ? 7				4
Black on White	W ? 50				—

Notes:  
<sup>1</sup> The minimum maintained retroreflectivity levels shown in this table are in units of cd/lx/m<sup>2</sup> measured at an observation angle of 0.2° and an entrance angle of -4.0°.  
<sup>2</sup> For text and fine symbol signs measuring at least 1200 mm (48 in) and for all sizes of bold symbol signs  
<sup>3</sup> For text and fine symbol signs measuring less than 1200 mm (48 in)  
<sup>4</sup> 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		
<ul style="list-style-type: none"> <li>• W1-1, -2 – Turn and Curve</li> <li>• W1-3, -4 – Reverse Turn and Curve</li> <li>• W1-5 – Winding Road</li> <li>• W1-6, -7 – Large Arrow</li> <li>• W1-8 – Chevron</li> <li>• W1-10 – Intersection in Curve</li> <li>• W1-11 – Hairpin Curve</li> <li>• W1-15 – 270 Degree Loop</li> <li>• W2-1 – Cross Road</li> <li>• W2-2, -3 – Side Road</li> <li>• W2-4, -5 – T and Y Intersection</li> <li>• W2-6 – Circular Intersection</li> <li>• W3-1 – Stop Ahead</li> </ul>	<ul style="list-style-type: none"> <li>• W3-2 – Yield Ahead</li> <li>• W3-3 – Signal Ahead</li> <li>• W4-1 – Merge</li> <li>• W4-2 – Lane Ends</li> <li>• W4-3 – Added Lane</li> <li>• W4-5 – Entering Roadway Merge</li> <li>• W4-6 – Entering Roadway Added Lane</li> <li>• W6-1, -2 – Divided Highway Begins and Ends</li> <li>• W6-3 – Two-Way Traffic</li> <li>• W10-1, -2, -3, -4, -11, -12 – Highway-Railroad Advance Warning</li> </ul>	<ul style="list-style-type: none"> <li>• W11-2 – Pedestrian Crossing</li> <li>• W11-3 – Deer Crossing</li> <li>• W11-4 – Cattle Crossing</li> <li>• W11-5 – Farm Equipment</li> <li>• W11-6 – Snowmobile Crossing</li> <li>• W11-7 – Equestrian Crossing</li> <li>• W11-8 – Fire Station</li> <li>• W11-10 – Truck Crossing</li> <li>• W12-1 – Double Arrow</li> <li>• W16-5p, -6p, -7p – Pointing Arrow Plaques</li> <li>• W20-7a – Flagger</li> <li>• W21-1a – Worker</li> </ul>

Fine Symbol Signs – Symbol signs not listed as Bold Symbol Signs.

Special Cases
<ul style="list-style-type: none"> <li>• W3-1 – Stop Ahead: Red retroreflectivity ? 7</li> <li>• W3-2 – Yield Ahead: Red retroreflectivity ? 7; White retroreflectivity ? 35</li> <li>• W3-3 – Signal Ahead: Red retroreflectivity ? 7; Green retroreflectivity ? 7</li> <li>• W3-5 – Speed Reduction: White retroreflectivity ? 50</li> <li>• For non-diamond shaped signs such as 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.</li> </ul>

- ▶▶ Adopt-A-Highway signs
- ▶▶ All signs with blue or brown backgrounds
- ▶▶ Bikeway signs that are intended for exclusive use by bicyclists or pedestrians

For a complete listing of changes in Revision 2 to the 2003 Edition of the *MUTCD*, visit the FHWA's *MUTCD* website at <http://mutcd.fhwa.dot.gov>. Additional information on methods to maintain traffic sign flexibility may be found on the FHWA Office of Safety's Nighttime Visibility website at [http://safety.fhwa.dot.gov/roadway\\_dept/retro/index.htm](http://safety.fhwa.dot.gov/roadway_dept/retro/index.htm).



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# TALK TO TTAP

We are always looking for your comments, ideas and suggestions to help make the TTAP Program more useful to you. Please fill out and fax the form below to TTAP at (865) 974-3889 or mail to TTAP; Suite 309 Conference Center Building, Knoxville, TN 37996-4133.

1. Please send me more information on the following articles mentioned in this newsletter.

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2. Please list any additional training workshops you would be interested in attending.

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3. Please list topics for videos you would like TTAP to obtain.

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\_\_\_\_\_

4. Please list any other ideas or suggestions on how TTAP could assist you.

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5. Please list your name and organization to verify for TTAP's mailing list.

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