



Pavement Marking Materials: Selecting the Right Product for Your Situation

by Matt Cate, Technical Assistance Coordinator

In the previous issue of RoadTalk we discussed the importance of pavement markings and the need to maintain them above a minimum level of performance. In this article, we will discuss the advantages and disadvantages with several common types of pavement marking materials.

The physical makeup of

pavement marking materials offers insight as to their anticipated nighttime performance and service life. As with any commodity, the performance and durability of pavement markings generally increase with cost. While the specifics of pavement markings differ with material type and manufacturer, most pavement markings consist of three primary

components: the binder that gives the marking its thickness and adheres to the roadway surface, the pigment that gives the marking its color, and the glass beads that give the marking its retroreflective properties.

The most inexpensive marking material is paint. While initial costs are relatively low, paint markings offer the shortest service life. In fact, most painted markings are rated for no more than one year of useful life. Compare this to the

continued on page 4



This yellow 6-inch wet reflective tape features raised squares designed to provide increased retroreflectivity in wet conditions. This marking material is commonly used on PCC surfaces such as freeway ramps and bridge decks.

Pavement Markings	
Solutions	1
From the Director	2
National Work Zone	
Week	3
2007 Winners of Roadway	
Work Zone Safety	3
FHWA National Scenic	
Byway Funding	3
TTAP Training	6
FHWA Fun Facts	7

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.

Director

Dr. David B. Clarke, P.E.

Training Coordinator

Frank Brewer

Technical Assistance Coordinator

Matt Cate, P.E.

Safety Circuit Rider

John Tidwell, P.E. (retired)

Technician

Linda Capps

RoadTalk Editor

Jenny Jones

Administrative Specialist

Mollie Mitchell

Course Registration

Wilma Wilson

Course Materials

Julie Asbell

The University of Tennessee does not discriminate on the basis of race, sex, color, religion, national origin, age, disability, or veteran status in provision of education programs and services or employment opportunities and benefits. This policy extends to both employment by and admission to the University. • The University does not discriminate on the basis of race, sex, or disability in the education programs and activities pursuant to the requirements of Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, and the Americans with Disabilities Act (ADA) of 1990. • Inquiries and charges of violation concerning Title VI, Title IX, Section 504, ADA, the Age Discrimination in Employment Act (ADEA), or any of the other above referenced policies should be directed to the Office of Equity and Diversity; 1840 Melrose Avenue; Knoxville, TN 37996-3560; telephone (865) 974-2498 (TTY available). Requests for accommodation of a disability should be directed to the ADA Coordinator at the Office of Human Resources Management; 600 Henley Street; Knoxville, TN 37996-4125. • PA# E01-2510-001-002-08

From the Director

As I write this, we're about done with winter. Thankfully, we've been spared much of the ice and snow that other areas of the country have experienced. Some Tennessee communities did experience very severe storms, with major damage from tornados and rain. We hope that all of you reading this came through unscathed.

The spring training season is again upon us. Frank Brewer has put together a busy schedule. We're teaching several of the new TATE core classes. In addition, we have a host of other classes, both for the technical and non-technical audience. Remember, local agencies must send personnel to Management of Funded Transportation Projects as a pre-requisite to managing transportation projects involving federal funds (even if state pass-through). We hope to see you in class this spring. As always, if you have any suggestions on existing or potential classes, please let us know!

We are continuing full bore with the Safety Circuit Rider program. Matt Cate and John Tidwell are busy working with selected counties throughout the state. We also plan to conduct some road safety audit review courses for local agencies. If you're interested in hosting one of these, please contact Matt. Federal Highway Administration is sponsoring the classes.

The Southeastern Local Roads Conference, a fixture of the spring season for the past decade or so, is taking a hiatus this year. The next conference is planned for 2009 in Alabama. We'll let you know when and where as plans develop.

Well, that's about it for now. The staff is pushing me for course materials, so I'd best get back to work. Plus, I'd like to let you read the rest of the newsletter. As always, please feel free to contact TTAP for technical assistance, training, or information. We look forward to serving you.



National Work Zone Awareness Week (April 7-11, 2008) “Slow for the Cone Zone”

Each year in April, National Work Zone Awareness Week (NWZAW) is held to bring national attention to motorist and worker safety and mobility issues in work zones. Beginning in late 1999, FHWA has worked with the American Association of State Highway and Transportation Officials (AASHTO) and the American Traffic Safety Services Association (ATSSA) to coordinate and sponsor the event. Since then other transportation partners have joined the effort to support NWZAW.

The ninth annual National Work Zone Awareness Week will be held April 7-11, 2008. The theme for this year is “Slow for the Cone Zone.” The national kickoff for this event will be held on April 8 at 11:00 am in Sacramento, California. This marks the first time that the kickoff will be held outside the Washington, DC area.

ARTBA Foundation Announces Winners of 2007 Roadway Work Zone Safety Awareness Awards

Public and private transportation groups from across the country were recognized for their commitment to safety at the American Road & Transportation Builders Association Transportation Development Foundation (ARTBA-TDF) seventh annual “Roadway Work Zone Safety Awareness Awards” competition.

The program recognizes outstanding efforts to help reduce roadway work zone construction accidents, injuries and fatalities. The awards are divided into four categories: private outreach campaigns, government outreach programs, safety training and innovations in technology. An independent panel of judges reviewed the entries and selected the winners.

The category under **Government Outreach—State/Provincial/Regional** recognizes the specific public outreach campaigns or safety programs by federal, state or local government agencies aimed at improving roadway work zone safety.

We are pleased to announce that the **Tennessee Department of Transportation** “Get in the Zone” Campaign tied for Second Place with the South Carolina Department of Transportation. TDOT began the statewide “Get in the Zone” campaign to target high school students who were preparing to get their driver’s license. The program included high-tech, interactive presentations provided in schools throughout the state at no cost and geared to reduce a student’s chance of being involved in work zone accidents. The program was conducted in assemblies and individual classes, and included a role-playing/remote control work zone driving course as well as videos and discussion guides.

FHWA National Scenic Byway Funding Available

The Federal Highway Administration is now seeking grant proposals for National Scenic Byways Program funding consideration for FY 2008. SAFETEA-LU authorized up to \$40 million for this fiscal year; FHWA has decided to be more strategic in its grant awards process by targeting its resources toward projects that provide the greatest benefits. FHWA is particularly focusing on projects with demonstrated benefits for the byway traveler and invites the application of large-scale, high-cost projects that provide strategic benefits to the byway. **Applications are due to FHWA division offices by April 11, 2008, and to FHWA headquarters by May 9, 2008.**

Begin this process at www.bywaysonline.org You will need to submit your application electronically and send 5 hard copies to TDOT Beautification, J. K. Polk Building Ste. 400, 505 Deaderick St., Nashville, TN 37243. TDOT will rank the grant applications received and then send them on to FHWA for funding decisions. Remember, these projects are supposed to be part of a local effort to establish a scenic byway and must support that process.

For both seasoned and first time applicants, please remember that submitting an application is a two-step process, and includes registering your organization with Grants.gov. The details of this registration process can be found on the Grants.gov website (see www.grants.gov/GetStarted). Because there are a number of steps involved, we encourage you to begin now! For more information on submitting an application to the National Scenic Byways Program for funding consideration, please see www.bywaysonline.org/grants/.

Contact Shawn Bible at (615) 532-3488 or email shawn.a.bible@state.tn.us if you have questions.

typical service life of asphalt pavement, which can go more than ten years between overlays when serving light traffic. Transportation agencies utilizing painted markings should plan to replace the markings several times over the life of the pavement surface. New regulations and concerns for the environment have made water-based paints the most commonly used traffic marking paints in recent years. While these markings are environmentally friendly and easy to use, most agencies report that water-based paints are not as durable as were their solvent-based predecessors.

The most commonly utilized markings for high-volume roadways are thermoplastics. Thermoplastic markings are applied hot, usually by extruding the material by gravity feed or under pressure, or by spraying it onto the surface. Thermoplastics offer several advantages over paint. First, thermoplastic materials are more resistant to wear than paint, providing additional service life compared to painted markings of the same thickness. Second, thermoplastic markings are usually applied in a much thicker layer than painted markings, offering additional resistance to wear. Third, glass beads are mixed throughout the material, so that as the material wears new glass beads are exposed to ensure continued retroreflectivity.

Thermoplastic materials do have some limitations. These markings often do not adhere well to Portland cement concrete (PCC) surfaces, especially on new pavements. Thermoplastic is very sensitive to variations in surface preparation and application, making quality control vital in the performance of the marking. Thermoplastic is substantially more expensive than paint, but this initial cost is often offset by a service life that can exceed ten years under proper conditions.

The final category of pavement markings in widespread use are preformed tapes. These markings offer advantages over paint and thermoplastic in several situations. Some tapes are easily removed using proper equipment, making them ideal for temporary applications in locations such as work zones where lane configurations may change frequently. Other tapes offer enhanced retroreflectivity in wet conditions. Some tapes may offer an advantage because they can be applied in small quantities where use of a conventional longitudinal striping truck would



Special markings like this left arrow use pre-cut pieces for ease of installation.

not be practical. These applications include transverse markings (crosswalks and stop bars) and short lengths of longitudinal markings. Tapes offer consistent quality because they are manufactured in a factory as opposed to being mixed in the field. However, this quality comes at a price. These are the most expensive marking materials, but their performance justifies the additional expense in specific circumstances.

Pigment plays an important role in pavement marking performance. A marking's pigment obviously determines its color, whether it be yellow, white, or blue. Pigment color can also impact the marking's

continued on page 5



The small black dots visible on this white 6-inch sprayed thermoplastic marking are individual glass beads imbedded in its surface.

useful life, as yellow markings generally begin with lower retroreflectivity values than a comparable white marking. With similar rates of decline in nighttime performance, the yellow marking will fall below the threshold value for retroreflectivity before the white marking.

Most pavement marking materials draw their retroreflective properties from the use of glass beads. These beads are present on the top surface of all marking materials. Thermoplastic markings and some preformed tapes have beads mixed throughout the depth of the marking to ensure retroreflectivity over a greater period of time. Three characteristics of glass beads affect the nighttime performance of pavement markings: the size of the bead, the depth that the bead is embedded into the marking binder, and the quality of the glass itself.

Performance of glass beads is described using a refractive index. A higher refractive index means that the bead will reflect more light than one with a lower refractive index. The size and depth of embedment are closely related for beads that are dropped or sprayed onto a wet marking. A balance must be struck to ensure that the proper size or sizes of beads are used to attain the ideal depth for a given binder. More beads mean more light reflected back to

the driver in nighttime conditions. While glass beads seem simple compared to the selection of a binder material, this is no place to skimp.

Raised pavement markers (RPMs) can be used to supplement the nighttime performance of pavement markings. RPMs are placed at regular intervals to mimic the color and pattern of the marking that they supplement. These markers are inexpensive, easy to install, and effective. RPMs often provide superior performance to any pavement parking material in wet or rainy conditions because they protrude farther above the pavement surface. Conversely, RPMs are more susceptible to damage from snow plowing than pavement markings. Selective use of RPMs may allow an agency to extend the life of some pavement markings in a cost-effective manner.

This is already a tremendous amount of information to consider. Many agencies struggle with the decision between higher-quality materials with fewer applications versus less expensive markings with more-frequent applications. In many cases it can be truly difficult to accurately predict the performance of a given material due to the effects of the installation process and operating environment. Extreme weather, undetected problems during installation, and increasing truck and traffic volumes can significantly shorten the useful service life of any marking. At some point the retroreflectivity of the marking falls below an acceptable value and it must be replaced.

What is the proper retroreflectivity threshold? Numerous research efforts have produced widely varying recommendations. Variables such as the age of the driver, type of vehicle, and color of the marking, and speed of travel impact the perceived need for retroreflection. In general, retroreflectivity should increase with the speed of traffic. Additionally, the presence of both center line and edge line markings may allow the use of markings with lower retroreflectivity than the use of center lines alone. Retroreflectivity requirements may be reduced in locations where RPMs are also in use.

continued on page 7



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.

Title	Month	Day	Location	Instructor/s
Signs & Pavement Markings	April	4	Knoxville	Cate
Management of Funded Transportation Projects aka Local Government Guidelines Manual	April	8	Chattanooga	Various
Management of Funded Transportation Projects aka Local Government Guidelines Manual Training	April	9	Chattanooga	Various
Management of Funded Transportation Projects aka Local Government Guidelines Manual Training	April	10	Chattanooga	Various
Pedestrians, Infrastructure & Accessible Design	April	11	Nashville	Brown/Childers
Basic Traffic Studies	April	15	Knoxville	Clarke
Fundamentals of Traffic Control	April	21	Knoxville	Cate
Pedestrians, Infrastructure & Accessible Design	April	23	Chattanooga	Brown/Childers
Work Zone Traffic Control/Flagging	April	30	Jackson	Brewer
Roadway Design Principles	May	12	Chattanooga	Childers
Drainage System Maintenance	May	15	Knoxville	Clarke
Traffic Flow Principles	May	22	Chattanooga	Clarke
Management of Funded Transportation Projects aka Local Government Guidelines Manual Training	August	12	Nashville	Various
Management of Funded Transportation Projects aka Local Government Guidelines Manual Training	August	13	Nashville	Various
Traffic Flow Principles	September	9	Jackson	Clarke
Work Zone Traffic Control/Flagging	September	16	Jackson	Brewer
Work Zone Traffic Control/Flagging	September	17	Nashville	Brewer
Work Zone Traffic Control/Flagging	September	19	Chattanooga	Brewer
Roadway Drainage	September	23	Knoxville	Clarke
Tractor Loader/Back Hoe Safety	October	6	Chattanooga	Bevin
Tractor Loader/Back Hoe Safety	October	7	Jackson	Bevin
Work Zone Traffic Control/Flagging	October	9	Knoxville	Brewer
Drainage System Maintenance	October	16	Nashville	Clarke
Fundamentals of Traffic Control	October	23	Jackson	Cate
Intersections Design At-Grade Intersections	October	28	Nashville	Childers
Management of Funded Transportation Projects aka Local Government Guidelines Manual Training	November	4	Knoxville	Various
Management of Funded Transportation Projects aka Local Government Guidelines Manual Training	November	5	Knoxville	Various
GeoTech Design/Earthwork	November	12-13	Chattanooga	Drumm
Basic Traffic Studies	November	19	Nashville	Clarke
Geometric Design of 2-lane Roads & Streets	November	20	Jackson	Clarke

FHWA Fun Facts: *Traffic Congestion*

reprinted from FHWA January 2008 Press Release

According to new data from the Federal Highway Administration:

- Americans drove more than 3 trillion miles in 2006, the most recent year for which data are available. This is the highest figure ever recorded for the nation's driving and represents the 27th consecutive increase in surface transportation, an indicator of traffic congestion nationally.

- Preliminary data show that Americans drove 3,033,753,000,000 miles in 2006. This figure is roughly double the nation's total mileage traveled in 1980 and more than four times the total mileage traveled in 1957, the interstate's first year.

- In 2006, drivers increased the nation's total distance driven by 43.9 billion miles – the equivalent of nearly 6 trips to Pluto and back – over the previous year.

- Total vehicle registration, which indicates the total inventory of vehicles driving, increased slightly over the previous year to 244,165,686 vehicles including motorcycles. This is the fourth consecutive year vehicle registration has increased and continues a trend broken only infrequently since 1900, the earliest year for which such data are available.

The data will be published in the forthcoming "Highway Statistics 2006," an annual compilation of data reported to the Federal Highway Administration by all U.S. states, Washington, D.C., and Puerto Rico. The Highway Statistics series, which consists of statistical data on motor fuel, motor vehicles, driver licensing, highway-user taxation, state and local government highway finance, has been produced each year since 1945.

Pavement Marking Materials, *continued from page 5*

A number of resources exist to assist agencies in the pavement marking decision-making process. While these resources were also mentioned in our previous article on pavement marking retroreflectivity, they are worth repeating. 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. Agencies interested in evaluating measurable performance thresholds for the replacement of pavement marking materials may find the FHWA report titled *Updates* to be very helpful. The Texas Department of Transportation's *Pavement Marking Handbook* (2004) offers some helpful background information regarding the selection, installation, and performance of various types of pavement markings.

Resources on the Web

1. FHWA: *Updates to Research on Recommended Minimum Levels for Pavement Marking Retroreflectivity to Meet Driver Night Visibility Needs* (2007), <http://www.tfhr.gov/safety/pubs/07059/07059.pdf>
2. Texas DOT: *Pavement Marking Handbook* (2004), <http://www.dot.state.tx.us/publications/traffic/pmh.pdf>
3. FHWA: *Roadway Delineation Practices Handbook* (1993), http://safety.fhwa.dot.gov/ped_bike/docs/rdwyclin.pdf



Tennessee Transportation Assistance Program
 Center for Transportation Research
 The University of Tennessee
 309 Conference Center Building
 Knoxville, TN 37996-4133
 Ph. (865) 974-5255/(800) 252-ROAD
 Fax. (865) 974-3889
 Email. TTAP@utk.edu
 Web. <http://ctr.utk.edu/ttap>

Non-Profit Org.
 U.S. Postage
 PAID
 Permit No. 309
 Knoxville, TN



Federal Highway
 Administration



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.

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

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

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

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

Name _____

Address _____

Title _____

Organization _____

Phone _____ Fax _____

Email _____

Are you currently on TTAP's mailing list?
 ___ yes ___ no

Do you wish to be on the mailing list?
 ___ yes ___ no