Case Study on the Application of Temporary Orange Pavement Markings in Work Zones

The contents of this document has been modified from a Synthesis Document ATSSA compiled for its members. The contents are intended for informational purposes only as the industry investigates the use of orange pavement markings as an experiment.

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To further advance traffic safety and reduce work zone injuries and fatalities, ATSSA promotes innovation in work zone traffic control practices, materials, and equipment. Recently, the ATSSA Pavement Marking Committee brought together individuals from various public and private organizations with different backgrounds to identify needs and challenges, share new technology and information, and discover and advocate for proven safety countermeasures. One recent focus for the committee included the application of temporary orange pavement markings in work zones, an experimental technique per the Manual on Uniform Traffic Control Devices (MUTCD). To assess orange pavement marking practices, ATSSA created a task force focused on this innovation. Seven DOTs have applied orange pavement markings in various configurations to improve work zone safety for the traveling public.

Since 1969, the American Traffic Safety Services Association (ATSSA) has represented companies and individuals in the traffic control and roadway safety industry. ATSSA members provide many features, services, and devices used to make America's roadways safer. Being our nation's leader means that ATSSA remains current and relevant, and ATSSA continuously strives to address modern day problems through collaboration and consensus, to move Toward Zero Deaths on the nation's roads. ATSSA represents the roadway safety infrastructure industry with effective legislative advocacy, roadway safety training, and a far-reaching member partnership. ATSSA helps shift the focus of transportation towards saving lives and reducing injuries.

As evidenced below, ATSSA's core purpose is to advance roadway safety.

- ATSSA members accomplish the advancement of roadway safety through the design, manufacture, and installation of road safety and traffic control devices.
- ATSSA brings together members, road safety experts, and public agencies to identify and solve road safety issues.
- ATSSA's primary focus is to move Toward Zero Deaths on our nation's roads.
- ATSSA staff, members, and local chapters have a finger on the pulse of the needs and challenges facing practitioners today.

ATSSA is a member partnership comprised of approximately 1,500 companies representing over 11,000 industry professionals in sign manufacturing, pavement marking, guardrail and barrier, traffic services, and traffic signals technical divisions. ATSSA carries out its work as a national-level highway safety advocate through a robust and comprehensive structure of committees, subcommittees, councils, and task forces, with each group having a specific purpose. The Association depends on the dedication and commitment of its members to ensure the vitality of the Association's progress. Each year, hundreds of members serve on committees. ATSSA's work with transportation officials within ATSSA membership, its chapter network, and during ATSSA's Annual Convention and Traffic Expo have also resulted in meaningful and long-term relationships with state departments of transportation (DOT) that give ATSSA an inside look at specific organizations to gain a deep understanding of an individual state's needs, trends, or requirements.

In 2023, ATSSA created a synthesis document[1] on the application of different types of temporary orange pavement markings in the United States. To date, the following agencies have implemented this work zone application:

- California Department of Transportation (paint)
- Indiana Department of Transportation (paint and tape)
- Kentucky Transportation Cabinet (paint, thermoplastic)
- Michigan Department of Transportation (paint)
- North Texas Tollway Authority (thermoplastic)
- Washington Department of Transportation (paint)
- Wisconsin Department of Transportation (paint, epoxy and tape)

Orange pavement markings have also been used internationally in Australia, Canada, New Zealand, and Switzerland. The international applications typically focused on efforts to match the pavement marking colors to the color of the channelizing devices and other features in use. In general, the primary focus is on alleviating the issue of "ghost" markings at permanent lane line and edge line locations that are removed for the new construction traffic pattern. One consistent theme from U.S. experiments is greater visibility of the temporary markings at locations with complex driving maneuvers, such as lane shifts approaching the workspace.

The following section highlights this traffic control innovation as an example of the how ATSSA promotes innovation in work zone traffic control. The following section highlights Wisconsin's application of orange pavement markings.

Interstate 94 locations near Milwaukee and Oconomowoc, Wisconsin

The Wisconsin Department of Transportation (WisDOT) installed orange temporary pavement markings on I-94 as part of the $1.7 billion, six-year Zoo Interchange Reconstruction Project on the west side of Milwaukee. This interchange is a major freeway connector for downtown Milwaukee, Chicago, Madison and Fond Du Lac and carries over 350,000 vehicles per day at the intersection of I-94 and Interstate 41.

WisDOT considered the potential benefits of applying the orange pavement markings, including greater visibility for drivers, especially for lane shifts in winter conditions. However, the DOT also considered several challenges prior to implementation, including industry experience, availability of orange marking materials, specification needs, and cost effectiveness.

Project Summary	
Location:	Interstate 94 (Zoo Interchange) and a section near Oconomowoc
Cross Section:	4-lane freeway with limited shoulders during construction
Material Used:	Non-fluorescent paint, fluorescent epoxy, and tape
Configuration:	Lane line and edge line markings
Timeline:	2014 – 2016
Metrics:	Percentage of vehicles straddling lanes (video), visibility, driver comprehension, overall driver perception

In developing the specifications for the project, potential marking solutions included paint with standard glass beads, paint with enhanced prismatic beads, Methyl Methacrylate (MMA), and epoxy. WisDOT developed a change order for the contractor that included epoxy supplied by the DOT (in cooperation with a local vendor) with provisions for the contractor to perform the application. The experimental project request included an 18-month evaluation period, with one direction maintained with traditional pavement marking colors to serve as a control for comparison.

The initial application worked well (See Figure 1), and WisDOT requested that FHWA allow orange markings in both directions, which FHWA granted. After the first year of application, WisDOT requested a 2-year extension to further experiment on a bridge re-decking project on I-94. This project included a crossover with orange temporary tape installed throughout the crossover. Evaluation results showed similar metrics between control sites and the bridge deck project. From driver surveys, 27% of drivers noted the orange markings were much easier to see than white markings and 20% noted the orange markings were somewhat easier to see. Engineers also noted better visibility with the orange tape. After several adjustments to the orange markings, WisDOT determined that using fluorescent orange epoxy from November to April worked well for winter conditions and a non-fluorescent orange latex paint supplemented by orange raised pavement markers (RPM) worked well from May to October for warm weather conditions. A less vibrant orange paint was shown to have better ultraviolet light resistance.

Additionally, WisDOT procured orange preformed tape for use in locations where small sections of the orange markings required fixes, such as where potholes may form along the painted line. WisDOT also determined that a 5-inch-wide pavement marking would provide enhanced visibility as compared with a traditional 4-inch-wide marking.

Assessment of cost effectiveness included metrics such as improved traffic safety during the winter, in addition to contractor economies of scale for volume of application. With application trucks already using traditional white and yellow paint, each application of orange required the contractor to clean the equipment prior to placement – leading to some cost increases in application. While the cost of orange markings was higher in each case, WisDOT concluded that there was enough increase in overall traffic safety benefit with use. In addition, WisDOT anticipates lower costs with more widespread use.

Figure 1. Orange Temporary Marking on Asphalt Surface

User surveys from local businesses showed that initial orange markings were not as visible as users expected, especially at night. The addition of the enhanced prismatic beads and higher overall material fluorescence produced an 80% favorable rating by surveyed users for the orange temporary pavement markings. Video evidence showed drivers maintained their lane better and the DOT received 95% fewer complaint calls regarding pavement markings. The percentage of vehicles straddling lanes was marginally lower under dusk and rain conditions with the orange pavement markings. Law enforcement and project staff also observed better driver navigation at the lane shifts.

Several observations from the orange marking experiments are included in the list below.

- Temporary orange contrast markings may be an approach that some agencies take since permanent markings often include black contrast lines in addition to the traditional yellow and white edge and lane lines.
- Agencies are commonly using orange markings at the approaches to project lane shifts to alleviate lane straddling and improve safety, especially for larger commercial vehicles.
- Temporary orange marking application should be evaluated against other types of strategies, such as longer shifting taper lengths that accommodate larger vehicles (i.e., exceeding the 1/2L minimum shifting taper as outlined in the MUTCD).
- Some agencies also use wider lane lines on transitions within work zones to alleviate the potential risks of drivers missing the intended movements (even with appropriate signing).
- Future application of connected vehicle technologies will need to include further investigations to determine if the variation in color of orange markings will identify work zones or approaches to lane shifts or other more complex temporary traffic patterns.
- Guidance on line widths, material thickness and type of material best suited to long-term work zone applications could benefit decision-makers and those implementing policies for use of orange markings as a work zone safety strategy.

REFERENCES

1. American Traffic Safety Services Association, *Synthesis Report on the Application of Temporary Orange Pavement Markings in Work Zones,* June 2023