



Project Summary Report 4940-S
Project O-4940: Photometric Requirements for Arrow Panels and
Portable Changeable Message Signs

Authors: Mark D. Wooldridge, P.E., Melisa D. Finley, John Denholm, and Douglas Mace

Arrow Panel and Portable Changeable Message Sign Requirements

Arrow panels are often used in work zones to inform drivers of the need for a lane change or, under certain conditions, caution on the part of the driver. Portable changeable message signs are used to advise motorists of unexpected traffic and routing situations. Although these devices have been used in

traffic control applications for many years, there are no established photometric standards that can be used as the basis for a procurement specification.

This report summarizes the Texas Transportation Institute's (TTI) recommendations for test methods for measuring the photo-

metric properties of Type C arrow panels (Figure 1) and portable changeable message signs (Figure 2). The intent of the test method is to provide TxDOT with measurable criteria for qualifying arrow panels and changeable message signs for purchase by TxDOT.



Figure 1. Type C arrow panel





Figure 2. Portable changeable message sign

What We Did . . .

Researchers investigated a number of issues related to arrow panels and changeable message signs, focusing on the photometric characteristics of the devices.

What We Found . . .

Arrow Panels

As shown in Figure 3, increased viewing angle can sharply reduce the effective output of an arrow panel as seen by the driver. Researchers reviewed potential angularity effects due to lane positioning and roadway curvature by examining lateral clearance between vehicles and arrow panels in various positions. By combining vehicular operating speeds, typical roadway alignments, and viewing



Figure 3. The effect of angularity on arrow panel visibility (the arrow sign on the right is at a slight angle)



times for sign displays, researchers established minimum angularity requirements for viewing arrow panels.

The daytime conspicuity of varying luminous intensity levels was tested in a study that manipulated arrow panel luminous intensity to test its influence on motorist behavior. Observations of the number of vehicles in the closed lane indicated that luminous intensity levels were related to the lane-changing behavior of the motorists. Comparisons between driver responses showed that even in low-complexity visual environments there is a minimum level that is necessary to facilitate timely lane changing.

Portable Changeable Message Signs

Examining portable changeable message signs, researchers used a luminance meter to make a series of background luminance measurements (sign “off”) under sun overhead, backlit, and washout conditions. Additional luminance measurements of the sign’s immediate surroundings were taken and used to evaluate external contrast. By combining well-established recommendations from the literature with the background measurements made in the field, recommendations for character luminance were developed so that the desired contrast levels could be achieved under

backlit, sun overhead, and some washout conditions.

The Researchers Recommend . . .

Researchers developed recommendations for the photometric properties of both Type C arrow panels (diesel and solar) and portable changeable message signs, recommending changes to their respective specifications by TxDOT.

Arrow Panels

Based on the field studies conducted and findings reported in the literature, researchers developed a table of recommended luminous intensities for arrow panels, shown in Table 1. The values provide a level of performance that will help ensure that most drivers in most situations can see the information they need in a timely manner. Recommendations regarding minimum angularity performance were also developed to help ensure acceptable performance in commonly encountered situations.

Portable Changeable Message Signs

Researchers recommend a minimum daytime character luminance of 4000 cd/m² and a contrast ratio of 5. However, both backlit and washout conditions present tremen-

dous problems for portable changeable message sign visibility, particularly with older motorists. Because of this, no minimum luminance level can ensure that the sign be read by all observers under all conditions. Protective screens should be well maintained to maximize the contrast that this luminance will provide, particularly in washout conditions.

Based on previous research, researchers recommend a minimum nighttime character luminance of 30 cd/m². Little research has been conducted with respect to a nighttime maximum character luminance needed to prevent unacceptable levels of glare; thus, a maximum value was not recommended.

Testing Procedures

Recommended testing procedures were developed to ensure that specified performance levels are met. The procedures center on the use of a tripod-mounted luminance meter. By measuring the performance of the arrow panels or portable changeable message signs with a luminance meter, TxDOT can reliably compare the performance of purchased equipment in the field with the panel specification values. Additionally, a laboratory test on a sample of the individual lamps used in arrow panels is recommended to ensure that arrow panels purchased can meet all specifications, including hot spot and angularity requirements.

Table 1. Recommended luminous intensity requirements

Time of Day	Speed (mph)	Minimum On-Axis		Minimum Off-Axis		Maximum On-Axis
		cd/lamp	cd ^a	cd/lamp	cd ^a	cd ^a
Day	≥ 45	500	4000	100	800	NA
Night	≥ 45	150	1200	30	240	5500

^a Intensity requirements for the entire panel when displaying a left or right flashing arrow (10 lamps illuminated)

NA. Not applicable



For More Details . . .

The research is documented in the following reports:

4940-1 *Photometric Requirements for Arrow Panels*

4940-2 *Photometric Requirements for Portable Changeable Message Signs*

Research Supervisor: Mark D. Wooldridge, TTI, m-wooldridge@tamu.edu, (979) 845-9902

Researchers: Melisa D. Finley, John Denholm, Douglas Mace, and Benedict Patrick

TxDOT Project Director: Glenn Hagler, GHAGLER@dot.state.tx.us, (512) 416-2082

To obtain copies of the reports, contact Dolores Hott, Texas Transportation Institute, Information & Technology Exchange Center, (979) 845-4853, or e-mail d-hott@tamu.edu. See our on-line catalog at <http://tti.tamu.edu>.

TxDOT Implementation Status February 2002

The products required for this project were test methods for measuring the photometric properties of portable changeable message signs and Type C arrow panels.

Minimum photometric characteristics for these devices have been incorporated in TxDOT purchase specifications. TxDOT test methods are being developed for the devices. Testing of arrow panels should begin in March. Testing of portable changeable message signs will begin in the near future.

For more information, please contact RTI RMC4 Research Engineer at (512) 465-7403.

YOUR INVOLVEMENT IS WELCOME!

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the opinions, findings, and conclusions presented herein. The contents do not reflect the official views or policies of the Texas Department of Transportation (TxDOT) or the Federal Highway Administration (FHWA). This report is not intended to constitute a standard, specification, or regulation, nor is it intended for construction, bidding, or permit purposes. The engineer in charge of the project was Mark D. Wooldridge (TX-65791).