SURFACE VEHICLE RECOMMENDED PRACTICE

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Blind Spot Monitoring System (BSMS): Operating Characteristics and User Interface

RATIONALE

The current document recommends a visual BSMS indicator. BSMS detects and conveys to the driver via a visual indicator the presence of a target (e.g., vehicle) adjacent to the subject vehicle in the 'traditional' Adjacent Blind Spot Zone (ABSZ). The purpose of this update is to change the ISO symbols in 4.2.1.2 to the latest ISO symbol for ide Object Detection.

FOREWORD

This recommended practice is intended to be consistent only with the "Blind Spot Warning Function" in ISO FDIS 17387-Lane Change Decision Aid System. The functionality of the "Closing Vehicle Warning" and the "Lane Change Warning" are not considered in this document.

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1. SCOPE

This document specifies the minimum recommendations for Blind Spot Monitoring System (BSMS) operational characteristics and elements of the user interface. A visual BSMS indicator is recommended.

BSMS detects and conveys to the driver via a visual indicator the presence of a target (e.g., a vehicle), adjacent to the subject vehicle in the "traditional" Adjacent Blind Spot Zone (ABSZ). The BSMS is not intended to replace the need for interior and exterior rear-view mirrors or to reduce mirror size. BSMS is only intended as a supplement to these mirrors and will not take any automatic vehicle control action to prevent possible collisions. While the BSMS will assist drivers in detecting the presence of vehicles in their ABSZ, the absence of a visual indicator will not guarantee that the driver can safely make a lane change maneuver (e.g., vehicles may be approaching rapidly outside the ABSZ area).

This document applies to original equipment and aftermarket BSMS systems for passenger vehicles. This document does not apply to installing a BSMS on either motorcycles or commercial vehicles. Finally, this document does not address Lane Change Warning systems, which monitor areas substantially farther back than the side blind spot areas monitored by the BSMS (See ISO FDIS 17387).

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of ISO publications shall apply.

2.1.1 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO FDIS 17387 Intelligent transport systems—Lane change decision aid systems—Performance requirements and test procedures (ISO/TC204WG14/N40.32)

ISO 2575 Road vehicles—Symbols for controls, indicators and tell-tales

2.1.2 NHTSA Publication

Available from US Department of Transportation, NHTSA, 1200 New Jersey Ave., SE, West Building, Washington, DC, 20590, Tel: 888-327-4236, www.nhtsa.gov.

National Highway Traffic Safety Administration. Laboratory Test Procedure for FMVSS 111-Rearview Mirrors (Other than School Buses) (TP111V-000). Washington, DC: US Department of Transportation.

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J941 Motor Vehicle Drivers' Eye Locations

SAE J2830 Process for Comprehension Testing of In-Vehicle Icons

2.2.2 FHWA Publication

Available from US Department of Transportation, FHWA, 1200 New Jersey Ave., SE, Washington, DC, 20590, www.fhwa.dot.gov.

Campbell, J. L., Richman, J. B., Carney, C., and Lee, J. D. (2004). In-Vehicle Display Icons and Other Information Elements Volume I: Guideline (Technical Report FHWA-RD-03-065). Federal Highway Administration, Washington DC.

2.2.3 Elseiver Publication

Available from Elseiver Customer Service Department, 11830 Westline Industrial Drive, St. Louis, MO 63146, Tel: 800-545-2522 (inside USA), www.elseiver.com.

Kiefer, R. J., and Hankey, J. M. (2008) Lane Change Behavior with a Side Blind Zone Alert System. Accident Analysis and Prevention, 40, 683-690.

2.2.4 HFES Publication

Available from HFES, 1124 Montana Ave., Suite B, Santa Monica, CA 90403-1617, Tel: 310-394-1811, www.hfes.org.

Olsen, E. (2004). Lane Change Warning Design Guidelines. Proceedings of the 48th Annual Meeting of the Human Factors and Ergonomics Society. Santa Monica, CA: Human Factors and Ergonomics Society.

3. DEFINITIONS

3.1 BLIND SPOT MONITORING SYSTEM (BSMS)

A combination of sensor(s) and visual display(s) that detect and communicate to the driver the presence of a target in the left and/or right side operation zone(s).

3.2 LANE CHANGE WARNING SYSTEM

Any system that employs an additional operating zone extending rearward from the BSMS rearmost boundaries and is capable of providing warning(s) when a vehicle is detected in those zone(s).

3.3 SUBJECT VEHICLE

The vehicle equipped with the BSMS.

3.4 SYMBOL

Visually perceptible figure used to transmit information independently of language, produced by drawing, printing or other means. (ISO 2575)

3.5 BSMS TARGETS

3.5.1 Mandatory Targets

Any highway licensable vehicle, considered here to be a vehicle larger than a 125 cc motorcycle, except those excluded in 3.5.2 and 3.5.3.

3.5.2 Optional Targets

Pedestrians, pedalcyclists, or motor vehicles with an engine less than 125 cc. May also include vehicle the SV driver is passing.

3.5.3 Non-Targets

Vehicles moving in the opposing direction and objects which are stationary, including parked vehicles, and roadside furniture and appurtenances.

3.6 OPERATIONAL ZONE

Area to the left of subject vehicle between horizontal lines B and C and vertical lines F and G, and to the right of the subject vehicle between horizontal lines B and C and vertical lines K and L, where the lines are defined below: (Figure 1).

B: parallel to the trailing edge and 3.0 m behind it.
C: parallel to the leading edge and center of the 95th percentile eyellipse.
F: parallel to centerline and 0.5 m to the left of the left outermost edge.
G: parallel to centerline and 3.0 m to the left of the left outermost edge.
K: parallel to centerline and 0.5 m to the right of the right outermost edge.
L: parallel to centerline and a 3.0 m to the right of the right outermost edge.

NOTE: This operational zone is consistent with the ISO FDIS 17387 specification for ABSZ.

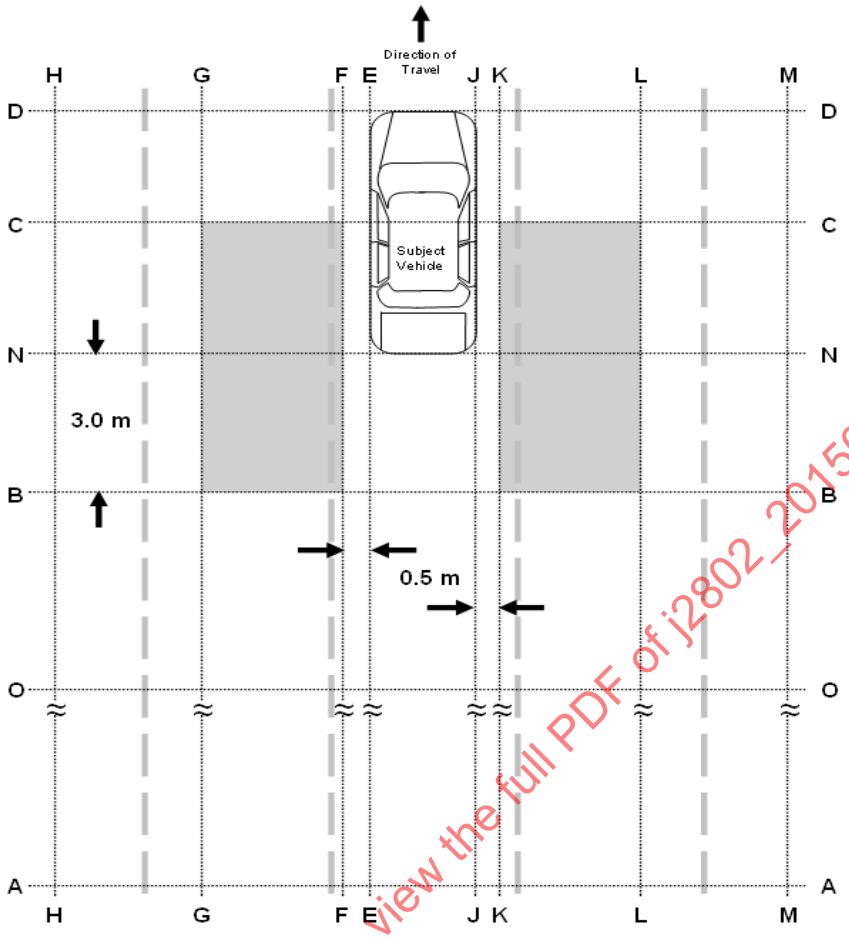

FIGURE 1 - ABSZ AS DEFINED BY ISO FDIS 17387

3.7 ADJACENT BLIND SPOT ZONE (ABSZ)

Zones to the left and right of the subject vehicle that extend into the adjacent lane. The exact size, position, and shape of the zones are given in Figure 1.

3.8 VISUAL INDICATOR

Visual signal given to the driver of the SV when a target has been detected in the ABSZ and the criteria (discussed in 4.1.2) have been met.

3.9 FMVSS 111 VIEWING TRIANGLE

A triangular plane defined in the U.S. DOT FMVSS 111 – Rearview Mirrors, that the driver must be able to see in the rearview mirror. The viewing triangle is outlined by points A, B, and C in Figure 2.

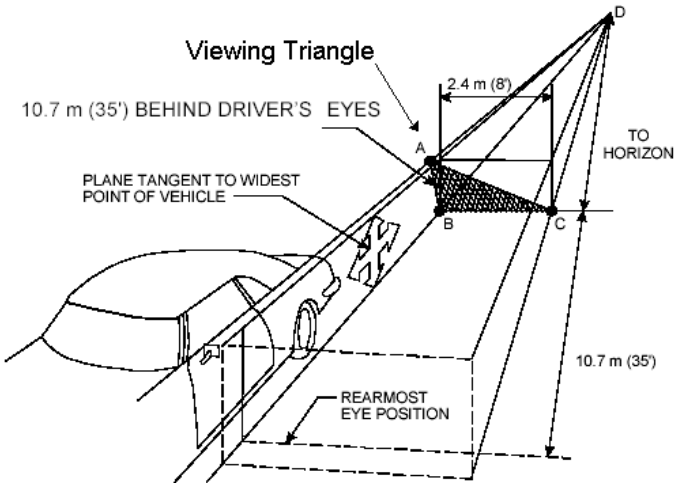

FIGURE 2 - FMVSS 111 VIEWING TRIANGLE

4. REQUIREMENTS

4.1 Operational Characteristics

4.1.1 Operational Speed

The system shall be operational when the vehicle is in a forward gear at a minimum speed of 60 km/hr (37.3 mph). The system may be operational at lower forward speeds. As the system is intended to monitor the blind spot of the vehicle while moving forward, it should not be operational when the driver is in reverse or park gear.

4.1.2 Criteria for Eliciting a Visual Indicator

4.1.2.1 Location in ABSZ on Left Side

Using Figure 1 as a reference, all of the target shall be located behind line C and to the left of line F and any part of the target vehicle shall be in front of line B and to right of line G to elicit a visual indicator.

4.1.2.2 Location in ABSZ on Right Side

Using Figure 1 as a reference, all of the target shall be located behind line C and to the right of line K and any part of the target vehicle shall be in front of line B and to left of line L to elicit a visual indicator.

4.1.2.3 Targets

The BSMS shall give a visual indicator for mandatory targets.

The BSMS may give a visual indicator for optional targets.

The BSMS should not give visual indicators to non-targets.

4.1.3 Deactivation

4.1.3.1 User Deactivation

The user shall be informed of the activation state (i.e., system active, system not active) at start-up, or whenever the state changes. A user may be provided with a means to deactivate and reactivate the system. The system may automatically reactivate upon the next ignition cycle.

4.1.3.2 Qualified Technician Deactivation

A method may be provided that allows the customer to have the system permanently deactivated by a qualified technician. Allowing the customer to permanently deactivate the system via a qualified technician is intended to accommodate customers who view the system as an annoyance.

4.1.4 Fault Indication

The system shall notify the driver at the time of the fault and at all subsequent vehicle ignition cycles during which there is a system fault.

4.2 Displays

A visual indicator shall be used to notify the driver that a target is detected in the ABSZ, regardless of whether there is sufficient evidence that the driver is planning or executing a lane change maneuver in the direction of a target detected in the ABSZ.

4.2.1 Visual

4.2.1.1 Location

One indicator shall be dedicated to the left ABSZ and another indicator shall be dedicated to the right ABSZ. The displays shall be located on, or in close proximity to, each side view mirror. This recommendation is intended to help ensure that drivers continue to check their mirrors before changing lanes, which is necessary for detecting vehicles outside the ABSZ areas, particularly rapidly approaching vehicles.

The Kiefer and Hankey (2008) in-traffic study suggests that placing the BSMS indicators attached directly to the mirror or in the mirror will reduce the number of lane changes attempted without checking mirrors relative to a baseline (no BSMS system available) condition. This display placement recommendation also provides a means of addressing any potential risks associated with drivers that incorrectly assume that the BSMS monitors areas beyond the ABSZ areas.

In addition, placing the BSMS indicators (particularly the BSMS symbol; see 4.2.1.2) either in the mirror or attached directly to the mirror may help drivers comprehend the meaning of the blind spot indicator. The visual indicator, if positioned on the reflective surface of the outside rearview mirror shall be placed outside the area of the mirror that encompasses the FMVSS 111 viewing triangle.

4.2.1.2 Use of ISO Symbols

The ISO Side Object Detection symbols, illustrated in Figure 3, should be used as either the visual indicator or as the identifier for the visual indicator (K.17, ISO/IEC registration number 7000-2796).

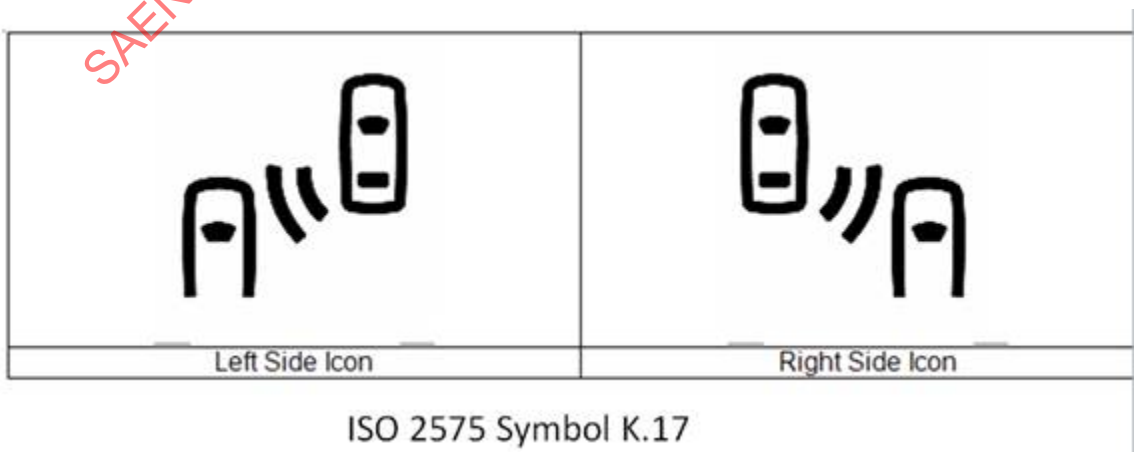

FIGURE 3 - ISO SIDE OBJECT DETECTION SYMBOLS

The symbol on the passenger's side should be displayed as a reverse image of the driver's side symbol. This use of symbols should aid in a correct interpretation of the relationship between the subject vehicle compared to a target in their blind spot.

If the ISO symbol is not used as the visual indicator, a solid color, point source (i.e., an LED) may be used. The ISO symbol should be used to identify the point source.

4.2.1.3 Color

The ISO symbol or point source should be illuminated in amber. It shall not be illuminated in red.

4.2.1.4 Luminance

The light source of the visual indicator should be capable of achieving at least 6000 cd/m^2 for daytime usage.

The display should have the ability to be dimmed at night so as to mitigate the potential that the display is a source of annoyance glare or possibly disability glare. For example, this dimming may be achieved through an automatic ambient light control or sensor, in conjunction with headlamp operation, or via a separate manual control.

The measurements of luminance should be taken with the photometer located at the centroid of the driver cyclopean eyellipse (SAE J941) and aimed at the center of the illuminated surface of the BSMS visual indicator on each side of the vehicle. Figure 4 provides sample values for such an approach applied to the driver's side visual indicator. The photometer is angled 42 degrees horizontally outboard, –12 degrees down at a 700 mm distance from the illuminated surface of the visual indicator. A similar measurement should be performed to the passenger's side mirror, recognizing that the values shown in Figure 4 will differ.