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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J845

**REV.
MAR92**

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Superseding J845 JAN84

(R) 360 DEGREE WARNING DEVICES FOR AUTHORIZED EMERGENCY, MAINTENANCE, AND SERVICE VEHICLES

1. Scope—This SAE Recommended Practice provides test procedures, requirements, and guidelines for single color, 360 degree warning devices.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J575—Tests for Motor Vehicle Lighting Devices and Components

SAE J576—Materials for Use in Optical Parts Such as Lenses and Reflectors of Motor Vehicle Lighting Devices

SAE J578—Color Specification of Electric Signal Lighting Devices

SAE J590—Turn Signal Flashers

2.1.2 OTHER PUBLICATIONS

National Bureau of Standards Special Publication 480-16—Emergency Vehicle Warning Lights: State of the Arts

2.2 Definitions

2.2.1 360 DEGREE WARNING DEVICE—A device that projects light in a horizontal 360 degree arc. It will appear to project a regularly repeating pattern of flashes to an observer positioned at a fixed location. Its function is to inform other highway users to stop, yield right-of-way, or indicate the existence of a hazardous situation.

2.2.2 ROTATING SIGNAL DEVICE—A warning device in which the beam or beams rotate either because one or more lamps rotate around fixed axes or because one or more lenses, reflectors, or mirrors rotate around fixed 360 degree light sources projecting light through a 360 degree arc.

2.2.3 OSCILLATING SIGNAL DEVICE—A warning device in which the beam or beams oscillate (turn back and forth) through fixed angles, either because one or more lamps oscillate around fixed axes or because one or more lenses, reflectors, or mirrors oscillate around fixed 360 degree light sources projecting light through a 360 degree arc.

2.2.4 FLASHING SIGNAL DEVICE—A warning device in which the light source is turned on and off through circuit interruption producing repetitive flashes of light to all points on a 360 degree arc.

2.2.5 PRIMARY WARNING DEVICE—Devices or groups of devices that are intended to provide the primary visual warning signal as called out in each service class. Unless prohibited by law or regulation, a Class 1 device may be used in place of Class 2 device and a Class 1 or 2 device in place of Class 3 device.

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2.2.6 **SECONDARY WARNING DEVICES**—Devices or groups of devices of lower performance that can be used to provide supplemental warning to that provided by the primary warning device or devices.

2.2.7 **CLASS 1 WARNING DEVICES**—Primary warning devices for use on authorized emergency vehicles responding to emergency situations. These devices are utilized to capture the attention of motorists and pedestrians and warn of a potentially hazardous activity or situation.

2.2.8 **CLASS 2 WARNING DEVICES**—Primary warning devices for use on authorized maintenance or service vehicles to warn of traffic hazards such as a lane blockage or slow moving vehicle.

2.2.9 **CLASS 3 WARNING DEVICES**—Primary warning devices for use on vehicles authorized to display a warning device for identification only.

3. **Lighting Identification Code**—360 Degree warning devices may be identified by the codes:

- a. W3-1, Class 1
- b. W3-2, Class 2
- c. W3-3, Class 3

in accordance with SAE J759.

4. Tests

4.1 SAE J575 is a part of this report. The following tests are applicable with the modifications as indicated.

All tests are to be made at 12.8 V dc for devices intended for operation on 12.8 V systems and 25.6 V dc for 24 V systems.

4.1.1 VIBRATION TEST

4.1.2 MOISTURE TEST

4.1.3 DUST TEST

4.1.4 CORROSION TEST

4.1.5 **PHOTOMETRY**—In addition to the test procedures in SAE J575, the following apply:

4.1.5.1 *Flash Energy Method for Measuring Photometric Performance*—For 360 degree warning devices producing flashes of 0.125 s or less duration, photometric performance can be determined by measuring flash energy. The flash rate shall be measured and recorded at the end of the test.

4.1.5.1.1 *Alternate Method of Measuring Photometric Performance*—For 360 degree warning devices with a flash rate of 2 Hz or less, photometric performance can be determined by measuring the luminous intensity of the steady on light source (not flashing).

4.1.5.2 *Devices Flashed by Current Interruption*—Photometric measurements shall be made with the device mounted in its normal operating position and all measurements shall be made with the incandescent filament of the device at least 18 m from the photometer. The device shall be mounted so that the horizontal plane through the photometer axis passes through the center of the light source. The vertical axis through the center of the light source shall be perpendicular to this horizontal plane. The device shall be turned about its vertical axis until the photometer indicates minimum reading. This shall be the H-V point.

4.1.5.3 *Devices Flashed by Rotation or Oscillation*—Photometric measurements shall be made with the device mounted in its normal operating position and all measurements shall be made with the incandescent filament of the device at least 18 m from the photometer. The device shall be mounted so that the horizontal plane through the photometer axis passes through the center of the light source of the rotating element. The vertical axis through the center of rotation shall be perpendicular to this horizontal plane. The rotating element shall be turned about its vertical axis until the photometer indicates the maximum reading.

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For a device with a symmetrical lens, filter, or lamp filament orientation, this shall be the H-V point. For a device with an asymmetrical lens, filter, or lamp filament orientation, the H-V point shall be determined as previously stated after rotating the device about its vertical axis to determine the point of lowest photometric performance.

4.1.6 WARPAGE TEST FOR PLASTIC COMPONENTS

4.2 Color Test—SAE J578 is a part of this report.

4.3 Additional Tests

4.3.1 HIGH TEMPERATURE FLASH RATE TEST—The device shall be subjected to an ambient temperature of $50^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for a period of 6 h. The device shall be off (not operating) during the first hour and shall operate continuously for the next 5 h of the test. The flash range shall be measured before the test, not less than 3 min nor more than 4 min after the beginning of the second hour of the test, and not less than 3 min nor more than 4 min after the end of the test.

4.3.2 LOW TEMPERATURE FLASH RATE TEST—The device shall be subjected to an ambient temperature of $-30^{\circ}\text{C} \pm 3^{\circ}\text{C}$ for a period of 6 h. The device shall be off (not operating) during the first 5 h and shall operate continuously for the last hour of the test. The flash rate shall be measured before the test, not less than 3 min nor more than 4 min after the beginning of the last hour of the test, and not less than 3 min nor more than 4 min after the end of the test.

4.3.3 DURABILITY TEST—The device shall be operated continuously for 200 h at an ambient temperature of $25^{\circ}\text{C} \pm 3^{\circ}\text{C}$ in cycles consisting of 50 min on and 10 min off. The flash rate shall be measured before the test and not more than 3 min after the last off period at the end of the test.

5. Requirements

5.1 Performance Requirements—A device, when tested in accordance with the test procedures specified in Section 4, shall meet the following requirements.

5.1.1 VIBRATION—SAE J575

5.1.2 MOISTURE—SAE J575

5.1.3 DUST—SAE J575

5.1.4 CORROSION—SAE J575

5.1.5 PHOTOMETRY—SAE J575

5.1.5.1 *Flash Energy*—The device shall meet the photometric requirements contained in Tables 1, 2, or 3, and Tables 4, 5, or 6, Photometric Requirements and their footnotes. The summation of the flash energy measurements at the specified test points in a zone shall be at least the value shown.

5.1.5.2 *Alternate Method*—The device shall meet the photometric requirements contained in Tables 7, 8, or 9 and Tables 10, 11, or 12, Photometric Requirements and their footnotes. The summation of the luminous intensity measurements at the specified test points in a zone shall be at least the value shown.

The steady-state totals for warning devices shown in the referenced Tables (7, 8, or 9, and 10, 11, or 12) apply to devices where two or more lamps, lenses, reflectors or mirrors rotate or oscillate around fixed axes.

5.1.5.3 For warning devices having only one lamp, lens, reflector or mirror, the steady-state zone totals and design guidelines shall be twice those shown in these Tables.

5.1.6 WARPAGE—SAE J575

5.1.7 COLOR—The color of light emitted shall be white, yellow, red, or signal blue as specified in SAE J578.

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5.2 Material Requirements—Plastic materials used in optical parts shall meet the requirements of SAE J576.

5.3 Additional Requirements

5.3.1 HIGH TEMPERATURE—There shall be no evidence of operating conditions which would result in failure to comply with Section 5 of this document. The flash rate at each of the required measurements shall be not less than 0.8 Hz nor more than 133% of the flash rate measured per 4.1.5.1.

However, if photometric performance was determined using the Alternate Method in 4.1.5.1.1, the flash rate at each of the required measurements shall be not less than 0.8 Hz nor more than 2.2 Hz.

5.3.2 LOW TEMPERATURE—There shall be no evidence of operating conditions which would result in failure to comply with Section 5 of this document. The flash rate at each of the required measurements shall be not less than 0.8 Hz nor more than 133% of the flash rate measured per 4.1.5.1.

However, if photometric performance was determined using the Alternate Method in 4.1.5.1.1, the flash rate at each of the required measurements shall be not less than 0.8 Hz nor more than 2.2 Hz.

5.3.3 DURABILITY—There shall be no evidence of operating conditions which would result in failure to comply with Section 5 of this document. The flash rate at each of the required measurements shall be not less than 1 Hz nor more than 133% of the flash rate measured in 4.1.5.1 up to a maximum of 4 Hz.

However, if photometric performance was determined using the Alternate Method in 4.1.5.2, the flash rate at each of the required measurements shall be not less than 1 Hz nor more than 2 Hz.

6. Guidelines

6.1 Photometric

6.1.1 FLASH ENERGY—For devices tested in accordance with 4.1.5.1, the Photometric Design Guidelines are contained in Tables 4, 5, or 6.

6.1.2 ALTERNATE METHOD—For devices tested in accordance with 4.1.5.1.1, the Photometric Design Guidelines are contained in Tables 10, 11, or 12.

6.2 Installation Guidelines—The following guidelines apply to 360 degree warning lamps as used on the vehicle and shall not be considered part of the requirements.

6.2.1 MOUNTING—The vertical axis of the device shall be installed normal to the longitudinal axis of the vehicle.

6.2.2 VISIBILITY—Visibility of the 360 degree warning lamp should be unobstructed by any part of the vehicle 5 degrees above to 5 degrees below the horizontal and provide a flashing light throughout a 360 degree circle.

6.2.3 INDICATOR—There should be a visible or audible means of giving a clear and unmistakable indication to the driver when the warning lamps are turned on and functioning normally.

6.2.4 "ON" TIME—For current interrupted devices the on period of the lamp shall be as specified in SAE J590.

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TABLE 1—PHOTOMETRIC REQUIREMENTS—CLASS 1 WARNING LAMPS

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds Signal Blue
		White	Yellow	Red	
1	5U-V 2.1/2U-V H-V 2.1/2D-V 5D-V	396	198	99	99

Notes:

1. A one-time adjustment in lamp orientation from design position may be made in determining compliance to Tables 1 and 4, provided each adjustment does not exceed 1 degree in any direction. The same shall comply after this one time, final reaim.
2. The measured value at each test point shall not be less than 60% of the minimum values in Table 4.

TABLE 2—PHOTOMETRIC REQUIREMENTS—CLASS 2 WARNING LAMPS

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds Signal Blue
		White	Yellow	Red	
1	5U-V 2.1/2U-V H-V 2.1/2D-V 5D-V	99	49.5	25	25

Notes:

1. A one-time adjustment in lamp orientation from design position may be made in determining compliance to Tables 2 and 5, provided such adjustment does not exceed 1 degree in any direction. The zone shall comply after this one time, final reaim.
2. The measured value at each test point shall not be less than 60% of the minimum values in Table 5.

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TABLE 3—PHOTOMETRIC REQUIREMENTS—CLASS 3 WARNING LAMPS

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds Signal Blue
		White	Yellow	Red	
1	5U-V				
	2.1/2U-V				
	H-V	40	20	10	10
	2.1/2D-V				
	5D-V				

Notes:

1. A one-time adjustment in lamp orientation from design position may be made in determining compliance to Tables 3 and 6, provided such adjustment does not exceed 1 degree in any direction. The zone shall comply after this one time, final realm.
2. The measured value at each test point shall not be less than 60% of the minimum values in Table 6.

TABLE 4—PHOTOMETRIC DESIGN GUIDELINES—CLASS 1 WARNING LAMPS

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds Signal Blue
		White	Yellow	Red	
1	5U-V	10	9	4.5	4.5
	2.1/2U-V	90	45	22.5	22.5
	H-V	180	90	45	45
	2.1/2D-V	90	45	22.5	22.5
	5D-V	10	9	4.5	4.5

TABLE 5—PHOTOMETRIC DESIGN GUIDELINES—CLASS 2 WARNING LAMPS

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds Signal Blue
		White	Yellow	Red	
1	5U-V	4.5	2	1	1
	2.1/2U-V	22.5	11.5	6	6
	H-V	45	22.5	11	11
	2.1/2D-V	22.5	11.5	6	6
	5D-V	4.5	2	1	1

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TABLE 6—PHOTOMETRIC DESIGN GUIDELINES—CLASS 3 WARNING LAMPS

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds	Minimum Flash Energy Candela Seconds Signal Blue
		White	Yellow	Red	
1	5U-V	1	1	0.5	0.5
	2.1/2U-V	9	4.5	2	2
	H-V	18	9	5	5
	2.1/2D-V	9	4.5	2	2
	5D-V	1	1	0.5	0.5

TABLE 7—PHOTOMETRIC REQUIREMENTS (ALTERNATE METHOD)—CLASS 1 WARNING LAMPS

Zone	Test Points Degrees	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela Signal Blue
		White	Yellow	Red	
1	5U-V				
	2.1/2U-V				
	H-V	39 600	19 800	9 900	9 900
	2.1/2D-V				
	5D-V				

Notes:

1. A one-time adjustment in lamp orientation from design position may be made in determining compliance to Tables 7 and 10 provided such adjustment does not exceed 1 degree in any direction. The zone shall comply after this one time, final realm.
2. The measured value of each test point shall not be less than 60% of the minimum values in Table 10.

TABLE 8—PHOTOMETRIC REQUIREMENTS (ALTERNATE METHOD)—CLASS 2 WARNING LAMPS

Zone	Test Points Degrees	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela Signal Blue
		White	Yellow	Red	
1	5U-V				
	2.1/2U-V				
	H-V	9 900	4 950	2 475	2 475
	2.1/2D-V				
	5D-V				

Notes:

1. A one-time adjustment in lamp orientation from design position may be made in determining compliance to Tables 8 and 11 provided such adjustment does not exceed 1 degree in any direction. The zone shall comply after this one time, final realm.
2. The measured value at each test point shall not be less than 60% of the minimum values in Table 11.

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TABLE 9—PHOTOMETRIC REQUIREMENTS (ALTERNATE METHOD)—CLASS 3 WARNING LAMPS

Zone	Test Points Degrees	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela	Minimum Luminous Intensity Zone Totals Candela Signal Blue
		White	Yellow	Red	
1	5U-V 2.1/2U-V H-V 2.1/2D-V 5D-V	3 960	1 980	990	990

Notes:

1. A one-time adjustment in lamp orientation from design position may be made in determining compliance to Tables 9 and 12 provided such adjustment does not exceed 1 degree in any direction. The zone shall comply after this one time, final read.
2. The measured value of each test point shall not be less than 60% of the minimum values in Table 12.

TABLE 10—PHOTOMETRIC DESIGN GUIDELINES (ALTERNATE METHOD)—CLASS 1 WARNING LAMPS

Zone	Test Points Degrees	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela Signal Blue
		White	Yellow	Red	
1	5U-V 2.1/2U-V H-V 2.1/2D-V 5D-V	1 000 9 000 18 000 9 000 1 000	900 4 500 9 000 4 500 900	450 2 250 4 500 2 250 450	450 2 250 4 500 2 250 450

TABLE 11—PHOTOMETRIC DESIGN GUIDELINES (ALTERNATE METHOD)—CLASS 2 WARNING LAMPS

Zone	Test Points Degrees	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela Signal Blue
		White	Yellow	Red	
1	5U-V 2.1/2U-V H-V 2.1/2D-V 5D-V	250 2 250 4 500 2 250 250	225 1 125 2 250 1 125 225	113 562 1 125 562 113	113 562 1 125 562 113

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TABLE 12—PHOTOMETRIC DESIGN GUIDELINES (ALTERNATE METHOD)—CLASS 3 WARNING LAMPS

Zone	Test Points Degrees	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela	Minimum Luminous Intensity Steady-State Beam Candela Signal Blue
		White	Yellow	Red	
1	5U-V	180	90	45	45
	2.1/2U-V	900	450	225	225
	H-V	1 800	900	450	450
	2.1/2D-V	900	450	225	225
	5D-V	180	90	45	45

7. Notes

- 7.1 **Marginal Indicia**—The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

PREPARED BY THE SAE LIGHTING COORDINATING COMMITTEE AND THE
SAE EMERGENCY WARNING LAMP AND DEVICES STANDARDS COMMITTEE