

**(R) OPTICAL WARNING DEVICES FOR AUTHORIZED EMERGENCY, MAINTENANCE,  
AND SERVICE VEHICLES**

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

2. **References**

2.1 **Applicable Publications**—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 J759—Lighting Identification Code

3. **Definitions**

3.1 **360 Degree Optical 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.

3.2 **Zonal Optical Warning Device**—A device that projects light in a defined horizontal arc of less than 360degrees. It will appear to project a regularly repeating pattern of flashes to an observer positioned at a fixed location within the arc of coverage. Its function is to inform other highway users to stop, yield right-of-way, or indicate the existence of a hazardous situation.

3.3 **Primary Optical Warning Devices**—Devices or groups of devices that are intended to provide the primary visual optical 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 may be used in place of Class 3 device.

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- 3.4 Secondary Optical Warning Devices**—Devices or groups of devices of lower performance that can be used to provide supplemental optical warning to that provided by the primary optical warning device or devices.
- 3.5 Class 1 Optical Warning Devices**—Primary optical 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.
- 3.6 Class 2 Optical Warning Devices**—Primary optical warning devices for use on authorized maintenance or service vehicles to warn of traffic hazards such as a lane blockage or slow moving vehicle.
- 3.7 Class 3 Optical Warning Devices**—Primary optical warning devices for use on vehicles authorized to display an optical warning device for identification only.
- 3.8 Light Pulse**—A single, continuous emission of optical energy.
- 3.9 Flash**—A light pulse or a train of light pulses, where a dark interval of at least 0.160 s separates the light pulse or the last pulse of the train of light pulses from the next pulse or the first pulse of the next train of light pulses. To be considered a train of light pulses, each pulse in the train must begin within 0.100 s after the end of the preceding light pulse.
- 4. Lighting Identification Code, Markings, and Notices**—The optical warning device may be also identified by the codes:
- a. W3-1, Class 1
  - b. W3-2, Class 2
  - c. W3-3, Class 3

in accordance with SAE J759. If the optical warning device is a zonal device covering less than 360 degrees, the angle of coverage may be indicated in parentheses. For example, a Class 1 device providing 120 degrees of signal may be marked W3-1 (120).

**5. Tests**

- 5.1** 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 V systems and 25.6 V dc for 24 V systems using the wiring supplied by the manufacturer or wire of the minimum size recommended by the manufacturer. The voltage shall be measured at 12 in  $\pm$  1 in from the point at which the wiring exits the device.
- 5.1.1 VIBRATION TEST
  - 5.1.2 MOISTURE TEST
  - 5.1.3 DUST TEST
  - 5.1.4 CORROSION TEST
  - 5.1.5 WARPAGE TEST FOR PLASTIC COMPONENTS

- 5.1.6 **FLASH RATE AND PHOTOMETRY**—In addition to the test procedures in SAE J575, photometric performance shall be determined by measuring flash energy. The flash rate shall be measured and recorded at the end of the test.

Photometric measurements shall be made with the device mounted in its normal operating position and all measurements shall be made with the light source 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 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 within its defined arc of coverage until the photometer indicates minimum reading. This shall be the H-V point.

- 5.2 **Color Test**—SAE J578 is a part of this report.

### 5.3 Additional Tests

- 5.3.1 **HIGH TEMPERATURE FLASH RATE TEST**—The device shall be subjected to an ambient temperature of  $50\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  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 rate 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.
- 5.3.2 **LOW TEMPERATURE FLASH RATE TEST**—The device shall be subjected to an ambient temperature of  $-30\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  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.
- 5.3.3 **DURABILITY TEST**—The device shall be operated continuously for 200 h at an ambient temperature of  $25\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  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.

- 5.4 **Materials Test**—SAE J576 is a part of this report.

## 6. Performance Requirements

- 6.1 **Performance Requirements**—A device, when tested in accordance with the test procedures specified in Section 5, shall meet the following requirements.

- 6.1.1 **VIBRATION**—SAE J575
- 6.1.2 **MOISTURE**—SAE J575
- 6.1.3 **DUST**—SAE J575
- 6.1.4 **CORROSION**—SAE J575
- 6.1.5 **WARPAGE**—SAE J575
- 6.1.6 **PHOTOMETRY**—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. The flash rate for devices shall be at least 1 Hz and not more than 4 Hz.

- 6.2 **Color**—The color of light emitted shall be white, yellow, red, or signal blue as specified in SAE J578.

### 6.3 Additional Requirements

- 6.3.1 HIGH TEMPERATURE—There shall be no evidence of operating conditions which would result in failure to comply with Section 6 of this document. Operation of the device shall begin and continue within 5 s of the beginning of each operating cycle and 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 5.1.6.
- 6.3.2 LOW TEMPERATURE—There shall be no evidence of operating conditions which would result in failure to comply with Section 6 of this document. Operation of the device shall begin and continue within 5 s of the beginning of each operating cycle and 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 5.1.6.
- 6.3.3 DURABILITY—There shall be no evidence of operating conditions which would result in failure to comply with Section 6 of this document. Operation of the device shall begin and continue within 5 s of the beginning of each operating cycle and 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 in 5.1.6.

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

### 7. Guidelines

#### 7.1 Photometric Guidelines

- 7.1.1 FLASH ENERGY—The Photometric Design Guidelines are contained in Tables 4, 5, or 6.
- 7.1.2 OPTICAL WARNING DEVICES CONTAINING MULTIPLE LIGHT SOURCES—The photometric performance of individual light sources contained in light bars and similar optical warning devices can be determined by testing each source independently over the specified arc of coverage.

**7.2 Installation Guidelines**—The following guidelines apply to optical warning devices as used on the vehicle and shall not be considered part of the requirements.

- 7.2.1 MOUNTING—The devices shall be installed within the guidelines provided by the manufacturer of the device.
- 7.2.2 VISIBILITY—Visibility of the optical warning device should be unobstructed by any part of the vehicle from 5 degrees above to 5 degrees below the horizontal. Multiple optical warning devices may be required to obtain 360 degrees of coverage. If a zonal device is used, the optical warning device shall be oriented to provide the desired coverage.
- 7.2.3 INDICATOR—There should be a visible or audible means of giving a clear and unmistakable indication to the driver when the optical warning devices are energized.

**TABLE 1—PHOTOMETRIC REQUIREMENTS—CLASS 1 WARNING DEVICES ZONE TOTALS<sup>(1)(2)</sup>**

Zone	Test Points Degrees	Minimum Flash Energy Candela			
		Seconds White	Seconds Yellow	Seconds Red	Seconds Signal Blue
1	5U-V	400	200	100	100
	2 1/2U-V				
	H-V				
	2 1/2D-V				
	5D-V				

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 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 4.

**TABLE 2—PHOTOMETRIC REQUIREMENTS—CLASS 2 WARNING DEVICES ZONE TOTALS<sup>(1)(2)</sup>**

Zone	Test Points Degrees	Minimum Flash Energy Candela			
		Seconds White	Seconds Yellow	Seconds Red	Seconds Signal Blue
1	5U-V	100	50	25	25
	2 1/2D-V				
	H-V				
	2 1/2D-V				
	5D-V				

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.

**TABLE 3—PHOTOMETRIC REQUIREMENTS—CLASS 3 WARNING DEVICES ZONE TOTALS<sup>(1)(2)</sup>**

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

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 reaim.
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 DEVICES

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds White	Minimum Flash Energy Candela Seconds Yellow	Minimum Flash Energy Candela Seconds Red	Minimum Flash Energy Candela Seconds Signal Blue
1	5U-V	20	10	5	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	20	10	5	5

TABLE 5—PHOTOMETRIC DESIGN GUIDELINES—CLASS 2 WARNING DEVICES

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds White	Minimum Flash Energy Candela Seconds Yellow	Minimum Flash Energy Candela Seconds Red	Minimum Flash Energy Candela Seconds Signal Blue
1	5U-V	5	2	1	1
	2 1/2U-V	22.5	12	6	6
	H-V	45	22	11	11
	2 1/2D-V	22.5	12	6	6
	5D-V	5	2	1	1

TABLE 6—PHOTOMETRIC DESIGN GUIDELINES—CLASS 3 WARNING DEVICES

Zone	Test Points Degrees	Minimum Flash Energy Candela Seconds White	Minimum Flash Energy Candela Seconds Yellow	Minimum Flash Energy Candela Seconds Red	Minimum Flash Energy Candela Seconds Signal Blue
1	5U-V	2	1	0.5	0.5
	2 1/2U-V	9	4	2	2
	H-V	18	10	5	5
	2 1/2D-V	9	4	2	2
	5D-V	2	1	0.5	0.5

## 8. Notes

- 8.1 **Marginal Indicia**—The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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