SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2498 AUG2011

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Superseding J2498 AUG2004

Minimum Performance of the Warning Light System Used on Emergency Vehicles

RATIONALE

Any reference to J1318 (cancelled January 2009) has been removed from this document.

SAE J1889 has been referenced since many light sources are now LED devices

1. SCOPE

This SAE Recommended Practice provides test procedures, requirements, and guidelines for the system of optical warning devices used on emergency vehicles.

2. REFERENCES

2.1 Applicable Publications

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

2.1.1 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 J575 Test Methods and Equipment for Lighting Devices and Components for Use on Vehicles Less Than 2032 mm in Overall Width

SAE J576 Plastic Material or Materials for Use in Optical Parts Such as Lenses and Reflex Reflectors of Motor Vehicle Lighting Devices

SAE J578 Color Specification

SAE J595 Directional Flashing Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE J845 Optical Warning Devices for Authorized Emergency, Maintenance, and Service Vehicles

SAE J1330 Photometry Laboratory Accuracy Guidelines

SAE J1690 Flashers

SAE J1889 LED Signal and Marking Lighting Devices

3. DEFINITIONS

3.1 ACTIVE HORIZONTAL AND VERTICAL ANGLES OF LIGHT EMISSION

The angles, specified by the manufacturer of the optical device, throughout which the optical warning device contributes optical power to the lighting system.

3.2 CENTER OF THE LENS

For optical warning devices with one lens, the geometric center of the lens. For optical warning devices with multiple lenses, the geometric center of the array of lenses.

3.3 EMERGENCY VEHICLE

An ambulance, fire apparatus, police car, or other vehicle which is permitted by law to call for the right of way and violate the rules of the road while responding to an incident affecting the public safety and to block the public road while at the scene of such an incident.

3.4 LOWER LEVEL OPTICAL WARNING DEVICES

Warning devices mounted with the center of the lens between 46 cm and 157 cm (18 in and 62 in) above grade. For the purposes of this document, warning devices are considered Upper Level Warning Devices when mounted with the center of the lens at a height greater than 157 cm (62 in) above grade.

3.5 OPTICAL POWER

The unit of measure designed to combine the flash energy and flash rate of a light source into one power measurement representing the true visual effectiveness of the emitted light. The units of optical power are candela-seconds/minute.

3.6 LIGHT SOURCE

Any single, independently mounted, light emitting component in the lighting system. A light source may consist of a single optical element or a fixed array of any number of optical elements whose geometric positioning relative to each other is fixed by the manufacturer of the light source and not intended to be modified.

3.7 OPTICAL WARNING DEVICE

A manufactured assembly of one or more light sources.

3.8 UPPER LEVEL OPTICAL WARNING DEVICES

Warning devices mounted with the center of lens at a height greater than 157 cm (62 in) above grade. For the purposes of this document, warning devices are considered Lower Level Warning Devices when mounted with the center of the lens at a height between 46 cm and 157 cm (18 in and 62 in) above grade.

3.9 ZONES

For the purpose of defining and measuring the required optical performance of upper and lower level optical warning devices, the upper and lower warning levels shall each be divided into four warning zones. The four zones shall be determined by drawing lines through the geometric center of the emergency vehicle at 45 degrees to a line lengthwise of the emergency vehicle through the geometric center.

The four zones shall be designated A, B, C, and D in a clockwise direction with zone A to the front of the emergency vehicle. Zones BF and DF comprise the front half of zones B and D which are adjacent to Zone A. (See Figure 1.)

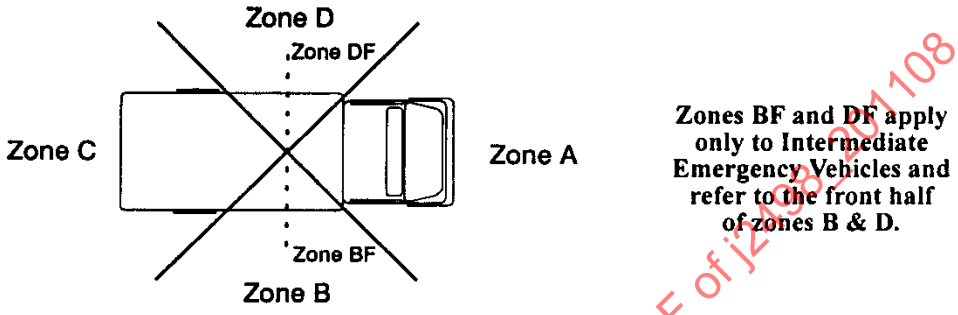

FIGURE 1 - WARNING ZONES

3.10 ZONE TOTAL

A zone total reflects the combined performance of the individual optical warning devices oriented as installed on the vehicle when viewed along the perimeter of a circle of 30.5 m (100 ft) radius from the geometric center of the vehicle. The zone total is the sum of the optical power of all the devices that project signals of permissible color into the zone as measured at 5 degree increments along H.

There are 19 measurement points in Zones A, B, C, and D and 10 measurement points in Zones BF and DF. The calculation of the upper level zone totals assumes that all upper level light sources are mounted at the geometric center of the vehicle and at the same height above grade. The calculation of the lower level zone totals assumes that all lower level light sources are mounted at the geometric center of the vehicle and at the same height above grade.

With each optical warning device oriented as installed, the optical power contributed by every light source that would be visible at a given point is taken from the test reports provided by the manufacturer of the optical warning device and added together to determine the total optical power at that point. The zone total is the sum of the optical power at all of the measurement points in the zone. The zone totals of the upper and lower level optical warning devices are calculated independently.

4. MARKINGS AND NOTICES

4.1 Certification of Compliance

The emergency warning light installer or the owner shall be permitted to demonstrate compliance of the warning system by one of the following methods.

4.1.1 Certification that the system was installed within the geometric parameters specified by the manufacturer of the optical warning system and referencing the light source test reports provided by the manufacturer of the optical warning devices used in the system.

4.1.2 Certification that a mathematical calculation performed by a qualified person demonstrates that the combination of individual devices, as installed, meets the requirements of this document. This calculation shall be based on test reports for individual light sources provided by the manufacturer of the device.

4.1.3 Certification that the actual performance of the lighting system was measured by a qualified person following the Guidelines contained Section 7, and meets the requirements of this document.

5. TESTS

5.1 Mechanical and Environmental Tests

All optical warning devices including those tested under SAE J595 , shall be tested in conformance with SAE J845.

5.2 Photometric Tests

All optical warning devices shall be tested by, or on behalf of, the device manufacturer. The results of the testing shall be used to determine compliance with this document and shall be available upon request from the optical warning device manufacturer. The goniometer, integrating photometer, and other equipment used to make test measurements shall meet the requirements of SAE J1330.

5.2.1 The optical warning device shall be mounted in a goniometer and operated as it would be in a normal system application. The minimum distance between the light emitting surface of the source under test and the front face of the photometer detector shall be 18 m (59 ft). The goniometer shall be oriented and the integrating photometer shall be set to integrate light pulses from the source for a minimum of 20 s. If the optical warning device contains more than one light source, the test shall be repeated for each light source.

5.2.2 For all tests performed with the power applied, the optical warning device shall be operated at 12.8 V ± 0.1 V for 12-V rated equipment and 25.6 V ± 0.2 V for 24-V rated equipment measured at 30.5 cm ± 2.5 cm (12 in ± 1 in) from the point of entry into the device. If the equipment is rated for operation on both 12 V and 24 V, the tests shall be performed at both voltages.

5.2.3 The test shall be performed along the horizontal plane (H) passing through H-V, the center of light source, beginning at the vertical plane (V) passing through H-V, and repeated at 5 degree intervals to the left and right of V throughout the active horizontal angle of light emission of the light source being tested.

5.2.4 The test shall be repeated at 5 degrees up and 5 degrees down from the horizontal plane (H) passing through the center of light source (H-V), beginning at the vertical plane (V) passing through H-V, and repeated at 5 degree intervals to the left and right of V throughout the active horizontal angle of light emission of the light source.

6. PERFORMANCE REQUIREMENTS

6.1 Optical Warning Devices

Each emergency vehicle shall have a system of optical warning devices that meet or exceed the requirements of this document.

6.1.1 The optical warning system on large and intermediate emergency vehicles, as defined in 6.4.1 and 6.4.2, shall consist of upper and lower level warning devices, and the requirements for each level shall be met by the warning devices in that level without consideration of the warning devices in the other level. There are, however, no separate requirements for upper and lower level optical warning devices mounted on small emergency vehicles, as defined in 6.4.3.

All devices shall comply with the following performance requirements of SAE J845.

Vibration	High temperature
Moisture	Low temperature
Dust	Durability
Corrosion	Warpage

EXCEPTION: Optical devices and components designed for mounting only in weatherproof, interior spaces shall be required to comply only with the vibration test, high temperature test, low temperature test, durability test, and the warpage test for plastic components.

6.1.2 Each optical warning device shall be installed on the emergency vehicle and connected to the vehicle electrical system in accordance with the requirements of this document and the requirements of the manufacturer of the device.

6.1.3 A master optical warning system switch that energizes all of the optical warning devices shall be provided.

6.1.4 The optical warning system on the emergency vehicle shall be capable of two separate signaling modes during emergency operations. One mode shall signal to drivers and pedestrians that the emergency vehicle is responding to an emergency and is calling for the right-of-way. The other mode shall signal that the vehicle is stopped and is blocking the right-of-way.

6.1.5 A switching system shall be provided that senses the position of the parking brake or the park position of an automatic transmission. When the master optical warning system switch is closed, and the parking brake is released or the automatic transmission is not in park, the warning devices signaling the call for the right-of- way shall be energized. When the master optical warning system switch is closed, and the parking brake is on or the automatic transmission is in park, the warning devices signalling the blockage of the right-of-way shall be energized. The system shall be permitted to have a method of modifying the two signalling modes.

6.1.6 The optical warning devices shall be constructed or arranged to avoid the projection of light either directly or through mirrors into any driving or crew compartment(s).

6.1.7 The front optical warning devices shall be placed to maintain the maximum possible separation from the headlights.

6.1.8 The light sources in the optical warning devices mounted on each level shall be of sufficient number and arranged so that failure of a single light source does not create a measurement point in any zone, on the same level as the failed light source, without a warning signal at a distance of 30.5 m (100 ft) from the geometric center of the emergency vehicle. This requirement does not apply to Zones BF and DF on Intermediate Emergency Vehicles.

6.2 Flashrate

6.2.1 The minimum number of flashes from all of the light sources visible at each measurement point shall be 150 flashes per minute and shall be determined by adding together the flash rates given on the test reports provided by the manufacturer of the optical warning device for every warning device visible at each measurement point.

Steady burning, non-flashing optical sources shall be permitted to be used, but the optical energy provided by the non-flashing sources shall not be included in the calculation of the zone total optical power.

6.2.2 The flasher of any current interrupted, incandescent filament, flashing light source shall meet the requirements of SAE J1690.

6.3 Color

6.3.1 Permissible colors or combination of colors in each zone, within the constraints imposed by applicable laws and regulations, shall be as shown in Table 1. The colors shall be white, red, yellow, or blue specified in SAE J578.

TABLE 1 - ZONE COLORS

Color	Call for Right-of-Way	Blocking Right-of-Way
Red	Any Zone	Any Zone
Blue	Any Zone	Any Zone
Yellow	Any Zone Except A	Any Zone
White	Any Zone Except C	Not Permitted

6.4 Size

6.4.1 Requirements for Large Emergency Vehicles

If the emergency vehicle has a bumper-to-bumper length of 6.7 m (22 ft) or greater, the requirements of 6.4.1.1 through 6.4.1.4 shall apply.

6.4.1.1 The upper level optical warning devices shall be mounted as high and as close to the corner points of the vehicle as is practical in order to define the clearance lines of the vehicle. However, these optical warning devices shall not be mounted above the maximum height, specified by the device manufacturer, that gives an intensity value at 1.2 m (4 ft) above grade and 30.5 m (100 ft) from the optical warning device of less than 50% of that required at H.

6.4.1.2 In order to define the clearance lines of the emergency vehicle, each lower level optical warning device at the front of the vehicle shall be mounted so that the center of the lens is forward of the centerline of the front axle and as close to the front corner points of the vehicle as is practical. Each lower level optical warning device at the rear of the vehicle shall be mounted so that the center of the lens is behind the centerline of the rear axle and as close to the rear corner points of the vehicle as is practical.

6.4.1.3 A lower level, midship optical warning device shall be mounted on both the right and left sides of the emergency vehicle if the distance between the center of the lens on the lower level front optical warning device and center of the lens of the rear lower level optical devices exceeds 6.7 m (22 ft).

Additional midship optical warning devices shall be required where necessary to maintain a horizontal distance between the centers of the lenses of adjacent lower level optical warning devices at 6.7 m (22 ft) or less.

6.4.1.4 For each operating mode, the combined optical power of all the light sources shall meet or exceed the zone total optical requirement shown in Tables 2A and 2B. No individual measurement point shall be less than that shown in Tables 2A and 2B.

TABLE 2A - MINIMUM OPTICAL POWER REQUIREMENT FOR LARGE EMERGENCY VEHICLES
MODE OF OPERATION—CLEARING THE RIGHT-OF-WAY

Zones	Level	Zone Total at H	Min. Value at any H Point	Min. Value at any ± 5 degree H Point
A	Upper	1 000 000	10 000	3500
B	Upper	400 000	10 000	3500
C	Upper	400 000	10 000	3500
D	Upper	400 000	10 000	3500
A	Lower	150 000	3750	1300
B	Lower	150 000	3750	1300
C	Lower	150 000	3750	1300
D	Lower	150 000	3750	1300

TABLE 2B - MINIMUM OPTICAL POWER REQUIREMENT FOR LARGE EMERGENCY VEHICLES
MODE OF OPERATION—BLOCKING THE RIGHT-OF-WAY

Zones	Level	Zone Total at H	Min. Value at any H Point	Min. Value at any ± 5 degree H Point
A	Upper	400 000	10 000	3500
B	Upper	400 000	10 000	3500
C	Upper	800 000	10 000	3500
D	Upper	400 000	10 000	3500
A	Lower	150 000	3750	1300
B	Lower	150 000	3750	1300
C	Lower	150 000	3750	1300
D	Lower	150 000	3750	1300

NOTE: All values are in candela-seconds/minute.
H = Horizontal plane passing through the center of the light source.

6.4.2 Requirements for Intermediate Emergency Vehicles

If the emergency vehicle has a bumper-to-bumper length of less than 6.7 m (22 ft) and has the center of the lens of any optical warning device at more than 208 cm (82 in) above grade, the requirements of 6.4.2.1 through 6.4.2.3 shall apply.

6.4.2.1 The upper level optical warning devices shall be mounted as high and as close to the corner points of the vehicle as is practical in order to define the clearance lines of the vehicle. However, these optical warning devices shall not be mounted above the maximum height, specified by the device manufacturer, that gives an intensity value at 1.2 m (4 ft) above grade and 30.5 m (100 ft) from the optical warning device of less than 50% of that required at H.

6.4.2.2 In order to define the clearance lines of the emergency vehicle, each lower level optical device at the front of the vehicle shall be mounted so that the center of the lens is forward of the centerline of the front axle and as close to the front corner points of the vehicle as is practical.

6.4.2.3 For each operating mode, the combined optical power of all the light sources shall meet or exceed the zone total optical power requirement shown in Tables 3A and 3B. No individual measurement point shall be less than that shown in Tables 3A and 3B.

TABLE 3A - MINIMUM OPTICAL POWER REQUIREMENT FOR INTERMEDIATE EMERGENCY VEHICLES
MODE OF OPERATION—CLEARING THE RIGHT-OF-WAY

Zones	Level	Zone Total at H	Min. Value at any H Point	Min. Value at any ± 5 degree H Point
A	Upper	1 000 000	10 000	3500
B	Upper	400 000	10 000	3500
C	Upper	400 000	10 000	3500
D	Upper	400 000	10 000	3500
A	Lower	150 000	3750	1300
BF	Lower	75 000	3750	1300
C	Lower	None	None	None
DF	Lower	75 000	3750	1300

TABLE 3B - MINIMUM OPTICAL POWER REQUIREMENT FOR INTERMEDIATE EMERGENCY VEHICLES
MODE OF OPERATION—BLOCKING THE RIGHT-OF-WAY

Zones	Level	Zone Total at H	Min. Value at any H Point	Min. Value at any ± 5 degree H Point
A	Upper	400 000	10 000	3500
B	Upper	400 000	10 000	3500
C	Upper	800 000	10 000	3500
D	Upper	400 000	10 000	3500
A	Lower	150 000	3750	1300
BF	Lower	75 000	3750	1300
C	Lower	None	None	None
DF	Lower	75 000	3750	1300

NOTE: All values are in candela-seconds/minute.
H = Horizontal plane passing through the center of the light source.

6.4.3 Requirements for Small Emergency Vehicles

If the emergency vehicle has a bumper-to-bumper length of less than 6.7 m (22 ft) and has the center of lens of all optical warning devices at 208 cm (82 in) or less above grade, the requirements of 6.4.3.1 through 6.4.3.2 shall apply.

6.4.3.1 The optical warning devices shall be mounted as high as practical, but not over 208 cm (82 in) at the center of the lens. They shall be permitted to be combined in one or more enclosures and shall be permitted to be mounted on the cab roof or any other convenient point(s).

6.4.3.2 For each operating mode, the combined optical power of all the light sources shall meet or exceed the zone total optical power requirement shown in Tables 4A and 4B. There are no separate requirements for the