



SURFACE VEHICLE RECOMMENDED PRACTICE

J595™

AUG2021

Issued 1948-12
Reaffirmed 2012-08
Revised 2021-08

Superseding J595 MAR2014

(R) Directional Flashing Optical Warning Devices
for Authorized Emergency, Maintenance, and Service Vehicles

RATIONALE

The color green was added to the photometric and color requirements for Class 3 devices to reflect the use of green warning lamps to identify an incident command post, the private vehicles of volunteer firefighters or EMS personnel, or private security vehicles as described in U.S. Fire Administration document FA-336/February 2014 "Emergency Vehicle Safety Initiative." Due to societal associations of the color green with the concept of normalcy (green GO signal of traffic lights, green indicator lamps to signify a device is operating within its normal operating limits, etc.) the color green shall not be used on its own for applications that require Class 1 or 2 performance levels.

Electromagnetic interference guidelines were added for devices containing electronic controlling elements, converters, regulators, or actuators. Emergency, maintenance, and service vehicles utilize two-way radio communication devices that can be adversely affected by excessive electromagnetic emissions from warning devices.

2.1.1: Document SAE J1889 is no longer an applicable document since the definition of photometric stability was added to this document. SAE J2357 was added because it is now referenced in the electromagnetic interference guidelines.

Section 3: Reordered and renumbered definitions to place them in alphabetical order per ANSI guidelines.

3.1: The phrase "to call for the right-of-way" was added to the definitions to clarify conditions that indicate the need for Class 1 performance and to provide common language with SAE J2498.

3.5: The definition of the term "duty-cycle" was added to clarify its meaning within the document.

3.6: The limitation of "in all modes if the mode of the device is vehicle operator adjustable" was removed from the determination of when multiple EWD lamp assemblies can be considered as a single device because it is unnecessary.

3.7: The definition of the term "emergency warning device photometric stability" was added to clarify its meaning within the document.

3.9: The definition of the term "flash energy" was added to clarify its meaning within the document.

3.11: The definition of the term "on-time" was added to clarify its meaning within the document.

3.14: The definition of the term "peak intensity" was added to clarify its meaning within the document.

3.17: The definition of the term "pulse width modulation" was added to clarify its meaning within the document.

3.19: The definition of the term "Talbot's law" was added to clarify its meaning within the document.

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3.20: The definition of the term “warning mode” was added to clarify its meaning within the document.

Section 4: Modified the language in the Class definition to include single warning mode allowance. Added the appending of the letter “M” to the device marking code to indicate devices that contain warning modes of different performance.

Section 5: Renumbered the section to improve clarity.

5.1.1: Added random vibration allowance.

5.1.5: This section was re-written to clarify the measurement procedure and match the practices of test laboratories. Methods are provided to determine the photometric performance of un-tested flash patterns by photometric testing of a single flash pattern and determining an adjustment factor that can be applied to the photometric test results of the tested flash pattern. References to SAE J1330 and SAE J1889 removed.

5.2: Revised the text to clarify incandescent sources may be operated steady burning and that device chromaticity be tested at 1 minute and when photometric stability has been reached.

5.4: Revised the flash characteristics that must be measured to the ones needed to determine compliance to the definition of a flash.

6.4: References to the definitions of a light pulse and flash were added to the requirements to eliminate ambiguity. The list of required characteristics that must be included in a report was deleted.

1. SCOPE

This document provides design guidelines, test procedure references, and performance requirements for directional, single color, flashing optical warning devices used on authorized emergency, maintenance, and service vehicles. It is intended to apply to, but is not limited to, surface land vehicles.

2. REFERENCES

2.1 Applicable Documents

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 +1 724-776-4970 (outside USA), www.sae.org.

SAE J575	Test Methods and Equipment for Lighting Devices 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	Chromaticity Requirements for Ground Vehicle Lamps and Lighting Equipment
SAE J759	Lighting Identification Code
SAE J1330	Photometry Laboratory Accuracy Guidelines
SAE J1339	Tests for Signal and Marking Devices Used on Vehicles 2032 mm or More in Overall Width
SAE J2357	Application Guidelines for Electronically Driven and/or Controlled Exterior Automotive Lighting Equipment

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 US, and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J387 Terminology - Motor Vehicle Lighting

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

SAE J2498 Minimum Performance of the Warning Light System Used on Emergency Vehicles

3. DEFINITIONS

3.1 CLASS 1 DIRECTIONAL OPTICAL WARNING DEVICE

A device utilized on authorized vehicles to capture the attention of motorists and pedestrians to call for the right-of-way or warn of a potentially hazardous activity or emergency situation.

3.2 CLASS 2 DIRECTIONAL OPTICAL WARNING DEVICE

A device utilized on authorized vehicles to capture the attention of motorists and pedestrians and warn of traffic hazards such as a lane blockage or a slow moving vehicle.

3.3 CLASS 3 DIRECTIONAL OPTICAL WARNING DEVICE

A device utilized on authorized vehicles to identify them to pedestrians and motorists.

3.4 DIRECTIONAL FLASHING OPTICAL WARNING DEVICE

An optical warning device that projects light in a minimum area horizontally from 20 degrees right to 20 degrees left and vertically from 10 degrees up to 10 degrees down. It will project flashes of light to an observer positioned at a fixed location within the area of coverage.

3.5 DUTY-CYCLE

The on-time divided by the flash period.

3.6 EMERGENCY WARNING DEVICE (EWD) LAMP ASSEMBLY

Any single, independently mounted, light-emitting component in the lighting system. An emergency warning device (EWD) lamp assembly 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 device and not intended to be modified. To be considered a single source, the optical elements must be adjacent and operate simultaneously in the mode under consideration.

3.7 EMERGENCY WARNING DEVICE PHOTOMETRIC STABILITY

The point at which the photometry value is stable to within $\pm 3\%$ within any 15-minute period.

3.8 FLASH

A repetitive light pulse or a train of light pulses, where a dark interval of at least 160 ms 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 100 ms after the end of the preceding light pulse. Dark interval luminous intensity shall not exceed 2% of the maximum luminous intensity of a flash.

3.9 FLASH ENERGY

The integration of the luminous intensity of the flashing EWD lamp assembly for the duration of a flash. Units are cd·s.

$$\text{Flash Energy} = \int_{t_1}^{t_2} I dt \quad (\text{Eq. 1})$$

where:

I = instantaneous intensity (candela)

t₁ = time at start of flash (seconds)

t₂ = time at end of flash (seconds)

3.10 LIGHT PULSE

A single, visually continuous emission of optical energy.

3.11 ON-TIME

The summation of the durations of the individual light pulse or train of pulses within a flash. The duration of dark intervals within a light pulse due to pulse width modulation are ignored when determining the duration of the light pulse.

3.12 OPTICAL ELEMENT

Any discrete light emitter such as, but not limited to, an incandescent filament, HID, or individual light emitting diode.

3.13 OPTICAL POWER

The integration of the luminous intensity of the flashing EWD lamp assembly over a period of 60 seconds ($\int I dt$). Alternatively, the optical power of a repetitive flash is the flash energy multiplied by the number of flashes produced in one minute. Units are cd·s/min.

3.14 PEAK INTENSITY

The highest luminous intensity of the flashing EWD lamp assembly during a flash. When a flash is also pulse width modulated, the peak intensity will be the intensity determined by Talbot's law. Units are candela (cd).

3.15 PRIMARY OPTICAL WARNING DEVICE

A device or group 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 a Class 2 device, and a Class 1 or 2 device in place of a Class 3 device.

3.16 PSEUDO-RANDOM FLASH PATTERN

A flash pattern that varies over time and is composed of blocks of compliant flashes presented in a sequential or random order.

3.17 PULSE WIDTH MODULATION

A method of reducing the visual intensity of an EWD by switching the electrical signal applied to the light source on and off at a fixed frequency thereby reducing the average power delivered to the light source.

3.18 SECONDARY OPTICAL WARNING DEVICE

A device or group of devices of lower performance that can be used to provide supplemental visual optical warning to that provided by the primary visual optical warning device or devices.

3.19 TALBOT'S LAW

If a point on the retina is excited by a light stimulus that undergoes periodic variations in magnitude at a frequency that exceeds the fusion frequency, the visual sensation produced is identical with that produced by a steady stimulus whose magnitude equals the mean magnitude of the variable stimulus taken over one period.

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3.20 WARNING MODE

One of a set of pre-defined operating states that provide a warning signal that may be chosen from a switch or switches either on the device or mounted external of the device (e.g., within the passenger compartment of the vehicle). The term "a switch or switches" is not intended to be limiting and includes any method of communicating to the device that a change in warning mode is desired (e.g., a photocell output, a vehicle CAN bus message, etc.). Operating states may include variations in the number of active EWD lamp assemblies, color, flash pattern, or intensity.

4. LIGHTING IDENTIFICATION CODE, MARKINGS, AND NOTICES

In accordance with SAE J759, the optical warning device may be identified by the codes:

"W-1," for directional warning devices providing Class 1 performance in at least one of its warning modes.

"W-2," for directional warning devices providing Class 2 performance in at least one of its warning modes.

"W-3," for directional warning devices providing Class 3 performance in at least one of its warning modes.

The letter "M" shall be appended to the device code to indicate that the warning device contains warning modes:

- Of a lower Class rating than which it is marked
- That have non-compliant flash patterns