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GASEOUS DISCHARGE WARNING LAMP FOR AUTHORIZED EMERGENCY, MAINTENANCE, AND SERVICE VEHICLES—SAE J1318 APR86

SAE Recommended Practice

Report of the Lighting Committee approved April 1986. Rationale statement available.

1. Scope—This SAE Recommended Practice provides test procedures, requirements, and guidelines for single color gaseous discharge warning lamps.

2. Definitions

2.1 Light Pulse—A sudden emission of light of short duration and high intensity.

2.2 Light Flash—A single light pulse or a train of pulses. In order to be considered a flash all pulse peaks must occur within 100 ms.

2.3 Gaseous Discharge Warning Lamp—A device that produces a regularly repeating pattern of light flashes when electrical current is discharged periodically through an ionized gas.

2.4 360 Deg Warning Lamp—A lamp that projects a light in a horizontal 360 deg 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 to indicate the existence of a hazardous situation.

2.5 Directional Warning Lamp—A lamp that produces a repetitive flash of light which is directionally aimed and will project a flashing beam signal over a minimum area from 20 deg right to 20 deg left on a horizontal plane and from 10 deg up to 10 deg down on a vertical plane.

2.6 Primary Warning Lamps—Lamps or groups of lamps that are intended to provide the primary visual warning signal as called out in each service class.

2.7 Secondary Warning Lamps—Lamps or groups of lamps that can be used to provide a supplemental warning signal for each service class.

2.8 Class 1 Warning Lamps—Primary warning lamps for use on authorized emergency vehicles responding to emergency situations. These lamps are utilized to capture the attention of motorists and pedestrians and to warn of a potentially hazardous activity or situation.

2.9 Class 2 Warning Lamps—Primary warning lamps for use on authorized maintenance and service vehicles to warn of traffic hazards such as an accident, slow moving service truck, etc.

2.10 Class 3 Warning Lamps—Primary warning lamps for use on vehicles that are authorized to display flashing warning lamps for identification only.

2.11 Flash Energy—Flash energy is the total luminous energy per unit solid angle contained in the entire flash in candela seconds.

$$\text{candela-second} = \int_{t_1}^{t_2} I\,dt$$

where: I = Instantaneous intensity (candela)
t_1 = Time at start of flash (seconds)
t_2 = Time at end of flash (seconds)
$(t_2 - t_1)$ = Flash Duration (seconds)

2.12 Light Center—The light center of a gaseous discharge warning lamp is the geometric center of the light emitting element (arc or light source) of the lamp.

2.13 Flash Cycle—A sequence of light flashes and dark intervals which, with regular repetition, constitutes the complete output cycle of a flashing lamp. For a simple flashing lamp, the full cycle consists of a single on-off sequence.

3. Lighting Identification Code—Gaseous discharge warning lamps may be identified in accordance with SAE J759, Lighting Identification Code, by the codes:

360 deg gaseous discharge lamps

(W5-1)—Class 1
(W5-2)—Class 2
(W5-3)—Class 3

Directional gaseous discharge lamps

(W5)—

4. Tests

4.1 SAE J575, Tests for Motor Vehicle Lighting Devices and Components, is a part of this report. The following tests are applicable with modifications as indicated:

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 photometric test procedures in SAE J575, the following apply:

4.1.5.1 The device shall be allowed to operate for 15 min prior to making photometric measurements. In all instances where a device is required to be operated during a test specified in this report, the voltage applied to the input wires or terminals of the device shall be 12.8 V for nominal 12 V electrical systems and 25.6 V for nominal 24 V electrical systems.

4.1.5.2 *Photometric Measurement for 360 Deg Gaseous Discharge Warning Lamps*—Photometric measurements shall be made with the device

mounted in its normal operating position and all flash energy measurements shall be made with the light source of the signal lamp at least 18 m from the photometer sensor. The lamps 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 lamp shall be turned about its vertical axis until the photometer indicates minimum flash energy. This shall be the H-V point.

4.1.5.3 *Photometric Measurement for Directional Gaseous Discharge Warning Lamps*—Photometric measurements shall be made with the device mounted in its normal operating position and all flash energy measurements shall be made with the light source of the warning lamp at least 18 m from the photometer sensor. The lamps shall be mounted so that the horizontal plane through the photometer sensor 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.

4.1.5.4 Photometric luminous intensity measurements (candela seconds) shall be taken as the average of ten consecutive flash cycles. There shall be an off time before each flash of at least 50% of the total flash cycle time.

4.1.6 WARPAGE TEST ON DEVICE WITH PLASTIC COMPONENTS—The test described in paragraph 4.8.3.3 of SAE J575 shall be omitted and the following test conducted:

4.1.6.1 *Flash Tube Operation*—Unless otherwise specified, the gaseous discharge device shall be operated at design voltage and in a steady on, flashing operation.

4.2 Color Test—SAE J578, Color Specification for Electric Signal Lighting Devices, is a part of this report. Devices shall be tested with the light source normally supplied with the lamp. When it is not feasible to make measurements with this light source, a steady burning CIE Illuminant C (6774 K) light source shall be substituted.

4.3 Additional Tests

4.3.1 HIGH TEMPERATURE FLASH RATE TEST—The device shall be subjected to an ambient temperature of 50 ± 3°C for a period of 6 h. The device shall be off during the first hour and shall operate continuously for the next 5 h at 12.8 V for a nominal 12 V system and 25.6 V for a nominal 24 V system. 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.

4.3.2 LOW TEMPERATURE FLASH RATE TEST—The device shall be subjected to an ambient temperature of −30 ± 3°C for a period of 6 h. The device shall be off during the first 5 h and shall operate continuously for the last hour of the test at 12.8 V for a nominal 12 V system and 25.6 V for a nominal 24 V system.

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 ± 3°C in cycles of 50 min on and 10 min off at 12.8 V for a nominal 12 V system and 25.6 V for a nominal 24 V system. 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 in SAE J575:

TABLE 1

PHOTOMETRIC REQUIREMENTS CLASS 1
360 DEG GASEOUS DISCHARGE WARNING LAMPS

Minimum Flash Energy Requirements
Zone Totals (Candela-Seconds)

Zone	Flash Energy—Candela Seconds				
	Test Point Degree	White	Yellow	Red	Signal Blue
#1	5U–V 2.5U–V H–V 2.5D–V 5D–V	396	198	99	*

* Not Recommended.

NOTES:

a. A one time adjustment in lamp orientation from design position may be made in determining compliance to Tables 5, 6, 7, and 8 provided such adjustment does not exceed 1 deg in any direction. The zone shall comply after this one time, final reaim.

b. When calculating zone totals, the measured value at each test point shall not be less than 60% of the minimum values in Tables 5, 6, 7, and 8.

5.1.1 VIBRATION

5.1.2 MOISTURE

5.1.3 DUST

5.1.4 CORROSION

5.1.5 PHOTOMETRY—The lamp under test shall meet the photometric performance requirements contained in Tables 1, 2, 3, and 4. The summation of the flash energy measurements at the specified test points in a zone shall be at least the value shown.

5.1.6 WARPAGE—Shall meet the requirements of paragraph 4.8.4 of SAE J575.

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

5.2 Material Requirements—Plastic materials used in optical parts shall meet the requirements of SAE J576, Plastic Material for Use in Optical Parts such as Lenses and Reflectors of Motor Vehicle Lighting Devices.

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. After the unit has been allowed to operate for 3 min after the high temperature test, the flash rate shall not be less than 0.80 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. The lamp must flash and continue to flash within 20 s after the current is turned on or it is considered a failure. After the unit has been allowed to operate for 3 min after the low temperature test, the flash rate shall not be less than 0.80 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. 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. The flash rate shall be not less than 1 Hz nor more than 2 Hz.

TABLE 2

PHOTOMETRIC REQUIREMENTS CLASS 2
360 DEG GASEOUS DISCHARGE WARNING LAMPS

Minimum Flash Energy Requirements
Zone Totals (Candela-Seconds)

Zone	Flash Energy—Candela Seconds				
	Test Point Degree	White	Yellow	Red	Signal Blue
#1	5U–V 2.5U–V H–V 2.5D–V 5D–V	99	49.5	25	12.5

NOTES:

a. A one time adjustment in lamp orientation from design position may be made in determining compliance to Tables 5, 6, 7, and 8 provided such adjustment does not exceed 1 deg in any direction. The zone shall comply after this one time, final reaim.

b. When calculating zone totals, the measured value at each test point shall not be less than 60% of the minimum values in Tables 5, 6, 7, and 8.

TABLE 3

PHOTOMETRIC REQUIREMENTS CLASS 3
360 DEG GASEOUS DISCHARGE WARNING LAMPS

Minimum Flash Energy Requirements
Zone Totals (Candela-Seconds)

Zone	Flash Energy—Candela Seconds				
	Test Point Degree	White	Yellow	Red	Signal Blue
#1	5U–V 2.5U–V H–V 2.5D–V 5D–V	40	20	10	5

NOTES:

a. A one time adjustment in lamp orientation from design position may be made in determining compliance to Tables 5, 6, 7, and 8 provided such adjustment does not exceed 1 deg in any direction. The zone shall comply after this one time, final reaim.

b. When calculating zone totals, the measured value at each test point shall not be less than 60% of the minimum values in Tables 5, 6, 7, and 8.

TABLE 4

PHOTOMETRIC REQUIREMENTS CLASS 1
DIRECTIONAL, GASEOUS DISCHARGE WARNING LAMPS

Minimum Flash Energy Requirements
Zone Totals (Candela-Seconds)

Zone	Test Point Degree	Flash Energy—Candela Seconds White	Yellow	Red	Signal Blue
#1	5U–10L 5U–20L H–20L 5D–20L 5D–10L	108	54	27	*
#2	10U–5L 10U–V 10U–5R	56	28	14	*
#3	5U–5L H–10L 5D–5L	184	92	46	*
#4	5U–V H–5L H–V H–5R 5D–V	664	332	116	*
#5	5U–5R H–10R 5D–5R	184	92	46	*
#6	10D–5L 10D–V 10D–5R	56	28	14	*
#7	5U–10R 5U–20R H–20R 5D–20R 5D–10R	108	54	27	*

* Not Recommended.

NOTES:

a. A one time adjustment in lamp orientation from design position may be made in determining compliance to Tables 5, 6, 7, and 8 provided such adjustment does not exceed 1 deg in any direction. The zone shall comply after this one time, final realm.

b. When calculating zone totals, the measured value at each test point shall not be less than 60% of the minimum values in Tables 5, 6, 7, and 8.

TABLE 5

PHOTOMETRIC DESIGN GUIDELINES
360 DEG GASEOUS DISCHARGE WARNING LAMPS

Minimum Design Flash Energy Guidelines
Class 1 Warning Lamps

Test Point Degree	Flash Energy—Candela-Seconds White	Yellow	Red	Signal Blue
5U–V	18	9	4.5	*
2.5U–V	90	45	22.5	*
H–V	180	90	45	*
2.5D–V	90	45	22.5	*
5D–V	18	9	4.5	*

* Not Recommended.

6. Guidelines

6.1 Photometric Guidelines—Photometric design guidelines for 360 deg and directional gaseous discharge warning lamps, when tested in accordance with Section 4.1.5 of this report, are contained in Tables 5, 6, 7, and 8.

6.2 Installation Guidelines—The following guidelines apply to 360 deg and directional gaseous discharge 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 lamp should be installed normal to the longitudinal axis of the vehicle.

6.2.2 VISIBILITY—Visibility of the 360 deg warning lamp should be unobstructed by any part of the vehicle 5 deg above to 5 deg below the horizontal and provide a flashing light throughout a 360 deg circle. Additional primary warning lamps may be used whenever vehicle size or design prevents a single primary warning lamp from projecting 360 deg of a full strength warning signal. These additional warning lamps shall be mounted so that the 360 deg of full strength signal is obtained around the vehicle.

Directional warning lamps should be mounted as high as practical and if mounted in pairs, as far apart as practical. Visibility to the front and to the rear of the vehicle should be unobstructed by any part of the vehicle from 10 deg up to 10 deg below horizontal and from 45 deg

TABLE 6

PHOTOMETRIC DESIGN GUIDELINES
360 DEG GASEOUS DISCHARGE WARNING LAMPS

Minimum Design Flash Energy Guidelines
Class 2 Warning Lamps

Test Point Degree	Flash Energy—Candela-Seconds White	Yellow	Red	Signal Blue
5U–V	4.5	2	1	0.5
2.5U–V	22.5	11.5	6	3
H–V	45	22.5	11	5.5
2.5D–V	22.5	11.5	6	3
5D–V	4.5	2	1	0.5

TABLE 7

PHOTOMETRIC DESIGN GUIDELINES
360 DEG GASEOUS DISCHARGE WARNING LAMPS

Minimum Design Flash Energy Guidelines
Class 3 Warning Lamps

Test Point Degree	Flash Energy—Candela-Seconds White	Yellow	Red	Signal Blue
5U–V	2	1	0.5	0.25
2.5U–V	9	4.5	2	1
H–V	18	9	5	2.5
2.5D–V	9	4.5	2	1
5D–V	2	1	0.5	0.25

TABLE 8

PHOTOMETRIC DESIGN GUIDELINES
DIRECTIONAL, GASEOUS DISCHARGE WARNING LAMPS

Minimum Flash Energy Guidelines
Warning Lamps

Test Point Degree	Flash Energy—Candela-Seconds White	Yellow	Red	Signal Blue
10U–5L	12	6	3	*
10U–V	32	16	8	*
10U–5R	12	6	3	*
5U–20L	12	6	3	*
5U–10L	32	16	8	*
5U–5L	68	34	17	*
5U–V	100	50	25	*
5U–5R	68	34	17	*
5U–10R	32	16	8	*
5U–20R	12	6	3	*
H–20L	20	10	5	*
H–10L	48	24	12	*
H–5L	132	66	33	*
H–V	200	100	50	*
H–5R	132	66	33	*
H–10R	48	24	12	*
H–20R	20	10	5	*
5D–20L	12	6	3	*
5D–10L	32	16	8	*
5D–5L	68	34	17	*
5D–V	100	50	25	*
5D–5R	68	34	17	*
5D–10R	32	16	8	*
5D–20R	12	6	3	*
10D–5L	12	6	3	*
10D–V	32	16	8	*
10D–5R	12	6	3	*

* Not Recommended.

left to 45 deg right of the centerline of the vehicle. To improve the efficiency of the signal it is recommended that when practical, the area surrounding the lamps should be black.

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.

7. *Test Equipment Guidelines*—The following guidelines apply to photometric test equipment and are not part of the technical requirements:

7.1 A pulse integrating photometer or other accepted means of measuring pulsed light signals shall have the following:

Response Time—1 μs or less

Sensor Response—Sensor shall be corrected to that of the 1931 C.I.E. standard observer (2 deg) photopic response curve. Sensor shall be calibrated for the color of the light being measured.

Range Linearity—Linearity of the sensor and photometer system shall be verified over the range of the luminous intensities being tested. Linearity deviation shall not deviate more than 2.5% from the calibration level to the extreme luminous intensity values measured.

7.2 The regulated D.C. power supply shall have the following minimum requirements:

Line regulations	±0.1%
Load regulation	±0.1%
Ripple voltage	±0.4%
Stability	±0.1% during test

References

ISO 4148, Road Vehicles—Special Warning Lights—Dimensions (1978).

NBS No. 480-3, Sirens and Emergency Warning Lights (June 1977).

NBS No. 480-36, Some Psychophysical Tests of the Conspicuities of Emergency Vehicle Warning Lights (July 1979).

NBS No. 480-37, Emergency Vehicle Warning Systems (May 1981).

SAE J595 AUG83.

SAE J845 JAN84.