



SURFACE VEHICLE RECOMENNDENED PRACTICE

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Superseding J595 NOV2008

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

RATIONALE

The definition of LIGHT SOURCE was renamed to EWD LAMP ASSEMBLY.

Test voltages were added to accommodate the electrical system voltages of industrial vehicles.

The flash rate limits were revised from "at least 1 Hz and not more than 4 Hz" to "at least 1.0 Hz and not more than 4.0 Hz" to eliminate rounding errors.

References to SAE J2139 were added as an alternative to SAE J575 to accommodate devices intended for vehicles wider than 2032mm.

A requirement was added that test samples which exhibit a partial outage of non-filament EWD lamp assemblies must still comply with the photometric requirements upon the completion of any of the required tests.

The photometric test procedure was revised to ensure that sources whose output increases prior to stabilizing will still comply with the photometric requirements at their lowest output levels.

The definition of pseudo-random flash pattern was added.

Requirements for pseudo-random flash patterns were added to section "FLASH RATE AND FLASH PATTERNS".

Sections 5.7 and 6.7 were renamed "FLASH RATE AND FLASH PATTERNS".

Added the "optical power" to the list of characteristics to be measured in Section 6.7 in order to be all inclusive. It is unknown why it was left out of earlier versions.

The characteristics, including optical power, peak intensity, flash rate, period, number of pulses per flash, on time (electrical), off time (electrical) and pulse separation, shall be measured and recorded. If the flasher or power supply/flasher has more than one flash pattern, the characteristics shall be measured and recorded for each pattern.

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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 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 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	Color Specification
SAE J759	Lighting Identification Code
SAE J1330	Photometry Laboratory Accuracy Guidelines
SAE J1889	L.E.D. Signal and Marking Lighting Devices
SAE J2139	Tests for Signal and Marking Devices Used on Vehicles 2032 mm or more in Overall

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 USA and Canada) or 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 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.

3.2 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 elements must be adjacent, and operate simultaneously in all modes if the mode of the device is vehicle operator adjustable.

3.3 OPTICAL ELEMENT

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

3.4 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 Class 2 device and a Class 1 or 2 device in place of Class 3 device.

3.5 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.

3.6 CLASS 1 OPTICAL WARNING DEVICE

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

3.7 CLASS 2 OPTICAL WARNING DEVICE

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

3.8 CLASS 3 OPTICAL WARNING DEVICE

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

3.9 LIGHT PULSE

A single, visually continuous emission of optical energy. High frequency modulation is permitted.

3.10 FLASH

A 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.

3.11 OPTICAL POWER

The integration of the luminous intensity of the flashing EWD light assembly for a time of 60 s (1_{ldt}). Units are Cd·s/min.

3.12 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.

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 Class 1 directional warning devices

"W-2", for Class 2 directional warning devices

"W-3", for Class 3 directional warning devices

A device may only have one class rating if it is vehicle operator adjustable. The rating shall be based on the mode with the lowest performance level.

5. TESTS

All tests are to be performed using the test voltages indicated in Table 1 below:

TABLE 1 - TEST VOLTAGES

System Voltage	Test Voltage	Test Voltage Tolerance
12	12.8	± 0.1
24	25.6	± 0.2
36	38.4	± 0.3
42	44.8	± 0.35
48	51.2	± 0.4
72	76.8	± 0.6
80	85.3	± 0.66

CAUTION: Adequate care must be exercised in order to maintain a safe test environment when handling voltages higher than 36 V.

Tests are to be made using the wiring supplied by the device manufacturer or wire of the minimum size recommended by the device manufacturer. For devices intended to be hard wired into the vehicle electrical system, the voltage shall be measured at 300 mm from the point at which the wiring exits the device. For portable devices equipped with an electrical connector, the voltage shall be measured at the supply side of the connector.

Either SAE J2139 or SAE J575 is a part of this document. The choice of which Recommended Practice is used depends on the width of the vehicle the warning light is intended to be used on. The following tests are applicable with the modifications as indicated.

5.1 Vibration Test

5.2 Moisture Test

5.3 Dust Test

The change in intensity may be measured at the H-V location.

5.4 Corrosion Test

5.5 Warpage Test for Plastic Component

The device shall be operated in the mode with the highest optical power.

5.6 Photometry

In addition to the test procedures in SAE J2139 or SAE J575, the photometric performance shall be determined by measuring the optical power and through either direct measurement or calculation, the peak intensity of each flash. Photometry shall be performed with the EWD lamp assembly flashing.

An integrating photometer shall be used to determine the optical power projected over 60 s. Any measurement period not less than 20 s may be used. These measurements shall then be corrected to obtain the optical power in units of Cd·s/min. If the flasher or power supply/flasher has more than one flash pattern, the optical power shall be measured and recorded for each pattern.

5.6.1 Photometric Stability

All photometry tests shall be performed in accordance with SAE J1330 and all EWD lamp assemblies shall operate until the photometric output is stable as defined in SAE J1889 prior to testing. Because the photometric output of a LED lighting device may either increase or decrease as the temperature of the LED EWD lamp assembly increases, the following stabilization and measurement method is required:

Energize the test device and record the H-V photometric value after 1 minute. Continue to energize the test device until photometric stability occurs. Record the photometric values at all the required test points. Calculate the ratio between the 1 minute H-V reading and the photometric stability H-V reading and apply the ratio to all of the required test points to determine the 1 minute photometric performance.

5.6.2 Device Mounting and Orientation

Photometric measurements shall be made with the device mounted in its normal operating position and all measurements shall be made with the geometric center of the EWD lamp assembly of the device at least 18 meters from the photometer sensor.

The device shall be mounted so that the horizontal plane through the photometer sensor axis passes through the center of the EWD lamp assembly. The vertical axis through the center of the EWD lamp assembly shall be perpendicular to this horizontal plane. If the EWD lamp assembly is composed of an array of optical elements, the geometric center of the array shall be used.

The H-V reference point shall be either (1) parallel to the vehicle longitudinal or lateral axis, (2) the midpoint of its coverage angle or (3) as indicated on the device, if it is so marked.

5.7 Flash Rate and Flash Patterns

Any device, incorporating an integral flasher, an external flasher or a combined power supply and flasher supplied by the manufacturer of the device, shall be tested with this flasher.

If a flasher is required and no flasher is supplied by the manufacturer of the device, the device shall be tested using a flasher having a flash rate of $1.20 \text{ Hz} \pm 0.14 \text{ Hz}$ with a $50\% \pm 2\%$ current on time.

5.8 Color Test

SAE J578 is a part of this document.

Incandescent devices may be measured while in a steady-state mode at design voltage.

5.9 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 starting 1 min after the device is activated and at the conclusion of the test. If the device has multiple flash patterns then the pattern with the highest optical power shall be used. The start time shall be measured at time of activation.

5.10 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 starting 1 min after the device is activated and at the conclusion of the test. If the device has multiple flash patterns then the pattern with the lowest optical power shall be used. The start time shall be measured at time of activation.

5.11 Durability Flash Rate 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 starting 1 min after the device is activated and at the conclusion of the test. If the device has multiple flash patterns then the pattern with the highest optical power shall be used.

5.12 Materials Test

SAE J576 is a part of this document.

6. PERFORMANCE REQUIREMENTS

A device, when tested in accordance with the test procedures specified in Section 5, shall meet the requirements of SAE J2139 or SAE J575. For devices with non-replaceable sources, such as LEDs, the evaluation of the sample at the completion of the test shall also include a functional lighting check. If a partial outage is observed, a photometry test (see 6.2) shall be performed. The sample must still comply with the photometric requirements.

6.1 Vibration

6.2 Moisture

6.3 Dust

On completion of the test, the test device shall be considered to have met all the requirements of the dust test when complying with either of the following requirements:

No dust shall be found on the interior surface of the test device, or

The maximum or HV luminous intensity measured after the dust exposure test shall be at least 90% of the initial maximum or H-V luminous intensity measured before the test.

6.4 Corrosion

6.5 Warpage

6.6 Photometry

To be considered compliant, a flash pattern shall meet the optical power requirements contained in the applicable Figure 1-W, 2-W, 3-W, 1-Y, 2-Y, 3-Y, 1-R/B, 2-R/B or 3-R/B and its footnotes. The summation of the optical power measurements for the specified test points in a zone shall be at least the optical power zone value shown. Additionally, the peak luminous intensity of the pattern shall meet the photometric requirements contained in the applicable Figure 1-W, 2-W, 3-W, 1-Y, 2-Y, 3-Y, 1-R/B, 2-R/B or 3-R/B and its footnotes. The summation of the peak luminous intensity measurements for the specified test points in a zone shall be at least the peak luminous intensity zone value shown. Compliance shall be demonstrated both at 1 minute after the device is energized and after it has reached photometric stability.

In the case of gaseous discharge devices, only compliance to the optical power requirements is required.

6.7 Flash Rate and Flash Patterns

The flash rate for devices shall be at least 1.0 Hz and not more than 4.0 Hz at all times.

The characteristics, including optical power, peak intensity, flash rate, period, number of pulses per flash, on time (electrical), off time (electrical) and pulse separation, shall be measured and recorded. If the flasher or power supply/flasher has more than one flash pattern, the characteristics shall be measured and recorded for each pattern.

The use of LEDs has made it possible to create very complex flash patterns. While the flash characteristics defined in this document attempt to accommodate these possible patterns, flash patterns that do not meet these characteristics are possible and may be desirable in special circumstances. To accommodate these complex flash patterns, the manufacturer of devices with multiple flash patterns shall indicate in the instruction manual which patterns comply with the requirements of this standard and to which class of performance, i.e., Class W-1, Class W-2, or Class W-3.

Pseudo-random flash patterns that are entirely composed of blocks of compliant flashes presented in a sequential or random order are acceptable.

6.8 Color

The color of light emitted in each mode shall be white, yellow, red, or signal blue as specified in SAE J578, except that the blue boundary for white shall be $x = 0.300$.

6.9 High Temperature Flash Rate Test

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. The measured flash rates shall not vary by more than 20% from the ambient flash rate.

6.10 Low Temperature Flash Rate Test

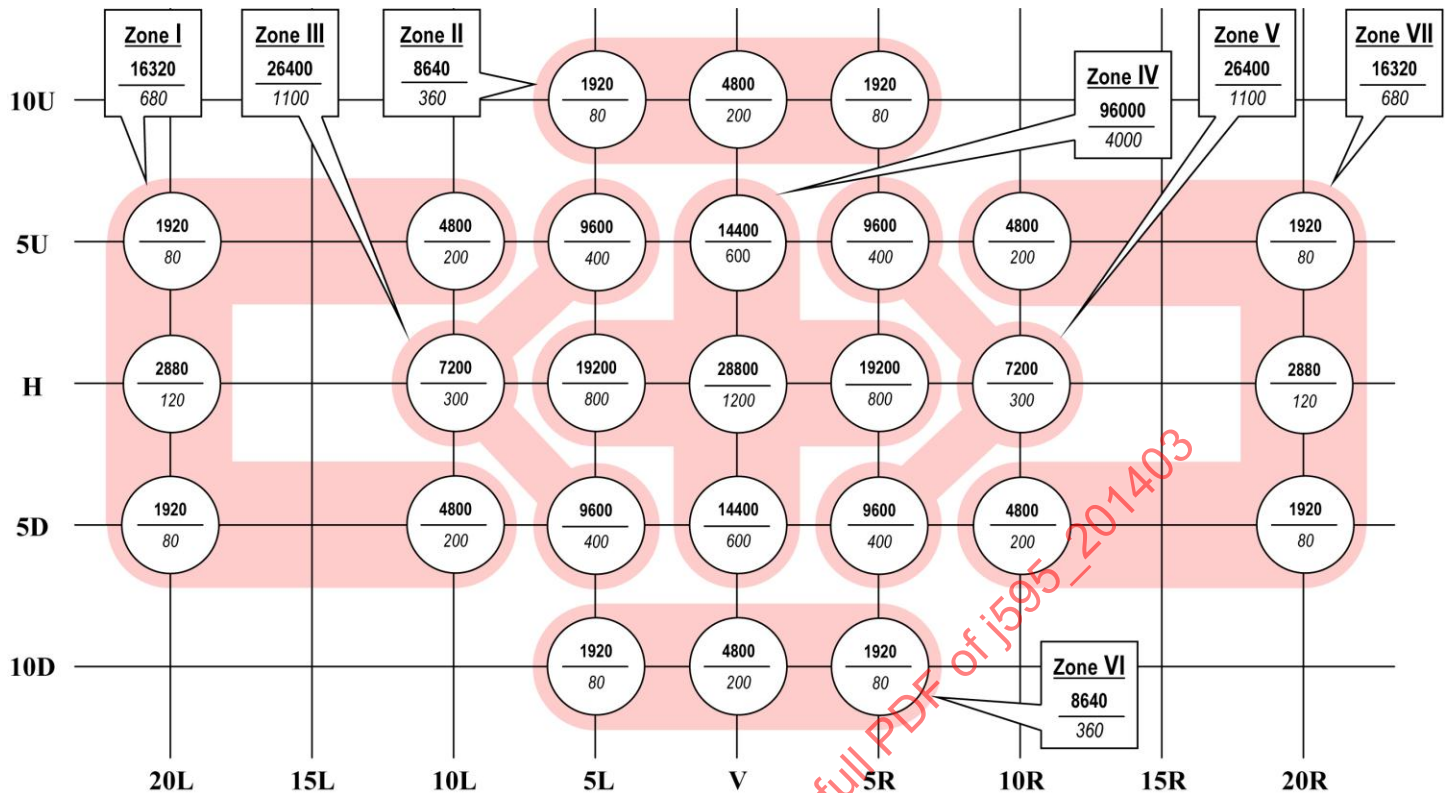
There shall be no evidence of operating conditions which would result in failure to comply with Section 6 of this document. Operation of the device shall begin and continue within 5 s of the beginning of each operating cycle. The measured flash rates shall not vary by more than 20% from the ambient flash rate.

6.11 Durability Flash Rate Test

There shall be no evidence of operating conditions which would result in failure to comply with Section 6 of the document. The final measured flash rates shall not vary by more than 20% from the initial flash rates.

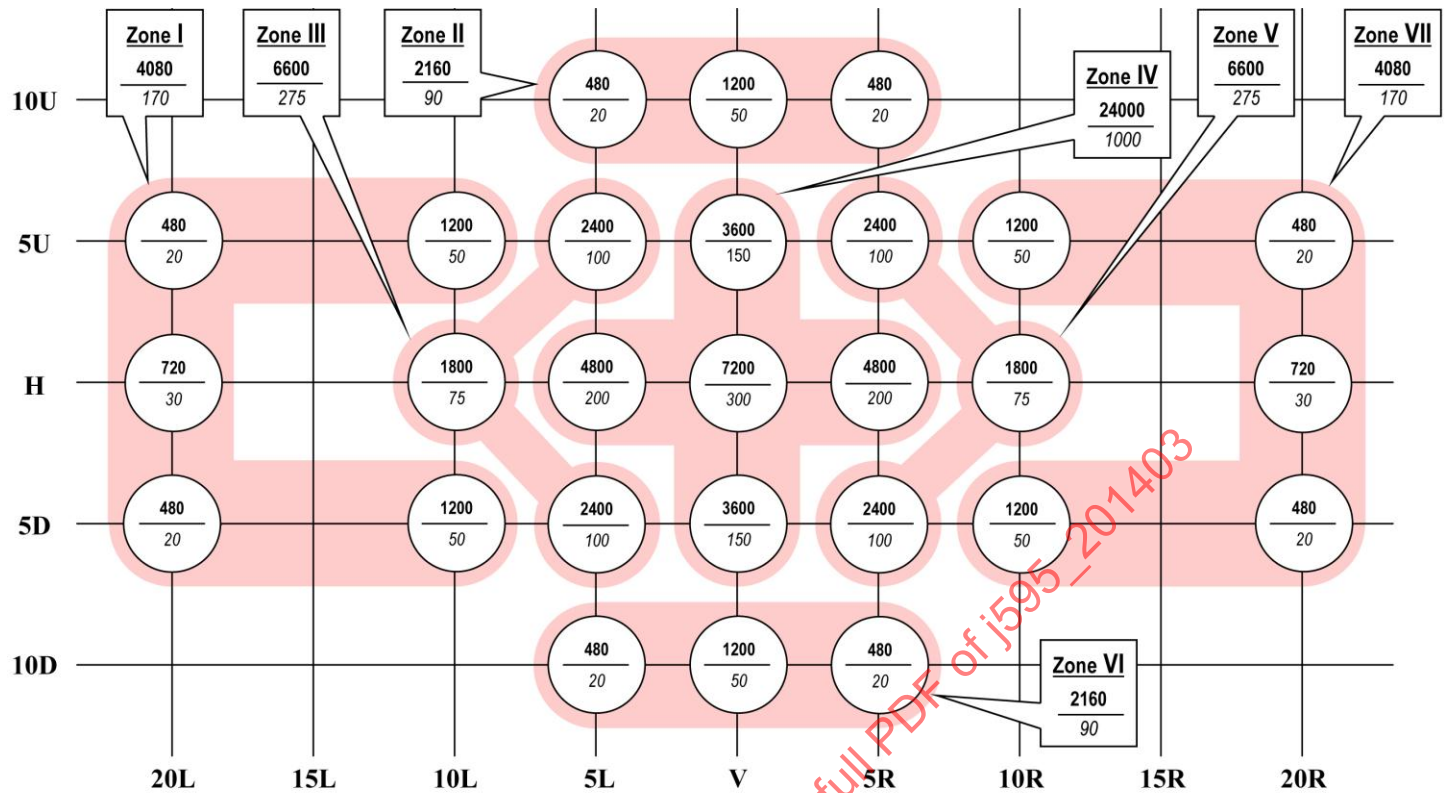
6.12 Material Requirements

Plastic materials used in optical parts shall meet the requirements of SAE J576.



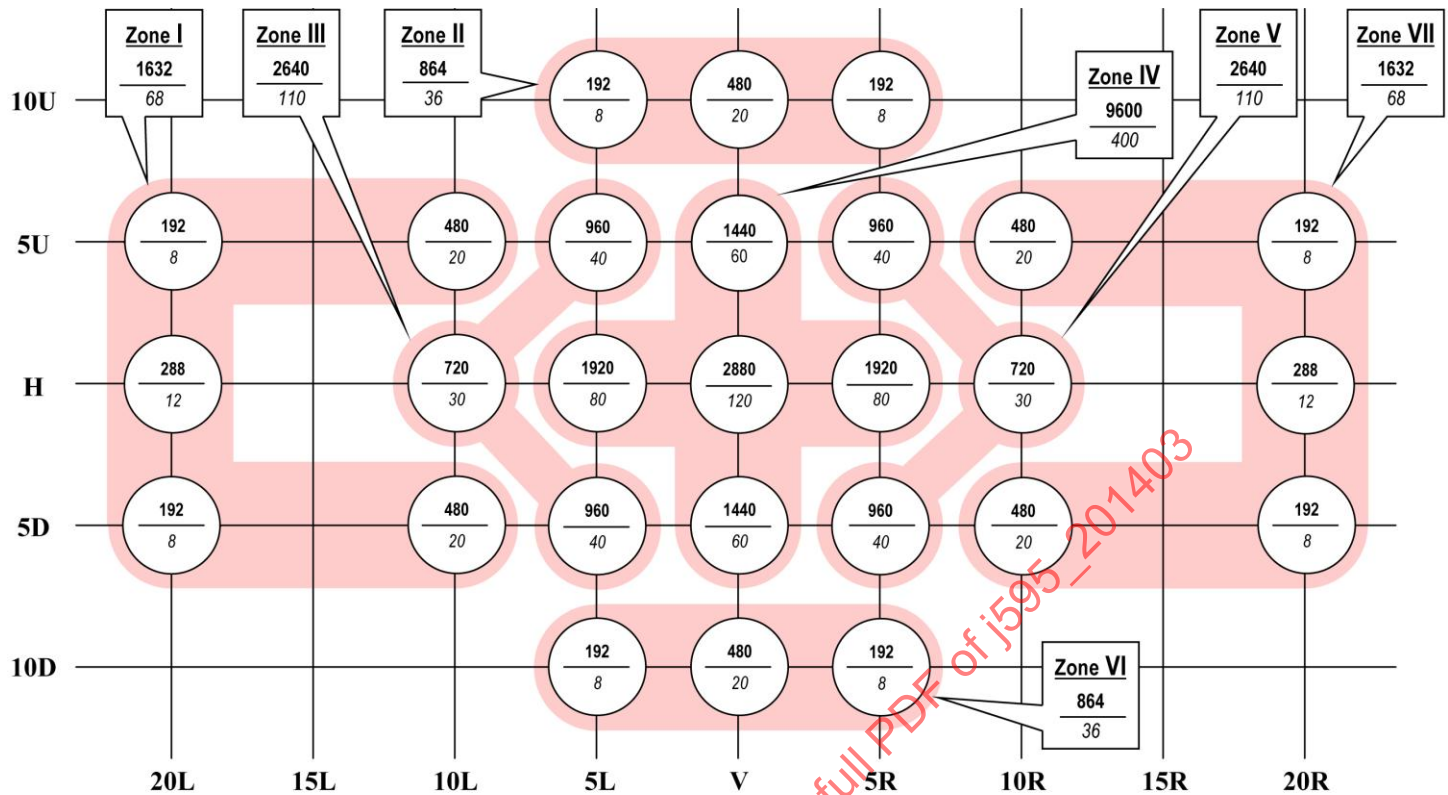
1. For each test point and zone total, the value shown in **bold** (top value) is the optical power requirement and the value shown in *italics* (bottom value) is the peak luminous intensity requirement.
2. The Measured values at each test point shall not be less than 60% of the required minimum values shown for that individual test point location.
3. The sum of the optical power measurements and the sum of the peak luminous intensity measurements for each test point within a zone, shall not be less than the corresponding zone total requirements shown. The measurements at each discrete test point shown within the corresponding zone are the values used to calculate the specified zone total.
4. An adjustment in device orientation from the design position may be made in determining compliance to the optical power and peak luminous intensity requirements, provided such adjustment does not exceed 1 degree in any direction. All zone totals must comply after reaim.

FIGURE 1-W - PHOTOMETRIC REQUIREMENTS CLASS 1-WHITE
 Optical Power (Cd-seconds/Minute) Shown in **Bold** (top value)
 Peak Luminous Intensity (Candela) Shown in *Italics* (bottom value)



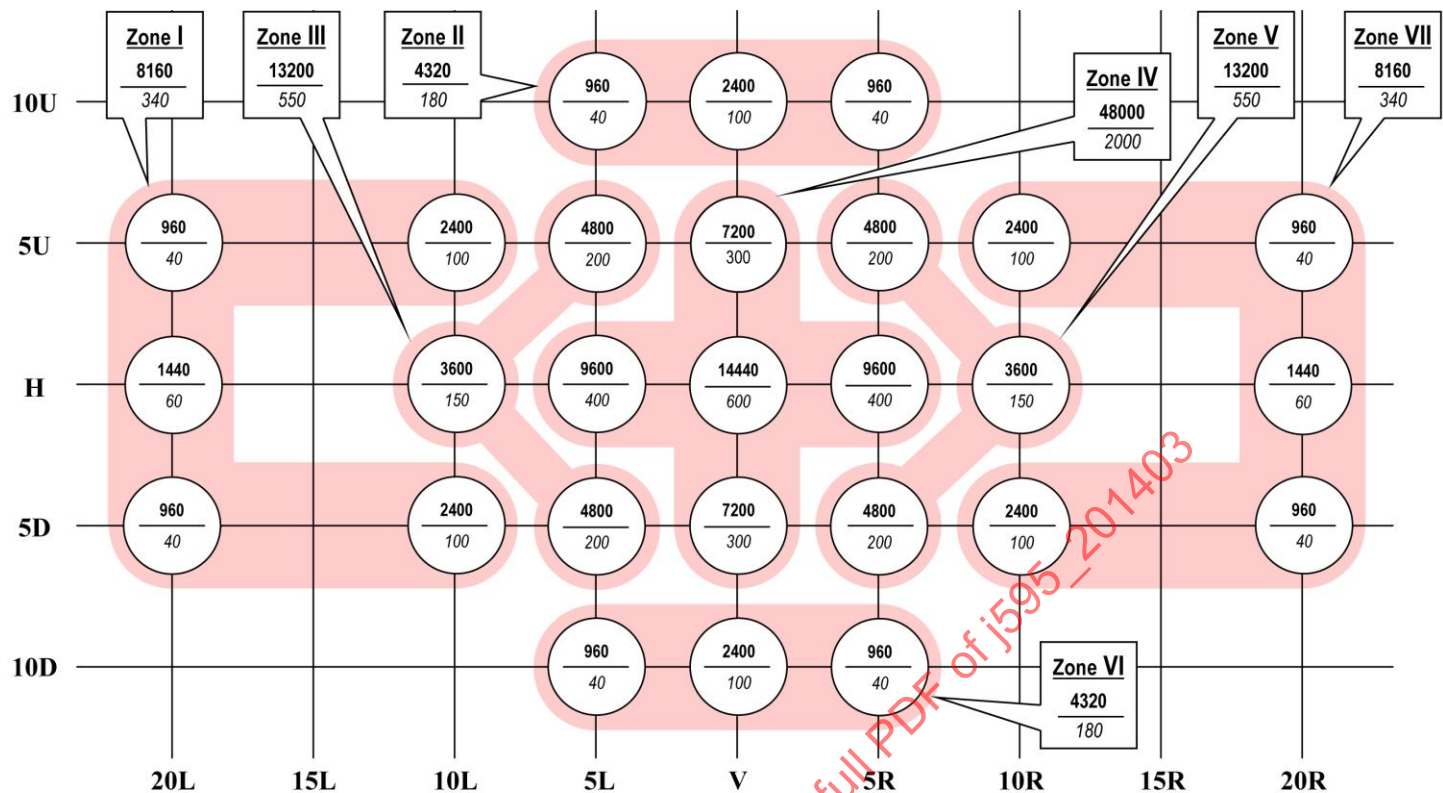
1. For each test point and zone total, the value shown in **bold** (top value) is the optical power requirement and the value shown in *italics* (bottom value) is the peak luminous intensity requirement.
2. The Measured values at each test point shall not be less than 60% of the required minimum values shown for that individual test point location.
3. The sum of the optical power measurements and the sum of the peak luminous intensity measurements for each test point within a zone, shall not be less than the corresponding zone total requirements shown. The measurements at each discrete test point shown within the corresponding zone are the values used to calculate the specified zone total.
4. An adjustment in device orientation from the design position may be made in determining compliance to the optical power and peak luminous intensity requirements, provided such adjustment does not exceed 1 degree in any direction. All zone totals must comply after reaim.

FIGURE 2-W - PHOTOMETRIC REQUIREMENTS CLASS 2-WHITE
 Optical Power (Cd-seconds/Minute) Shown in **Bold** (top value)
 Peak Luminous Intensity (Candela) Shown in *Italics* (bottom value)



1. For each test point and zone total, the value shown in **bold** (top value) is the optical power requirement and the value shown in *italics* (bottom value) is the peak luminous intensity requirement.
2. The Measured values at each test point shall not be less than 60% of the required minimum values shown for that individual test point location.
3. The sum of the optical power measurements and the sum of the peak luminous intensity measurements for each test point within a zone, shall not be less than the corresponding zone total requirements shown. The measurements at each discrete test point shown within the corresponding zone are the values used to calculate the specified zone total.
4. An adjustment in device orientation from the design position may be made in determining compliance to the optical power and peak luminous intensity requirements, provided such adjustment does not exceed 1 degree in any direction. All zone totals must comply after reaim.

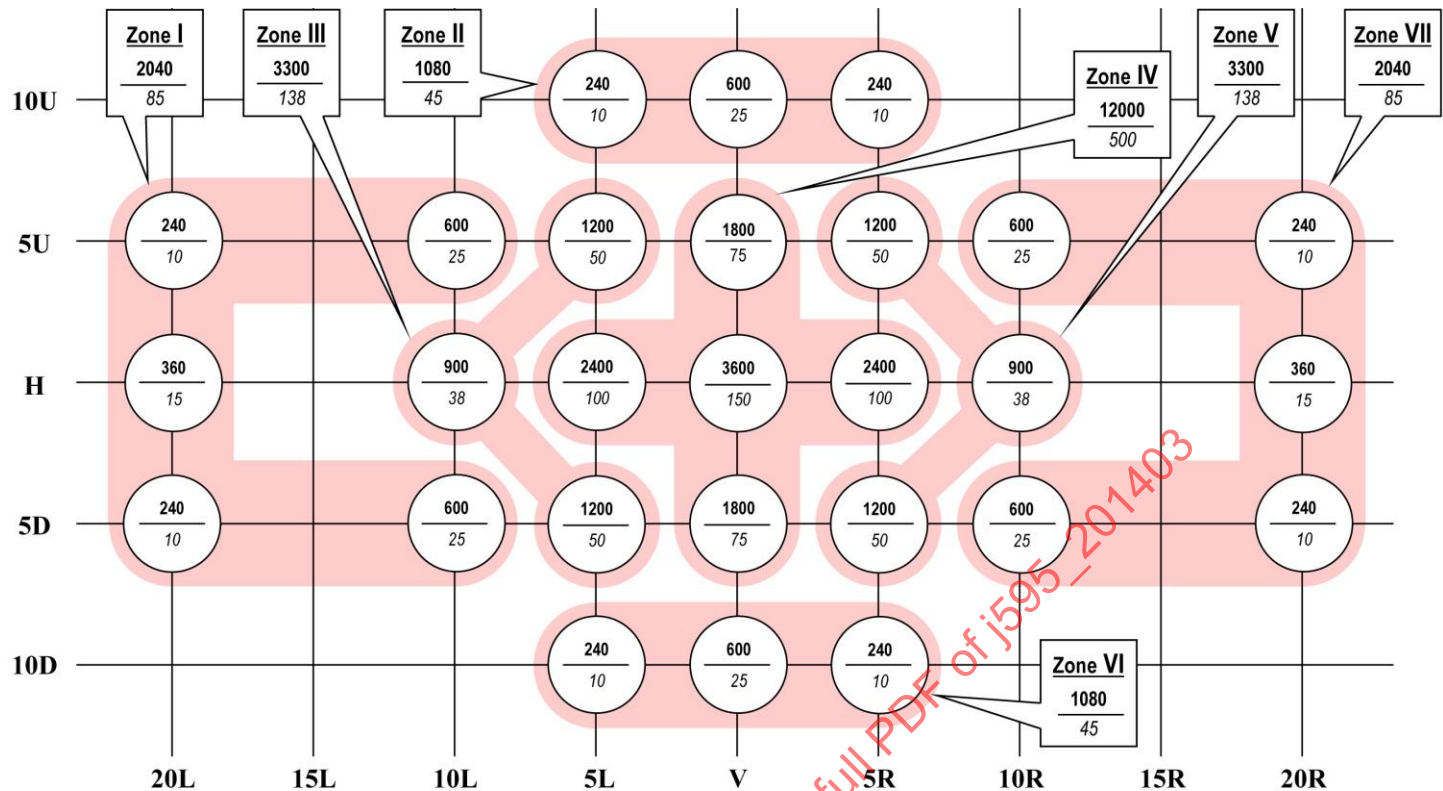
FIGURE 3-W - PHOTOMETRIC REQUIREMENTS CLASS 3-WHITE
 Optical Power (Cd-seconds/Minute) Shown in Bold (top value)
 Peak Luminous Intensity (Candela) Shown in Italics (bottom value)



1. For each test point and zone total, the value shown in **bold** (top value) is the optical power requirement and the value shown in *italics* (bottom value) is the peak luminous intensity requirement.
2. The Measured values at each test point shall not be less than 60% of the required minimum values shown for that individual test point location.
3. The sum of the optical power measurements and the sum of the peak luminous intensity measurements for each test point within a zone, shall not be less than the corresponding zone total requirements shown. The measurements at each discrete test point shown within the corresponding zone are the values used to calculate the specified zone total.
4. An adjustment in device orientation from the design position may be made in determining compliance to the optical power and peak luminous intensity requirements, provided such adjustment does not exceed 1 degree in any direction. All zone totals must comply after reaim.

FIGURE 1-Y - PHOTOMETRIC REQUIREMENTS CLASS 1-YELLOW

Optical Power (Cd-seconds/Minute) Shown in Bold (top value)
Peak Luminous Intensity (Candela) Shown in Italics (bottom value)

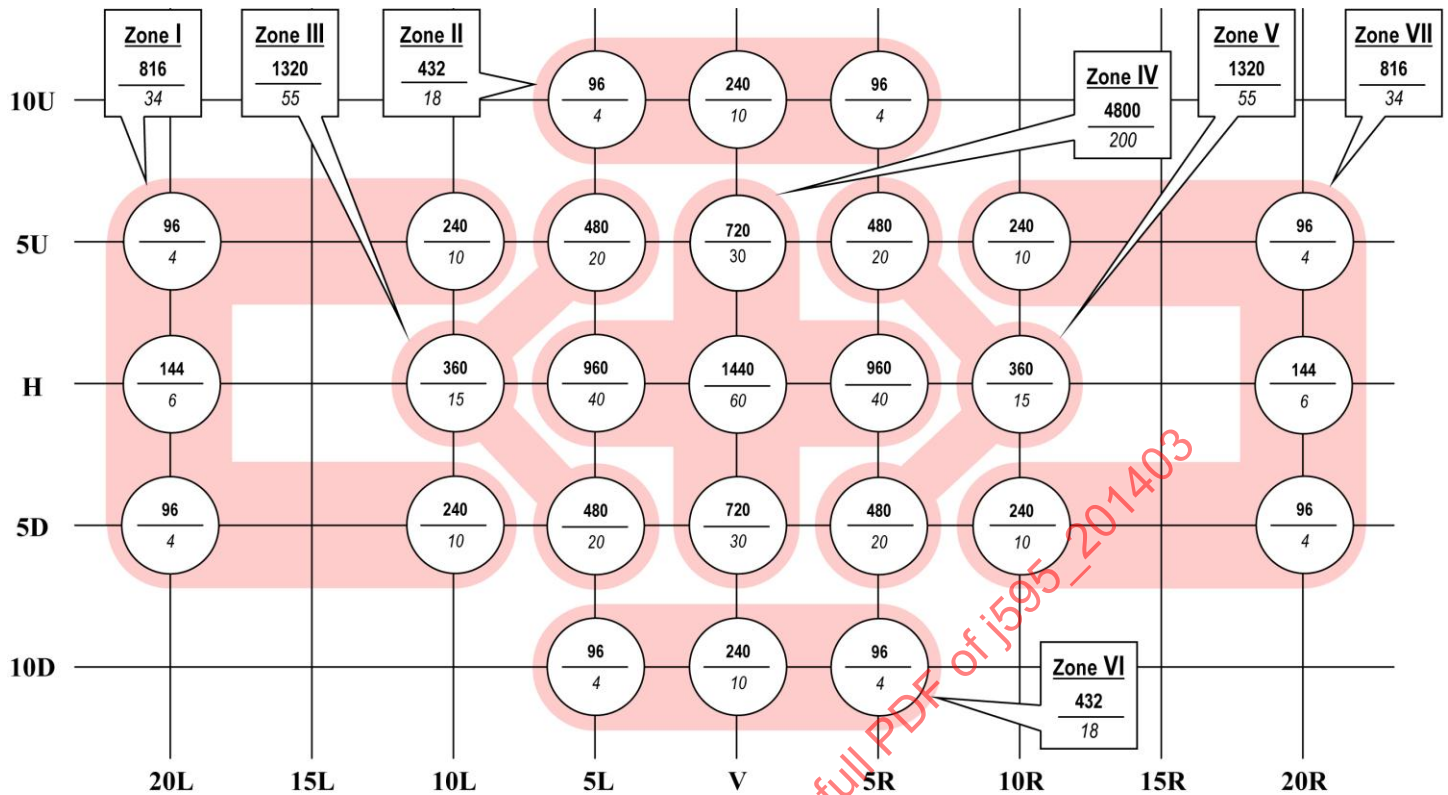


1. For each test point and zone total, the value shown in **bold** (top value) is the optical power requirement and the value shown in *italics* (bottom value) is the peak luminous intensity requirement.
2. The Measured values at each test point shall not be less than 60% of the required minimum values shown for that individual test point location.
3. The sum of the optical power measurements and the sum of the peak luminous intensity measurements for each test point within a zone, shall not be less than the corresponding zone total requirements shown. The measurements at each discrete test point shown within the corresponding zone are the values used to calculate the specified zone total.
4. An adjustment in device orientation from the design position may be made in determining compliance to the optical power and peak luminous intensity requirements, provided such adjustment does not exceed 1 degree in any direction. All zone totals must comply after reaim.

FIGURE 2-Y - PHOTOMETRIC REQUIREMENTS CLASS 2-YELLOW

Optical Power (Cd-seconds/Minute) Shown in Bold (top value)

Peak Luminous Intensity (Candela) Shown in Italics (bottom value)



1. For each test point and zone total, the value shown in **bold** (top value) is the optical power requirement and the value shown in *italics* (bottom value) is the peak luminous intensity requirement.
2. The Measured values at each test point shall not be less than 60% of the required minimum values shown for that individual test point location.
3. The sum of the optical power measurements and the sum of the peak luminous intensity measurements for each test point within a zone, shall not be less than the corresponding zone total requirements shown. The measurements at each discrete test point shown within the corresponding zone are the values used to calculate the specified zone total.
4. An adjustment in device orientation from the design position may be made in determining compliance to the optical power and peak luminous intensity requirements, provided such adjustment does not exceed 1 degree in any direction. All zone totals must comply after reaim.

FIGURE 3-Y - PHOTOMETRIC REQUIREMENTS CLASS 3-YELLOW

Optical Power (Cd-seconds/Minute) Shown in Bold (top value)
 Peak Luminous Intensity (Candela) Shown in Italics (bottom value)