Specification for Obstruction Lighting Equipment

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TABLES

CHAPTER 1. SCOPE AND CLASSIFICATION

1.1 Scope.

This specification sets forth the Federal Aviation Administration (FAA) requirements for obstruction lighting equipment used to increase conspicuity of structures to facilitate early obstruction recognition by pilots.

1.2 Equipment Classification.

Type	Description
L-810	Steady-burning red obstruction light
L-810 (F)	Flashing red obstruction light, 30 Flashes Per Minute (FPM)
L-856	High intensity flashing white obstruction light, 40 Flashes Per Minute (FPM)
L-857	High intensity flashing white obstruction light, 60 FPM
L-864	Flashing red obstruction light, 30 FPM
L-865	Medium intensity flashing white obstruction light, 40 FPM
L-866	Medium intensity flashing white obstruction light, 60 FPM
L-885	Flashing red obstruction light, 60 FPM

CHAPTER 2. REFERENCED DOCUMENTS

2.1 General.

The following is a listing of documents referenced in this AC.

2.2 FAA Advisory Circulars (ACs).

- AC 70/7460-1, *Obstruction Marking and Lighting*
- AC 150/5345-53, *Airport Lighting Equipment Certification Program*

2.3 FAA Engineering Briefs.

- Engineering Brief #67, *Light Sources Other Than Incandescent and Xenon for Airport and Obstruction Lighting Fixtures*
- Engineering Brief #98, *Infrared Specifications for Aviation Obstruction Light Compatibility with Night Vision Goggles (NVGs)*

2.4 Military Standards and Specifications.

- MIL-STD-810G, *Environmental Engineering Considerations and Laboratory Tests*
- MIL-DTL-7989C, *Covers, Light-Transmitting, for Aeronautical Lights, General Specification for*
- MIL-STD-3009, *Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible*

2.5 Code of Federal Regulations (CFR).

- Title 47, *Telecommunications,* Part 15, *Radio Frequency Devices*

2.6 Institute of Electrical and Electronics Engineers (IEEE) Publications.

- IEEE C62.41-1991, *IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits*
- IEEE C62.45-2002, *IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits*

2.7 International Standardization Organization (ISO) Publications.

- ISO-10012:2003, *Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment*

2.8 **International Civil Aviation Organization (ICAO).**

- Annex 14, Volume 1, *Aerodrome Design and Operations*

2.9 **Illuminating Engineering Society (IES).**

- *IES Handbook*, Reference and Application Volume, 10th Edition, 2011, Flashing Light Signals

2.10 **Sources.**

The documents listed above are available from the following locations:

1. FAA ACs: www.faa.gov/airports/resources/advisory_circulars/
2. FAA Engineering Briefs: www.faa.gov/airports/engineering/engineering_briefs/
3. Military standards and specifications: http://quicksearch.dla.mil/
4. IEEE standards: www.techstreet.com/ieee
5. ISO documents: www.iso.org/iso/home/store.htm
6. ICAO documents: https://www.iso.org/store.html
7. IES of North America (IESNA) documents: www.ies.org/store/

CHAPTER 3. EQUIPMENT REQUIREMENTS

3.1 General.

This section addresses environmental, design, and photometric requirements for obstruction light equipment. Criteria for selecting the proper obstruction lighting equipment, installation tolerances, and administrative information are in AC 70/7460-1.

3.2 Environmental Requirements.

Obstruction lighting equipment must be designed for continuous operation under the following conditions:

1. **Temperature**:
   a. Storage/shipping: -67° Fahrenheit (F) (-55° Celsius (C)) to 130° F (55° C).
   b. Operating: -40° F (-40° C) to 130° F (55° C).
2. **Humidity**. 95 percent relative humidity.
3. **Wind**. Wind speeds up to 150 miles per hour (mph) (240 kilometeres per hour (kmph)).
4. **Wind-blown Rain**. Exposure to wind-blown rain from any direction.
5. **Salt Fog**. Exposure to salt-laden atmosphere.
6. **Sunshine**. Exposure to solar radiation.

3.3 Design Requirements.

3.3.1 Light Unit.

1. The light unit must be lightweight and designed for easy servicing and lamp (or flashtube) replacement.
2. Materials used within the light unit must be selected for compatibility with their environment.
3. All plastic lens parts (including gaskets), that are exposed to ultraviolet radiation or ozone gas must not change color, crack, check, disintegrate, or be otherwise degraded (photometry must remain compliant) and meet the equipment warranty requirements of AC 150/5345-53, Appendix 2.

Note: The warranty requires that the lights meet the specifications for one year of installation or two years from shipment. Certification only applies to manufacturing.

4. Each light unit must be an independent unit and must flash at the specified intensity or at its highest intensity when control signals are absent.

3.3.2 Light Covers.

Light-transmitting covers for light units must be per the requirements in MIL-DTL-7989C. In addition, if plastic covers are used, they must be resistant to checking, crazing, or color changes caused by ultraviolet radiation or ozone gas exposure.

3.3.3 Light Colors.

The color for red obstruction lights must be per ICAO Annex 14, Volume 1, Appendix 1, *Colours for Aeronautical Ground Lights*, at operating temperature within the following chromaticity boundaries:

purple boundary $y = 0.980 - x$

yellow boundary $y = 0.335$

Note: Xenon flashtube emission or a color temperature range from 4,000 to 8,000 Kelvin is acceptable for white obstruction lights.

3.3.3.1 **Light Color During Daytime.**

Means must be provided on all L-810 obstruction lights to indicate the specified non-powered color during daytime viewing.

3.3.4 Mounting Provisions.

3.3.4.1 **Aiming (for L-856 and L-857).**

Light units must have a method for adjustment of the vertical aiming angle between 0 and +8 degrees. A spirit level or other device must be provided as part of each light unit for setting the vertical aiming angle of the light beam with an accuracy of one degree.

3.3.4.2 **Mounting (for L-810 and L-810(F)).**

The mechanical interface for L-810 and L-810(F) installation must be either ¾ or 1-inch National Pipe Thread (NPT) on the light unit side and/or bottom.

3.3.5 Control Unit.

3.3.5.1 **Flashing White Obstruction Lighting Systems.**

1. The control unit must set the system's flash rate, intensity and sequence and must be capable of controlling light units up to a distance of 2,500 feet (ft) (762 meters (m)).
2. If the control unit or control wiring fails, the light units must continue to flash per Table 3-4 flash rate. Failure of the flashing circuit must cause the light units to energize and continue to operate as flashing lights at 40 fpm.
3. Failure of an intensity step change circuit must cause all light units to remain operating at their proper intensity or alternatively to operate at the high intensity step.

3.3.5.1.1 Monitoring.

1. Each light unit must be monitored for FLASH/FAIL status. FAIL status is defined as either of the following conditions:
   a. unit misses four or more consecutive flashes;
   b. unit flashes at wrong intensity step during day operation.
2. Monitoring must be fail safe (i.e., active signals for FLASH and absence of signals for FAIL).
3. There must be a provision to permit connection to a remote alarm device, (supplied by others or as an option), to indicate system and individual light unit FLASH/FAIL status.

3.3.5.1.2 Placement.

The control and monitor functions may be consolidated into a light unit or into a single enclosure for remote mounting or they may be distributed into several light units.

1. **Remote Mounting**. In addition to the above, if it is placed in a remote mounted enclosure, the control unit must display the status of each light unit. An intensity control override switch must also be mounted in the enclosure to manually control light intensity during maintenance or in the event of a photoelectric control malfunction.

3.3.5.2 **Flashing Red Obstruction Lights.**

1. The control unit must set the system flash rate and flash sequence.
2. Failure of the flashing circuit must cause the light units to energize and operate as steady burning lights.
3. An override switch must be mounted on the control unit to manually control the lights during maintenance or in the absence of a photoelectric control signal.
4. To ensure proper operation, all flashing red obstruction lights (L-864 or L-810(F)) inclusive of any associated system of steady burning red lights, must be certified with a control unit whether internal or external to the lighting unit.

Note: Steady burning L-810 red obstruction lights do not need to be certified with a control unit.

3.3.5.2.1 Dual Lighting Systems.

1. The control unit may be a separate unit or incorporated as part of either the white or red obstruction light control unit.
2. The control unit must set the operating mode for each light unit in the system.

3. Outage of one of two lamps, or any failure in the device that causes a reduction in intensity of the horizontal beam or results in an outage in the uppermost red beacon (L-864 unit) or outage of any uppermost red strobe, must cause the white obstruction light system to operate in its specified "night" step intensity.
4. At no time should both red and white systems be on simultaneously. An override switch must be mounted on the control unit to manually control the operating mode of the system during maintenance or in the absence of a photoelectric control signal.

3.3.5.2.2 Monitoring.

1. Each separate L-864 light unit and each tier of L-810 light units must be monitored for FLASH/FAIL status.
2. FAIL is defined as outage of any lamp in an L-864 light unit, outage of any one lamp in a tier of L-810 light units, or failure of a flasher (steady on and/or total) for an L-864 or L-810(F) light unit.
3. Monitor signals must be fail safe (i.e., active signals for FLASH and absence of signals for FAIL).
4. There must be a provision to permit connection to a remote alarm device, (supplied by others or as an option) to indicate FLASH/FAIL status.

3.3.6 Input Voltage.

The obstruction lighting equipment must be designed to operate from the specified input voltage ±10 percent. Incandescent lamps must be operated to within ±3 percent of the rated lamp voltage to provide proper light output.

3.3.7 Performance Criteria.

Manufacturers are required to publish performance criteria for all light generating devices (see Engineering Brief #67).

3.3.8 Transient Protection.

Equipment with solid state devices must be designed to withstand and/or include separate surge protection devices that are tested against defined waveforms per IEEE C62.41-1991, Table 4, Location Category C1, for single phase modes (line to ground, line to neutral, line and neutral to ground).

Note: Does not apply to DC powered systems.

3.3.9 Radiated Emissions.

Note: *Optional only. No equipment qualification is required.*

1. Obstruction lighting that uses electronic circuitry to power the light source must be classified as an incidental radiator (47 CFR §15.13). This applies to equipment that

does not intentionally generate any radio frequency energy, but may create such energy as an incidental part of its intended operations.

2. Obstruction light systems must employ sound engineering practices to minimize the risk of harmful interference.

3.3.10 Warning Labels.

All enclosures that contain voltages exceeding 150 volts direct current (VDC) or alternating current (AC) root mean square (rms) must have high voltage warning label(s) placed at a conspicuous location(s). Also, a visual indicator must be included within the enclosure to indicate that greater than 150 VDC is present on the high voltage capacitors.

3.3.11 Interlock Switches.

Interlock switches must be incorporated in each power supply and optionally in each flashhead so that opening either unit must (1) interrupt incoming power and (2) discharge all high voltage capacitors within the enclosure to 50 volts or less within 30 seconds. Requirement for interlock switches limited to high voltage discharge xenon systems applications and voltages exceeding 150 volts direct current (VDC) or alternating current (AC) root mean square (rms).

3.3.12 Nameplate.

A nameplate, with the following information, must be permanently attached to each unit:

1. Name of unit (light unit, control unit, etc.).
2. FAA type (e.g., L-856, L-864, etc.).
3. Manufacturer's catalog number.
4. Manufacturer's name and address.
5. Rated separation distance in feet is ____ to _____ between power supply and optical head using American Wire Gage (AWG) ____ conductors. (Item e is required if a unique power supply and its associated optical head are separate components of the lighting system as in the case of some discharge lights.)

In addition to the above, the power supply must include nominal input voltage, number of phases (if other than single phase), frequency, and peak VA rating.

3.3.13 Optional Arctic Kit.

Light systems may be offered with an optional arctic kit to enable operation in temperatures below -40° F (-40° C) (see Engineering Brief #67 for additional information about arctic kits).

3.3.14 Component Ratings.

3.3.14.1 **Discharge Type Lighting Equipment.**

The flashtube or flashtubes must have a minimum rated life of two years without maintenance or loss of light output below the minimum specified candela.

3.3.14.2 **Component Separation Rating.**

1. If the light unit's power supply and optical head are separate components, the manufacturer must rate each light unit for maximum and minimum separation at a given AWG wire size.
2. The manufacturer must include this rating on the nameplate per paragraph 3.3.12. The rating certifies that the unit meets all requirements within the rated distances.
3. The manufacturer must maintain records of test results which support the stated separation rating until the next system re-qualification.

3.3.14.3 **Incandescent Light Equipment.**

Lamps must have a minimum rated life of 2,000 hours at rated voltage.

3.3.14.4 **Alternative Light Source Equipment.**

Light sources other than incandescent or xenon (for example: light emitting diodes (LEDs), cold cathode) must have a minimum rated life of two years without maintenance or loss of light output below the minimum specified intensity.

3.3.14.5 **Light Equipment Components.**

All components used in obstruction lighting equipment, except lamps, must be designed to meet performance requirements for a minimum of one year without maintenance.

3.3.15 Leakage Current.

All obstruction lighting equipment classified in paragraph 1.2 must be designed to withstand application of 1,000 volts AC or 1,414 volts DC between the input power leads and equipment chassis for 10 seconds during which the leakage current must not exceed 10 microamperes at ambient room temperature and humidity.

3.4 **Performance Requirements.**

3.4.1 Photometric.

3.4.1.1 **General.**

The effective intensity for flashing lights must be calculated per the following formula by the method described for Flashing Light Signals in

the *IES Handbook*, 1993 Reference and Application Volume 8th Edition, Pages 96 and 97:

$$I_e = \left[\int_{t_1}^{t_2} I\,dt\right] / \left(0.2 + (t_2 - t_1)\right)$$

Where:

I_e = Effective intensity (Candela)

I = Instantaneous intensity (Candela)

t_1, t_2 = Times in seconds of the beginning and end of that part of the flash when the value of I exceeds I_e. This choice of the times maximizes the value of I_e.

1. For discharge type flashing lights, the equipment must provide the specified light output at the specified temperature extremes as the input voltage simultaneously varies by ±10 percent from nominal.
2. The light intensity and beam distribution requirements for obstruction lighting equipment are specified beginning with paragraph 3.4.1.2. All intensities listed are effective intensities (except steady-burning red obstruction lights) measured at the flash rate specified in Table 3-4.
3. All incandescent lights will be tested as steady burning lights. Flashing lights with alternative lighting sources per Engineering Brief #67 must have all testing conducted in the flashing mode.
4. The effective intensity for multiple pulse flashes as used in lights during nighttime operation must be calculated by:

Note: Multiple pulse flashes cannot be used in day or twilight applications.

$$I_e = \left(\frac{\int_{t_1}^{t_A} I\,dt}{0.2 + t_A - t_1}\right) + \left(\frac{\int_{t_B}^{t_C} I\,dt}{0.2 + t_C - t_B}\right) + \left(\frac{\int_{t_D}^{t_E} I\,dt}{0.2 + t_E - t_D}\right) + \ldots + \left(\frac{\int_{t_X}^{t_Z} I\,dt}{0.2 + t_Z - t_X}\right)$$

5. The frequency of the pulses must not be less than 50 Hz and the interval $t_A - t_1$ must not vary by more than ±5% from the nominal value from pulse to pulse over the simultaneous extremes of temperature and input voltage.

3.4.1.1.1 Infrared Specifications for LED Obstruction Lights.

To be night vision goggle (NVG) compatible, LED-based L-810, L-864 and L-885 obstruction light fixtures must include infrared (IR) emitters or be used in conjunction with a standalone IR emitter. The IR emitters are

to be on whenever the visible light is energized and off whenever the visible light is de-energized.

Optional Monitoring:

1. If the IR emitter fails, the visible light is de-energized, and an alarm signal must be generated to provide an indication of the failure, (coupled).

OR

2. If the IR emitter fails, the visible light remains energized. The IR emitter is independently monitored in accordance with the monitoring requirements for FLASH/FAIL status of L-864, L-810 and L-885 visible light units. An alarm signal must be generated to provide an indication of the failure, (de-coupled).

The following infrared specifications must be used for LED-based L-810, L-864 and L-885 obstruction light fixtures. LED-based L-810, L-864 and L-885 obstruction light fixtures must be night vision goggle (NVG) compatible and must include infrared (IR) emitters or be used in conjunction with a standalone IR emitter. IR specifications are stated below to resolve the issues precluding the acquisition of LED obstruction light fixtures by pilots using NVGs with a Class B filter.

The following infrared specifications are used for LED-based L-810, L-864 and L-885 obstruction light fixtures:

1. **Output Wavelength**. The nominal IR output wavelength is 800-900 nm. This range coincides with the nominal spectral response range of NVGs, ensuring the fixtures will be visible by all current NVGs regardless of the class of objective lens filter used. See MIL-STD-3009 regarding relative spectral response characteristics.
2. **Beam Width**. For LED-based L-810, L-864 and L-885 light fixtures, the vertical radiometric requirements of the IR radiation are to be identical to the existing FAA requirements in Table 3-1 for the photometric beam width and distribution of the visible light. Therefore, the vertical beam width of IR emitters included in a LED-based L-810 light fixture or used in conjunction with a LED-based L-810 light fixture is minimum 10°, centered between +4 and +20°. The vertical beam width of IR emitters included in a LED-based L-864 and L-885 fixture or used in conjunction with a LED-based L-864 and L-885 light fixture is minimum 3°. The horizontal beam width is 360° unobstructed. The IR emissions must mimic both pulse width/duration of visible light so pilots do not experience a visual disparity when looking through and under the NVG.
3. **Minimum IR Radiant Intensity**. For wavelengths from 800 to 900 nm, the minimum radiant intensity for IR emitters included in LED-based L-810 light fixtures or for standalone IR emitters to be used in conjunction with LED-based L-810 light fixtures is 4 milliwatts per

steradian (mW/sr) [0.004 W/sr]. The minimum radiant intensity for IR emitters included in LED-based L-864 and L-885 light fixtures or for standalone IR emitters to be used in conjunction with LED-based L-864 and L-885 light fixtures is 246 milliwatts per steradian (mW/sr) [0.246 W/sr].

a. The minimum IR radiant intensities for LED-based L-810, L-864 and L-885 light fixtures are based on the minimum acquisition distances for nighttime VMC stated in AC 70/7460-1 (1.4 SM for the L-810 and 3.1 SM for the L-864/L-885). These distances are necessary to provide pilots with adequate time to see the obstruction and take evasive action to avoid coming within 2,000 ft of an obstruction.

Table 3-1. Infrared Specifications for LED L-810, L-864 and L-885 LED Obstruction Lights.

IR Wavelength (nominal)	Applicability	IR Vertical Beam Width	IR Radiant Intensity
800-900 nm	L-810 (L)	≥ 10° [1]	Minimum: 4 mW/sr
	L-864 (L) and L-885 (L)	≥ 3°	Minimum: 246 mW/sr

Note 1: The center of the vertical beam spread should be between +4 and +20 degrees.
Note 2: Multiple light units may be used to achieve a horizontal coverage of 360 degrees.

3.4.1.2 **L-810 Light Unit.**

The center of the vertical beam spread must be between +4 and +20 degrees. With a minimum vertical beam spread of 10 degrees and at all radials throughout 360 degrees, there must be a minimum intensity of 32.5 candela.

Note: The 32.5 candela requirement is over the minimum vertical beam spread of 10 degrees.

3.4.1.2.1 Flashing L-810 (F) Light Unit.

1. The light unit must flash simultaneously with the L-864 flashing light at a rate of 30 flashes per minute (FPM) (± 3 FPM). The IR emissions must mimic both pulse width/duration of visible light so pilots do not experience a visual disparity when looking through and under the NVG.
2. The center of the vertical beam spread must be between +4 and +20 degrees.
3. With a minimum vertical beam spread of 10 degrees and at all radials throughout 360 degrees, there must be a minimum average

instantaneous intensity of 32.5 candelas equivalent to steady burning mode. Evaluate L-810(F) with effective intensity, or limit the flash duration range to some value that insures adequate effective intensity.

Note: The center of the vertical beam must be between +4 and +20 degrees. With respect to the center of the beam and over a vertical range of ±5 degrees, there must be a minimum intensity of 32.5 candela for all radials throughout 360 degrees horizontal

3.4.1.3 **L-856 Light Unit.**

The beam spread and effective intensity must be per Table 3-2.

Table 3-2. L-856 Intensity Requirements.

Step	Beam Spread		Effective Intensity (candela) [2]
	Horizontal (degrees) [1]	Vertical (degrees)	
Day	90 or 120	3 – 7	270,000 ±25%
Twilight	90 or 120	3 – 7	20,000 ±25%
Night	90 or 120	3 - 7	2,000 ±25%

Note 1: Multiple light units may be used to achieve a horizontal coverage of 360 degrees.

Note 2: When the light unit is installed per the manufacturer's instructions, the intensity at zero degrees elevation angle (horizontal) must be at least as great as the minimum specified beam peak intensity. For stray light, the intensity at 10 degrees below horizontal, at any radial, must not be greater than 3% of the peak intensity at the same radial.

3.4.1.4 **L-857 Light Unit.**

Photometric requirements are defined in Table 3-3.

Table 3-3. L-857 Intensity Requirements.

Step	Beam Spread		Effective Intensity (candela) [2]
	Horizontal (degrees) [1]	Vertical (degrees)	
Day	90 or 120	3 – 7	140,000 ±25%
Twilight	90 or 120	3 – 7	20,000 ±25%
Night	90 or 120	3 - 7	2,000 ±25%

Note 1: Multiple light units may be used to achieve a horizontal coverage of 360 degrees.
Note 2: When the light unit is installed per the manufacturer's instructions, the intensity at zero degrees elevation angle (horizontal) must be at least as great as the minimum specified beam peak intensity. For stray light, the intensity at 10 degrees below horizontal, at any radial, must not be greater than 3% of the peak intensity at the same radial.

3.4.1.5 **L-864 Light Unit.**

At all radials throughout the omnidirectional 360 degrees, there must be a peak effective intensity of 2,000 ±25% candela. There must also be a minimum effective intensity of 750 candela throughout a minimum vertical beam spread of 3 degrees. Multiple light units may be used to achieve a horizontal coverage of 360 degrees.

3.4.1.5.1 Beam Adjustment.

When the light unit is installed per the manufacturer's instructions, the intensity at zero degrees elevation angle (horizontal) must be at least as great as the minimum specified beam peak intensity.

3.4.1.6 **L-865 Light Unit.**

Photometric requirements are defined in Table 3-4.

Table 3-4. L-865 Intensity Requirements.

Step	Beam Spread		Effective Intensity (candela) [2]
	Horizontal (degrees) [1]	Vertical (degrees)	
Day/ Twilight	360	3 minimum	20,000 ±25%
Night	360	3 minimum	2,000 ±25%

Note 1: Multiple light units may be used to achieve a horizontal coverage of 360 degrees.
Note 2: When the light unit is installed per the manufacturer's instructions, the intensity at zero degrees elevation angle (horizontal) must be at least as great as the minimum specified

beam peak intensity. For stray light, the intensity at 10 degrees below horizontal, at any radial, must not be greater than 3% of the peak intensity at the same radial.

3.4.1.7 **L-866 Light Unit.**

The requirements are the same as the L-865 light unit, except the flash rate must be 60 FPM.

3.4.1.8 **L-885 Light Unit.**

The requirements are the same as the L-864 light unit, except the flash rate must be 60 FPM.

3.4.2 Flash Rate and Duration.

Flash characteristics are defined in Table 3-5.

Table 3-5. Flash Characteristics for Obstruction Lights.

Type	Intensity Step	Flash Rate [1]	Flash Duration [2]
L-810(F)	Single	30 FPM (± 3 FPM)	1/2 to 2/3 of flash period if incandescent lighting [3], and between 100 and 1333 ms inclusive if other lighting sources.
L-856	Day & Twilight	40 FPM	Less than 100 ms
L-856	Night	40 FPM	Between 100 and 250 milliseconds (ms) inclusive
L-857	Day & Twilight	60 FPM	Less than 100 ms
L-857	Night	60 FPM	Between 100 and 250 ms inclusive
L-864	Single	30 FPM (± 3 FPM)	1/2 to 2/3 of flash period if incandescent lighting [3], and between 100 and 1333 ms inclusive if other lighting sources.
L-865	Day & Twilight	40 FPM	Less than 100 ms
L-865	Night	40 FPM	Between 100 and 1000 ms inclusive
L-866	Day & Twilight	60 FPM	Less than 100 ms
L-866	Night	60-FPM	Between 100 and 250 ms inclusive

Type	Intensity Step	Flash Rate [1]	Flash Duration [2]
L-885	Single	60 FPM	1/2 to 2/3 of flash period if incandescent lighting [3], and between 100 and 670 ms inclusive if other lighting sources.

Note 1: Flash rates have a tolerance of ±5 percent except L810(F) and L-864

Note 2: When the effective flash duration is achieved by a group of short flashes, the short flashes must be emitted at a rate of not less than 50 Hz.

Note 3: The light intensity during the "off" period must be less than 10 percent of the peak effective intensity. The "off" period must be at least 1/3 of the flash period.

3.4.3 System Flashing Requirements.

3.4.3.1 **Simultaneous Flashing Systems.**

All obstruction lights in systems composed of either L-810(F), L-864, L-856, or L-865 light units must flash within 1/60 of a second of each other.

3.4.3.2 **Sequenced Flashing Systems.**

1. Catenary support structure systems composed of L-857, L-866, or L-885 light units must have a sequenced flashing characteristic.
2. This system consists of three lighting levels on or near each supporting structure. One light level is near the top, one at the bottom or lowest point of the catenary, and one midway between the top and bottom.
3. The flash sequence must be middle, top, and bottom.
4. The interval between the beginning of the top and the beginning of the bottom flashes must be about twice the interval between the beginning of the middle and the beginning of the top flashes.
5. The interval between the end of one sequence and the beginning of the next must be about 10 times the interval between middle and top flashes.
6. The time for the completion of one cycle must be one second (±5 percent).

3.4.4 Intensity Step Changing.

3.4.4.1 **White Obstruction Lights.**

The light unit intensity must be controlled by a photocell facing the northern (polar) sky. White obstruction lights must automatically change intensity steps when the ambient light changes as follows:

1. From day intensity to twilight intensity when the illumination decreases below 60 foot-candles (645.8 lux) but before it reaches 35 foot-candles (376.7 lux).

2. From twilight intensity to night intensity when the illumination decreases below 5 foot-candles (53.8 lux) but before it reaches 2 foot-candles (21.5 lux).
3. From night intensity to twilight intensity when the illumination increases above 2 foot-candles (21.5 lux) but before it reaches 5 foot-candles (53.8 lux).
4. From twilight intensity to day intensity when the illumination increases above 35 foot-candles (376.7 lux) but before it reaches 60 foot-candles (645.8 lux).

3.4.4.2 **Red Obstruction Lights.**

If automatic control is utilized, the light unit must turn on when the ambient light decreases to not less than 35 foot-candles (367.7 lux) and turn off when the ambient light increases to not more than 60 foot-candles (645.8 lux). Single L-810 light units are controlled in a manner compatible with the particular installation.

3.4.4.3 **Dual Obstruction Lighting System.**

White obstruction lights must turn off and red obstruction lights must turn on when ambient light changes from twilight to night per paragraph 3.4.4.1 (item 2). Red obstruction lights must turn off and white obstruction lights must turn on when ambient light changes from night to twilight per paragraph 3.4.4.1 (item 3).

3.5 **Instruction Manual.**

An instruction manual containing the following information must be furnished with all obstruction lighting equipment.

1. Complete system schematic and wiring diagrams showing all components cross-indexed to the parts list.
2. Complete parts list of field replaceable parts with applicable rating and characteristics of each part, and with the component manufacturer's part number as appropriate.
3. Installation instructions, including leveling and aiming of light units.
4. Maintenance instructions, including lamp or flashtube replacement, theory of operation, troubleshooting charts and, as appropriate, conspicuous warnings about alignment and replacement of lamps and light units with other than manufacturer recommended items. Explanation of testing requirements regarding light units with specific lamps must be provided in the text. A discussion must be included about mixing light units as replacements with other manufacturers' units with emphasis on assuring that system design of obstruction lighting is not degraded.
5. Operating instructions.

CHAPTER 4. EQUIPMENT QUALIFICATION REQUIREMENTS

4.1 Qualification Procedures.

Procedures for qualifying equipment for certification are contained in AC 150/5345-53.

4.2 Qualification Tests.

Qualification tests must be conducted on the light unit in the following order:

1. Initial photometric test, per paragraph 4.2.1
2. Infrared Test, per paragraphs 4.2.4 and 4.2.5
3. Environmental tests, per paragraphs 4.2.4, 4.2.3, 4.2.5, 4.2.6, 4.2.7, 4.2.8, 4.2.9, and 4.2.10 (in any order)
4. 1000 hours of continuous operation, per paragraph 4.2.12
5. System Operational Test, per paragraph 4.2.12
6. Leakage Current Test, per paragraph 4.2.13
7. Sampling Photometric Test, per paragraph 4.2.1
8. Visual examination, per paragraph 4.2.14
9. Transient Protection Test, per paragraph 4.2.11. The equipment may be damaged by this test. It should only be performed when testing per items 1 through 3 above is complete.

Sample photometric and system operational tests must be conducted after completion of all environmental tests. The same unit(s) must be used throughout the tests. The following tests are required to demonstrate compliance with this specification. The tests may be run on the control unit, power supply, and a single light unit, with a simulated load replacing the other light units. Equipment tested must be as a complete system.

4.2.1 Photometric Test.

1. A full photometric test as described in this section must be performed before all environmental tests.

Note: To verify proper color correction, photometric testing conducted on alternative light source fixtures must be done with a detector having an up to date calibration including spectral response data (see Engineering Brief #67).

2. A sampling photometric retest must be conducted after the unit has been operated continuously for 1000 hours with normal (12 hour) day/night cycling. This sampling must consist of measuring the vertical beam pattern for compliance with photometric requirements at a minimum of two of the previously tested horizontal radials.
3. Light units must be energized by the system power supply and control unit, and must be tested for compliance with photometric requirements.

4. The specified intensity must be produced at high and low temperature extremes as the input voltage to the system power supply varies by ±10 percent from nominal. This requirement must also apply to alternative light sources.
5. Incandescent lamps must be tested at ±3 percent of their nominal voltage.
6. Red light intensity may be measured in white light and then calculated if the glassware manufacturer certifies the chromaticity and transmissivity values of the red filter material for the particular source.
7. If more than one lamp type is to be used, the qualification testing must be completed for each lamp type.
8. For a discharge type flashing system, if the power supply and optical head are separate components, the manufacturer must demonstrate that the required photometrics are produced with the units separated by maximum and minimum recommended distances and connected by cable recommended by the manufacturer.
9. Photometric test results must be in the forms of:
    a. Vertical beam pattern: Distribution curve (vertical angle versus candela) with minimum one degree spacing of test points over range of specified angles.
    b. Horizontal beam pattern: Polar plot (horizontal angle versus candela) with minimum 30-degree spacing of test points.

4.2.2 Infrared Test for LED Obstruction Lights.

1. An infrared test as described in this section must be performed.
2. Beam Spread for LED-based L-810, L-864 and L-885 light fixtures:
    a. Vertical radiometric requirements of the IR radiation are to be identical to the existing FAA requirements in this AC for the photometric beam width and distribution of the visible light.
    b. Vertical beam width of IR emitters included in a LED-based L-810 light fixture or used in conjunction with a LED-based L-810 light fixture minimum 10°, centered between +4 and +20°.
    c. Vertical beam width of IR emitters included in a LED-based L-864 and L-885 fixture or used in conjunction with a LED-based L-864 and L-885 light fixture minimum 3°.
    d. Horizontal beam width 360° minimum.

4.2.3 Minimum IR Radiant Intensity.

For wavelengths from 800 to 900 nm:

1. The minimum radiant intensity for IR emitters included in LED-based L-810 light fixtures or for standalone IR emitters to be used in conjunction with LED-based L-810 light fixtures is 4 milliwatts per steradian (mW/sr) [0.004 W/sr].
2. The minimum radiant intensity for IR emitters included in LED-based L-864 and L-885 light fixtures or for standalone IR emitters to be used in conjunction with LED-

based L-864 and L-885 light fixtures is 246 milliwatts per steradian (mW/sr) [0.246 W/sr].

4.2.4 High Temperature Test.

1. The high temperature test must be conducted per MIL-STD-810G, Method 501.5, Procedure II, Operation. The equipment must be subjected to a constant temperature of +130° F (+55° C) for 4 hours after equipment temperature stabilization and be operated throughout the test.
2. During the test, the manufacturer must demonstrate that the equipment maintains the specified flash rate and for a discharge type flashing light that the proper amount of energy is being delivered to the flashtube as the input voltage is varied by ±10 percent from nominal.
3. A visual examination must be conducted after the equipment is removed from the chamber. Failure of the equipment to operate as specified is cause for rejection.
4. For alternative light source equipment high temperature testing requirements, see Engineering Brief #67.

4.2.5 Low Temperature Test.

1. The low temperature test must be conducted per MIL-STD-810G, Method 502.5, Procedure II, Operation. The equipment must be placed in a chamber that maintains a temperature of -67 degrees F (-55° C) for shipping/storage requirements and -40° F (-40° C) for equipment operational requirements.
2. Equipment operation must be demonstrated at the beginning of the test.
3. The equipment storage and shipping low temperature requirement is -67 ° F (-55° C). The equipment must be stabilized and cold soaked at the storage/shipping temperature for one hour. The test chamber must then be ramped to the -40° F (-40° C) equipment operating temperature at no more than 6° F (3° C) per minute to prevent thermal shock to the equipment.
4. The equipment, with input power off, must then be exposed to a 24-hour soaking period at -40° F (-40° C) after which the equipment must be turned on for one hour, and must achieve specified flash rate and intensity within 1 minute after being energized.
5. During the one hour of operation, the manufacturer must demonstrate that the equipment maintains the specified flash rate and, for discharge type flashing light, the proper amount of energy is being delivered to the flashtube as the input voltage is varied by ±10 percent from nominal.
6. At the conclusion of the test, a visual inspection must be conducted. Failure of the equipment to operate as specified is cause for rejection.

4.2.6 Rain Test.

The wind-blown rain test must be conducted per MIL-STD-810G, Method 506.5, paragraph 4.4.2, Procedure I – Rain and blowing rain. The rain must be at a rate of 5.2

inches per hour (130 mm/hour) with an exposure time of 30 minutes per side. The equipment must be operated throughout the test. Failure of the equipment to operate as specified is cause for rejection.

4.2.7 Wind.

Evidence must be provided, either by testing or by calculation of an equivalent mechanical force, to demonstrate that installed light units meet the wind requirement in paragraph 3.2 (item 3).

4.2.8 Humidity Test.

The test must be per MIL-STD-810G, Method 507.5, paragraph 4.4.2.2, Procedure II - Aggravated. The equipment must be subjected to two complete cycles per Table 507.4-1, except the maximum chamber temperature must be +130° F (+55° C). Failure of the equipment to operate as specified is cause for rejection.

4.2.9 Salt Fog Test.

The salt fog test must be conducted per MIL-STD-810G, Method 509.5, paragraph 4.5.2, Procedure. Failure of the equipment to operate as specified is cause for rejection. If corrosion is present, the third-party certification body must determine if it has impacted equipment structural integrity or functionality.

4.2.10 Sunshine Test.

The equipment must be in its normal operational configuration for this test.

Note: The manufacturer may submit a certificate of compliance (for consideration by the third-party certification body) from the material(s) manufacturer attesting to UV resistance (per MIL-STD-810G) in lieu of the testing requirements below.

1. A sunshine test must be conducted per MIL-STD-810G, Method 505.5, paragraph 4.4.3, Procedure II, Steady State, for all obstruction lighting equipment with nonmetallic exterior parts or plastic/thermoplastic light covers.
2. The equipment must be subjected to a minimum of 56 cycles.
3. Perform an operational test of the equipment after 56 cycles.
4. Any evidence of deterioration of plastic parts: chalking, bleaching, cracking, hazing, or color changes (yellowing) to the thermoplastic lenses of the test unit must be causes for rejection.
5. For plastic/thermoplastic optical lenses or covers, the photometric performance must be measured after this test.

4.2.11 Transient Protection Test.

Note 1: The equipment may be damaged by this test. Perform this test only when tests in paragraphs 4.2.1 through 4.2.10 are completed.

Note 2: Does not apply to DC powered systems.

1. Subject the obstruction lighting equipment to 2 pulses at 15 second intervals to a combination wave 1.2 microseconds (µs)/50µs and 8µs/20µs (6,000 volts, 3,000 amps) test pulse per the descriptions in IEEE C62.41, Table 4, Location Category C1.
2. See IEEE C62.41-1991 Section 9.3 for test condition and test generator information.
3. See IEEE C62.41-1991 Section 9.4 for a detailed combination pulse generation and parameters discussion.
4. See also IEEE C62.45, *IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1,000 volts (V) and Less) AC Power Circuits*, for guidance about equipment test methods.
5. The equipment under test must operate normally at the conclusion of the test.

4.2.12 System Operational Test.

Note: Type L-810 steady burning red obstruction light units are excluded from the system operational test requirements in items 3 through 5 below.

1. A system operational test must be performed after the unit has been operated continuously without failure for 1000 hours with normal (12 hour) day/night cycling.
2. System components must be connected with the necessary wiring to electrically simulate an actual installation in which the top and bottom light units on a structure are separated by 2,000 feet (600 m) for a system composed of L-856 and/or L-865 and 500 feet (150 m) for system composed of L 857 or L-866, and the controller separated an additional 2,500 feet (800 m). Simulated interconnecting cables with equivalent impedance may be used in lieu of full cable lengths.
3. The system must be energized and operated to demonstrate compliance with all specification operating requirements such as flash rate, flash sequence, photoelectric switching of intensity steps, operation of interlocked devices, and satisfactory operation under input voltage variations.
4. If the power supply and optical head are separate components, it must be demonstrated that with the maximum and minimum nameplate rated separation between components, proper energy is delivered to the light unit to produce the specified photometrics.
5. It must be demonstrated that L-810(F) and L-864 flashing red lights produce the specified photometric requirement when energized over conductors (actual or simulated) representing the maximum and minimum nameplate rated cable length at the minimum input voltage.

4.2.13 Leakage Current Test.

Light units must be tested for compliance to the leakage current requirement in paragraph 3.3.15. Leakage current must be measured between the primary power connection points to the equipment chassis. The primary power connection points may be connected together during this test, but all other internal wiring must be connected as

in normal operation. Devices for surge and lightning protection connected directly to input power wiring may be disconnected during this test.

4.2.14 Visual Examination.

The obstruction lighting equipment must be examined for compliance with the requirements on materials, finish, and quality of workmanship.

CHAPTER 5. PRODUCTION TEST REQUIREMENTS

5.1 System Production Tests.

A visual examination must be performed for all components in a system to verify proper materials and assembly. Each component of the system must be energized and tested to verify specified operation and conformance to photometric requirements.

5.2 Incandescent Light Unit Production Tests.

All light units must be visually examined for proper materials and assembly. The manufacturer must demonstrate that the on-going production photometric test results show the manufacturing process has statistical capability with quality factor (Cpk) ≥ 1.0 and $\sigma \geq 3.0$, conforming to light unit photometric requirements as specified in paragraphs 3.4.1.2, 3.4.1.5, or 3.4.1.8.

5.3 Alternative Lighting Devices (ALD).

All light units must be visually examined for proper materials and assembly. The manufacturer must demonstrate that the ongoing production photometric test results show the manufacturing process has statistical capability with quality factor (Cpk) ≥ 1.0 and $\sigma \geq 3.0$, conforming to light unit photometric requirements as specified in paragraphs 3.4.1.2 through 3.4.1.8.

5.4 Discharge Light Unit Production Test.

All light units must be visually examined for proper materials and assembly. The units must be energized and tested to verify proper operation and conformance to photometric requirements as specified in Table 5-1 and Table 5-2.

5.5 Production Operational Test.

All light units must be tested to verify specified operation per the following minimum standards.

1. Each unit must be operated a minimum of 24 hours at highest intensity and a minimum of 12 hours at lowest intensity.
2. During highest intensity operation, each unit must be monitored for FLASH/FAIL as defined in paragraph 3.3.5.1.1. Minimum acceptable quality is zero FAILs in 24 hours of high intensity operation.
3. After a minimum 36-hours elapsed time of operation each light unit must be tested to verify proper operation of the following:
    a. All intensity step changes per paragraph 3.4.4.1.
    b. Proper operation of monitoring per paragraph 3.3.5.1.1.

c. Proper interlock switch operation and discharge time to 50 volts (bank potential) per paragraph 3.3.11.

d. Simultaneous flashing and intensity changing for multi-light systems per paragraphs 3.4.3.1 and 3.3.5.1, respectively.

e. Leakage current test per paragraph 3.3.15.

5.6 **Production Photometric Test.**

Photometric testing must be performed per Table 5-1 or Table 5-2 using either conventional sampling per column 2 or statistical process control (SPC) per column 3. If SPC is used for a characteristic, it must show statistical capability with Cpk ≥ 1.0 and $\sigma \geq 3.0$.

Table 5-1. L-856/L-857 Production Photometric Requirements.

Characteristic Tested [1]	Test Points	
	Conventional	**SPC**
a) Beam peak (Day Intensity)	3 radials each unit: 1 at center of Horizontal beam +2 radials ±45 degrees or ±60 degrees from center	1 radial each unit, random orientation
b) Beam peak (Twilight Intensity)	Same radials as (a)	Same radials as (a)
c) Beam peak (Night Intensity)	Same radials as (a)	Same radials as (a)
d) Intensity at -10 degrees (Night)	Same radials as (a)	Same radials as (a)

Note 1: Characteristic must meet all specifications per paragraph 3.4.1.3 or 3.4.1.4.

Table 5-2. L-865/866/864[1] /885[1] Production Photometric Requirements.

Characteristic Tested [2]	Test Points	
	Conventional	**SPC**
a) Beam peak (Day Intensity)	4 radials each unit: equally spaced, random orientation	1 radial each unit, random orientation

Note 1: Discharge type and alternative light source light only.
Note 2: Characteristic must meet all specifications per paragraph 3.4.1.5 or 3.4.1.6.

5.7 **Production Test Records.**

Records showing actual test results of all tests required by paragraph 5.5 must be maintained for a period of three years by the manufacturer. These records must be traceable to the units tested and in the case of discharge light units traceable by serial number.

5.8 **Production Test Equipment.**

All measuring and test equipment used in the production of obstruction lighting equipment classified under paragraph 1.2 must have its accuracy and precision maintained by a calibration program with traceability to ISO-10012, *Measurement Management Systems – Requirements for Measurement Processes and Measuring Equipment*, or current industry accreditation criteria. The manufacturer must show that all production photometric testing equipment correlates to the certifying laboratory's equipment to within ±5 percent. Photometric testing must be performed in a properly designed photometric range using a calibrated photometer. All photometric measurements must be based on a minimum five flash average.

Advisory Circular Feedback

If you find an error in this AC, have recommendations for improving it, or have suggestions for new items/subjects to be added, you may let us know by (1) mailing this form to Manager, Airport Engineering Division, Federal Aviation Administration ATTN: AAS-100, 800 Independence Avenue SW, Washington DC 20591 or (2) faxing it to the attention of the Office of Airport Safety and Standards at (202) 267-5383.

Subject: AC 150/5345-43J Date: _____

Please check all appropriate line items:

☐ An error (procedural or typographical) has been noted in paragraph _____ on page _____.

☐ Recommend paragraph _____ on page _____ be changed as follows:

_____
_____
_____

☐ In a future change to this AC, please cover the following subject:
(Briefly describe what you want added.)

_____
_____
_____

☐ Other comments:

_____
_____
_____

☐ I would like to discuss the above. Please contact me at (phone number, email address).

_____
_____
_____

Submitted by: _____ Date: _____

FAA
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Errata Sheet for Advisory Circular (AC) 150/5345-43J, Specification for Obstruction Lighting Equipment

Last Update: 4/29/2019

This errata sheet logs content errors and required updates identified after the Advisory Circular was signed on March 11, 2019. These errors have been corrected in the consolidated PDF version of the AC available on the FAA website.

#	Description of Correction	Location in Document	Rationale	Date Error Corrected
1	Remove - *Note: In the event of a failure of the IR emitter, the visible light must remain energized and an alarm signal must be generated to provide indication of the failure. The IR emitter must be monitored in accordance with the monitoring requirements for FLASH/FAIL status of L-864, L-810 visible light units in paragraph 3.3.5.1.1*.	3.4.1.1.1 note	Clarifies that IR emitter and RED LED fail can be either couple or de-coupled.	4/29/2019
2	Remove standalone sentence - *IR specifications are stated*	3.4.1.1.1	Sentence is redundant and out of place as it is repeated at the end of the next paragraph.	4/29/2019

	below to resolve the issues precluding the acquisition of red LED fixtures by pilots using NVGs with a Class B filter.			