U.S. Department of Transportation
Federal Aviation Administration

DEPARTMENT OF TRANSPORTATION
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Advisory Circular

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Subject: SPECIFICATION FOR OBSTRUCTION LIGHTING EQUIPMENT

Date: 7/15/88
Initiated by: AAS-200

AC No: 150/5345-43D
Change:

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1. PURPOSE. This advisory circular (AC) contains the Federal Aviation Administration (FAA) specification for obstruction lighting equipment.

2. EFFECTIVE DATE. Effective 6 months after the date of this circular, only that equipment qualified in accordance with this specification will be listed in AC 150/5345-1, Approved Airport Equipment.

3. CANCELLATION. AC 150/5345-43C, Specification for Obstruction Lighting Equipment, dated June 10, 1980, is cancelled.

4. APPLICATION. This specification is recommended for all applications involving obstruction lighting equipment. The specification is mandatory for obstruction lighting equipment funded under a Federal grant assistance program.

5. DEFINITIONS.

a. Beam Spread. Beam spread is the angle between the two directions in the plane in which the intensity is equal to 50 percent of the specified peak beam intensity.

b. Vertical Aiming Angle. The angle formed between the horizontal and a line through the center of the vertical beam spread.

c. Steady-Burning (fixed) Light. A light having constant luminous intensity when observed from a fixed point.

d. Effective Intensity. The effective intensity of a flashing light is equal to the intensity of a steady-burning (fixed) light of the same color which produces the same visual range under identical conditions of observation.

6. PRINCIPAL CHANGES. The following significant changes have been made in this circular:

a. The high intensity flashing white obstruction light, 60 flashes per minute, has a new designation: L-857.

b. The flashing red obstruction light, previously designated as L-866 (red), has been changed to L-864 to minimize confusion with the L-866 (white) flashing beacon.

c. The medium intensity flashing white obstruction light, 40 flashes per minute, has a new designation: L-865.

d. The medium intensity flashing white obstruction light, 60 flashes per minute, has a new designation: L-866.

e. The effective intensity for nighttime mode of the flashing white obstruction lights has been reduced from 4,000 to 2,000 candelas.

f. The effective intensity for nighttime mode of the flashing red beacon has been raised from 1,500 to 2,000 candelas.

g. The lower edge of the L-864, L-865, and L-866 vertical beam spread has been changed from (-1.0 to +1.5 degrees) to (-1.5 to -0.5 degrees).

h. For discharge flashing lights, the low and high temperature tests have been modified to require full light output at the temperature extremes while the input voltage is simultaneously varied by ±10 percent from nominal.

i. A salt fog test has been included.

j. The steady-burning red light, L-810, has been divided into two classes.

7. METRIC UNITS. To promote an orderly transition to metric (SI) units, this AC contains both English and metric dimensions. The metric conversions may not be exact, and until there is an official changeover to the metric system, the English dimensions will govern.

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SPECIFICATION FOR OBSTRUCTION LIGHTING EQUIPMENT

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 permit early identification by pilots.

1.2 Equipment Classification.

Type	Description
L-810	Steady-burning red obstruction light
	Class 1: Low intensity
	Class 2: High intensity
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, 20-40 FPM
L-865	Medium intensity flashing white obstruction light, 40 FPM
L-866	Medium intensity flashing white obstruction light, 60 FPM

2. APPLICABLE DOCUMENTS.

2.1 General. The following documents, of the issue in effect on the date of application for qualification, form a part of this specification and are applicable to the extent specified herein.

2.2 FAA Advisory Circulars.

AC 70/7460-1	Obstruction Marking and Lighting
AC 150/5345-1	Approved Airport Equipment

2.3 Military Standards and Specifications.

MIL-STD-810	Environmental Test Methods
MIL-C-7989	Covers, Light-Transmitting, for Aeronautical Lights, Guide Specification for

(Copies of FAA advisory circulars may be obtained from the Department of Transportation, Utilization & Storage Section, M-443.2, 400 7th Street, SW., Washington, D.C. 20590.)

(Copies of Military standards and specifications may be obtained from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Attention: Code CDS, Philadelphia, Pennsylvania 19120.)

3. REQUIREMENTS.

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

3.2 Environmental Requirements. Obstruction lighting equipment shall be designed for continuous operation under the following conditions:

a. **Temperature.** -67° F (-55° C) to +130° F (+55° C).

b. **Humidity.** 95 percent relative humidity.

c. **Wind.** Wind speeds up to 150 mph (240 kph).

d. **Wind-blown Rain.** Exposure to wind-blown rain from any direction.

e. **Salt Fog.** Exposure to salt-laden atmosphere.

3.3 Design Requirements.

3.3.1 Light Unit. The light unit shall be compact, lightweight, and designed for easy lamp replacement. Materials used within the light unit shall be selected for compatibility with their environment.

3.3.2 Light Covers. Light-transmitting covers for light units shall conform to the requirements of MIL-C-7989.

3.3.3 Light Colors. Red light systems shall emit aviation red light defined in accordance with the International Commission on Illumination (C.I.E.) Chromaticity Diagram as "y" co-ordinate not exceeding 0.335. Xenon flashtube emission is acceptable for white obstruction lights.

3.3.4 Aiming (for L-856 and L-857). Light units shall have a method for adjustment of the vertical aiming angle between 0 and +8 degrees. A spirit level or other device shall be provided as part of each light unit for setting the elevation angle of the light beam, and an indicator shall show the elevation angle with an accuracy of 1 degree.

3.3.5 Control Unit.

3.3.5.1 White Obstruction Lighting Systems.

3.3.5.1.1 Medium Intensity Lights. The control unit shall set the system's flash rate, flash sequence, and light intensity. The power and control functions may be consolidated in a single box with the light unit or may be distributed into several discrete units.

3.3.5.1.2 High Intensity Lights. The control unit shall set the system's flash rate, flash sequence, and light intensity. The system shall be designed for operation with light units located up to 2,500 feet (800 m) from the control unit. If the timing circuit fails, the light units shall continue to flash randomly or in accordance with Table 6. Failure of an intensity step change circuit shall cause all light units to operate at the high intensity step. An override switch shall be mounted on the control unit to manually control light intensity during maintenance or in the event of a photoelectric control malfunction.

3.3.5.1.3 Monitoring. The control unit shall monitor the specified operating mode of the flash lamp in a system. The operating status of each light unit in the system shall be displayed at the control unit. The control unit shall have provisions to permit connection to a remote indicator, supplied by others or as an option, which indicates the system status.

3.3.5.2 Red Obstruction Lights. Control units for these light systems are optional. When provided, control units shall be capable of providing one or more of the following functions:

a. On/Off photoelectric control.

b. Lamp failure monitor/remote display.

3.3.6 Input Voltage. The obstruction lighting equipment shall be designed to operate from the specified input voltage ±10 percent.

3.3.7 Transient Protection. The power input, control, and monitor interface circuitry shall be designed to withstand line to ground surges up to 5 kv for 10 milliseconds (ms) duration.

3.3.8 Warning Labels. All enclosures which contain voltages exceeding 150 volts shall have high voltage warning label(s) placed at a conspicuous location(s).

3.3.9 Interlock Switches. Interlock switches shall be incorporated in the control unit and power supplies so that opening the enclosure shall (1) disconnect incoming power and (2) discharge all high voltage capacitors to 50 volts or less within 30 seconds.

3.3.10 Nameplate. A nameplate, with the following information, shall be permanently attached to each unit (light unit, control unit, power supply, etc.) :

a. Name of unit (light unit, control unit, etc.).

b. FAA type (L-856, L-864, etc.).

c. Manufacturer's catalog number.

d. Manufacturer's name and address.

In addition to the above, the power supply shall include nominal input voltage, number of phases, frequency, and peak volt-ampere (VA) rating.

3.3.11 Component Ratings.

3.3.11.1 Discharge Lighting Equipment. All components in discharge lighting equipment, including the flashtube, shall be designed for ease of servicing and to meet performance requirements for a minimum of 1 year without maintenance.

3.3.11.2 Incandescent Lighting Equipment. All components in incandescent lighting equipment, except lamps, shall be designed to meet performance requirements for a minimum of 1 year without maintenance. Lamps shall have a minimum rated life of 2,000 hours at rated voltage.

3.4. Performance Requirements.

3.4.1 Photometric.

3.4.1.1 General. The effective intensity for flashing lights shall be calculated in accordance with the following formula:

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

Where:

I_e = Effective intensity (Candela)

I = Instantaneous intensity (Candela)

t_1, t_2 = Integration limits (seconds). The limits of integration shall be selected so that the value of I_e is maximized.

For discharge flashing lights, the equipment shall provide the specified light output at the specified temperature extremes as the input voltage simultaneously varies by ± 10 percent from nominal. The light intensity and beam distribution requirements for obstruction lighting equipment are specified below. All intensities listed are effective intensities (except steady-burning red obstruction lights) measured at the flash rate specified in Table 6.

3.4.1.2 L-810 Light Unit. The center of the vertical beam spread shall lie between $+4$ and $+20$ degrees. Photometric requirements are defined in Table 1.

Table 1. L-810 Intensity Requirements

Class	Step	Beam Spread		Peak Intensity (candelas)
		Horizontal (degrees)	Vertical (degrees)	
1	Single	360	10 minimum	30-70
2	Single	360	10 minimum	71-150

3.4.1.3 L-856 Light Unit. The beam spread and effective intensity shall be in accordance with Table 2.

Table 2. L-856 Intensity Requirements

Step	Beam Spread		Peak Intensity (candelas)
	Horizontal (degrees)	Vertical (degrees)	
Day	90 or 120(1)	3 - 7	270,000±25%
Twilight	90 or 120(1)	3 - 7	20,000±25%
Night	90 or 120(1)	3 - 7	2,000±25%

3.4.1.4 L-857 Light Unit. Photometric requirements are defined in Table 3.

Table 3. L-857 Intensity Requirements

Step	Beam Spread		Peak Intensity (candelas)
	Horizontal (degrees)	Vertical (degrees)	
Day	90 or 120(1)	3 - 7	140,000±25%
Twilight	90 or 120(1)	3 - 7	20,000±25%
Night	90 or 120(1)	3 - 7	2,000±25%

NOTE: (1) Multiple light units may be used to achieve a horizontal coverage (180 or 360 degrees).

3.4.1.5 L-864 Light Unit. The vertical beam spread shall be 3 degrees minimum. The lower edge of the vertical beam spread shall lie between -1.5 and -0.5 degrees.

Table 4. L-864 Intensity Requirements

Step	Beam Spread		Peak Intensity (candelas)
	Horizontal (degrees)	Vertical (degrees)	
Single	360	3 minimum	2,000±25%

3.4.1.6 L-865 Light Unit. The vertical beam spread shall be 3 degrees minimum. The lower edge of the vertical beam spread shall lie between -1.5 and -0.5 degrees. Photometric requirements shall be in accordance with Table 5.

Table 5. L-865 Intensity Requirements

Step	Beam Spread		Peak Intensity (candelas)
	Horizontal (degrees)	Vertical (degrees)	
Day/Twilight	360	3 minimum	20,000±25%
Night	360	3 minimum	2,000±25%

3.4.1.7 L-866 Light Unit. Photometric requirements are the same as the L-865 light unit, except the flash rate, shall be 60 FPM.

3.4.2 Flash Rate and Duration. Flash rate and duration for obstruction lights shall be as specified in Table 6.

Table 6. Flash characteristics for obstruction lights

Type	Intensity Step	Flash Rate [1]	Flash Duration [2]
L-856	Day & Twilight	40 FPM	Less than 10 ms
L-856	Night	40 FPM	Between 100 and 250 ms inclusive
L-857	Day & Twilight	60 FPM	Less than 10 ms
L-857	Night	60 FPM	Between 100 and 250 ms inclusive
L-864	Single	20-40 FPM	1/2 to 2/3 of flash period [3]
L-865	Day & Twilight	40 FPM	Less than 10 ms
L-865	Night	40 FPM	Between 100 and 250 ms inclusive
L-866	Day & Twilight	60 FPM	Less than 10 ms
L-866	Night	60 FPM	Between 100 and 250 ms inclusive

NOTES:
[1] Flash rates have a tolerance of ±5 percent.
[2] When the effective flash duration is achieved by a group of short flashes, the short flashes shall be emitted at a rate of not less than 30 per second.
[3] The light intensity during the "off" period shall be less than 10 percent of the peak effective intensity. The "off" period shall 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 L-856, and/or L-864, and/or L-865 light units shall flash simultaneously. The flash rate shall be as defined in Table 6.

3.4.3.2 Sequenced Flashing Systems. Systems composed of L-857 or L-866 light units shall have a sequenced flashing characteristic. 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. The flash sequence shall be middle, top, and bottom. The interval between top and bottom flashes shall be about twice the interval between middle and top flashes. The interval between the end of one sequence and the beginning of the next shall be about 10 times the interval between middle and top flashes. The time for the completion of one cycle shall be 1 second (±5 percent).

3.4.4 Intensity Step Changing.

3.4.4.1 White Obstruction Lights. The light unit intensity shall be controlled by a photocell facing the northern sky. White obstruction lights shall automatically change intensity steps when the ambient light changes as follows:

a. From day intensity to twilight intensity when the illumination decreases below 60 footcandles but before it reaches 35 footcandles.

b. From twilight intensity to night intensity when the illumination decreases below 5 footcandles but before it reaches 2 footcandles.

c. From night intensity to twilight intensity when the illumination increases above 2 footcandles but before it reaches 5 footcandles.

d. From twilight intensity to day intensity when the illumination increases above 35 footcandles but before it reaches 60 footcandles.

3.4.4.2 Red Obstruction Lights. If automatic control is utilized, the light unit shall turn on when the ambient light in the northern hemisphere decreases to not less than 35 footcandles and turn off when the ambient light in the northern hemisphere increases to not more than 60 footcandles. 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 shall turn off and red obstruction lights shall turn on when ambient light changes from twilight to night as specified in paragraph 3.4.4.1.b. Red obstruction lights shall turn off and white obstruction lights shall turn on when ambient light changes from night to twilight as specified in paragraph 3.4.4.1.c.

3.5 Instruction Manual. An instruction manual containing the following information shall be furnished with all obstruction lighting equipment.

a. Complete system schematic and wiring diagrams showing all components cross-indexed to the parts list. (If the obstruction light is provided as a single light unit, this requirement is omitted).

b. Complete parts list of field replaceable parts with applicable rating and characteristics of each part and with the component manufacturer's part number.

c. Installation instructions, including leveling and aiming of light units.

d. Maintenance instructions, including relamping, theory of operation, and troubleshooting charts.

e. Operating instructions.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Qualification Procedures. The procedure for obtaining qualification approval is contained in Appendix 2 of AC 150/5345-1, Approved Airport Equipment.

4.2 Qualification Tests. Photometric and system operational tests shall be conducted after completion of all environmental tests. The same unit(s) shall 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 shall be complete with optional equipment.

4.2.1 High Temperature Test. The high temperature test shall be conducted in accordance with MIL-STD-810, Method 501.2, Procedure II. The equipment shall be subject to a constant temperature of at least

+130° F (+55° C) for 4 hours after temperature stabilization. The equipment then shall be turned on for testing. During the test, the manufacturer shall demonstrate that the equipment maintains the proper flash rate and (for discharge flashing light) the proper amount of energy is being delivered to the lamp as the input voltage is varied by ±10 percent from nominal. A visual examination shall be conducted after the equipment is removed from the chamber. Failure of the equipment to operate properly or any deterioration in materials shall constitute failure of the test.

4.2.2 Low Temperature Test. The low temperature test shall be conducted in accordance with MIL-STD-810, Method 502.2, Procedure II. The equipment shall be placed in a chamber which maintains a temperature of -67° F (-55° C) or less. Equipment operation shall be demonstrated at the beginning of the test. The equipment shall then be exposed to a 24-hour soaking period after which the equipment shall be turned on for 1 hour, and shall achieve proper flash rate and intensity within 30 seconds after being energized. During 1 hour of operation, the manufacturer shall demonstrate that the equipment maintains the proper flash rate and (for discharge flashing light) the proper amount of energy is being delivered to the lamp as the input voltage is varied by ±10 percent from nominal. At the conclusion of the test, a visual inspection shall be conducted. Failure of the equipment to operate properly or any deterioration in materials shall constitute failure of the test.

4.2.3 Rain Test. The wind-blown rain test shall be conducted in accordance with MIL-STD-810, Method 506.2, Procedure I. The rain shall be at a rate of 5.2 inches per hour (130 mm/hour) with an exposure time of 30 minutes per side. The equipment shall be operated throughout the test. Failure of the equipment to operate properly, or any deterioration in materials, or excessive accumulation of water in the equipment shall constitute test failure.

4.2.4 Wind. Evidence shall be provided, either by testing or by calculations, to demonstrate that installed light units meet the wind requirement in paragraph 3.0.

4.2.5 Humidity Test. The test shall be in accordance with MIL-STD-810, Method 507.2, Procedure I. The equipment shall be subjected to three complete cycles (72 hours) according to Table 507.2-I, except the maximum temperature at Cycle 1 shall be +130° F (+55° C). Failure of the equipment to operate properly or any deterioration in materials shall constitute test failure.

4.2.6 Salt Fog Test. The salt fog test shall be conducted in accordance with MIL-STD-810, Method 509.2, Procedure I. Failure of the equipment to operate properly or any evidence of damage, rust, or corrosion in materials shall constitute test failure.

4.2.7 Photometric Test. Light units shall be energized by system power supply and control unit, and shall be tested for compliance with photometric requirements. For discharge flashing light, the specified intensity shall be produced at high and low temperature extremes as the input voltage to the system power supply varies by ±10 percent from nominal. 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 particular source. If more than one lamp type is to be used, the qualification testing shall be completed for each lamp type. For discharge flashing system, if the power supply and light unit are separate components, the manufacturer shall 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. Photometric test results shall be in the forms of:

a. Vertical beam pattern: Distribution curve (vertical angle versus candelas).

b. Horizontal beam pattern: Polar plot (horizontal angle versus candelas).

4.2.8 System Operational Test. System components shall 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 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 impedances may be used in lieu of full cable lengths. The system shall 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 interlock devices, and satisfactory operation under input voltage variations. If the light unit and power supply are separate components, it shall be demonstrated that with the maximum recommended separation between components, sufficient energy is

delivered to the light unit to produce the specified photometrics. This test shall be modified to verify the specific requirements for single L-810 and a system composed of L-810 and L-864.

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

4.3 Production Test.

4.3.1 System Production Tests. Each component of the system shall be energized and tested to verify proper operation. Discharge flashing light units shall be checked photometrically to verify each level of specified light output. A visual examination shall be performed for all components in a system to verify proper materials and assembly.

4.3.2 Single Light Unit Production Sampling Tests. Random sampling production tests shall be performed on at least 10 percent of purchase order quantity for all single light unit orders. For orders less than 10 units, at least 1 item shall be tested. The sample(s) shall be energized and tested to verify specified peak intensity. All single light units shall be visually examined for proper materials and assembly.