ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
Federal Aviation Administration
Washington, D.C.

Subject: SPECIFICATION FOR OBSTRUCTION LIGHTING EQUIPMENT

1. PURPOSE. This advisory circular contains the specification for equipment used in obstruction lighting systems.

2. EFFECTIVE DATE. Effective December 10, 1980, only that equipment qualified in accordance with the specification herein will be listed in AC 150/5345-1, Approved Airport Lighting Equipment.

3. PRINCIPAL CHANGES. Significant changes included in this revised advisory circular include the following:

a. Inclusion of all obstruction lighting equipment into one equipment specification.

b. Creation of a new equipment category (L-866) consisting of flashing beacons that were covered by the old L-856 and CAA-446 specifications.

c. Deletion of restrictions that limit application of state-of-the-art techniques to obstruction light design.

4. CANCELLATION. The following documents are cancelled:

a. AC 150/5345-2, Specification for L-810 Obstruction Light, dated 11/4/63.

b. AC 150/5345-43B, FAA/DOD Specification L-856, High Intensity Obstruction Lighting Systems, dated 11/1/73.

c. Specification CAA-446, Specification for Code Beacons, dated 7/1/42.

5. METRIC UNITS. To promote an orderly transition to metric units, the specification includes both English and metric dimensions. The metric conversions may not be exact equivalents, and until an official changeover to metric units is effected 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 requirements for obstruction lighting equipment used to provide obstruction warnings to aircraft pilots.

1.2 Classification. Three types of equipment are covered by this specification.

Type	Description
L-856	High intensity flashing white lights
L-866	Medium intensity flashing red or white lights
L-810	Red steady-burning lights

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 Federal Aviation Administration (FAA) Publications.

FAA-G-2100/1	Electronic Equipment, General Requirements; Basic Requirements for all Equipments
FAA-STD-013	Quality Control Program Requirements
AC 70/7460-1	Obstruction Marking and Lighting

2.3 Military Standards and Specifications.

MIL-STD-810	Environmental Test Methods
MIL-C-7989	Covers, Light-Transmitting, for Aeronautical Lights, Guide Specification for
MIL-C-25050 (ASG)	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for

2.4 Other Publications.

Illuminating Engineering Society (IES)

IES Guide for Calculating the Effective Intensity of Flashing Signal Lights, published in Illuminating Engineering, Volume LIX, page 747 (November 1964)

(Copies of FAA specifications and standards may be obtained from the Federal Aviation Administration, Airway Facilities Service, Washington, D.C. 20591.)

(Copies of FAA advisory circulars may be obtained from the Department of Transportation, Publications Section, M-443.1, Washington, D.C. 20590.)

(Copies of military specifications and standards may be obtained from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120, Attention: Code 1052.)

(Copies of IES documents may be obtained from the Illuminating Engineering Society, 345 East 47th Street, New York, New York 10017.)

3. REQUIREMENTS.

3.1 General. The lighting units specified herein are to be used in obstruction lighting systems as specified in Advisory Circular 70/7460-1, Obstruction Marking and Lighting. That advisory circular gives detailed descriptions of the four systems listed below. The systems are listed here solely to allow description of the photometric characteristics, flash sequence, and construction of the component lighting equipment. For criteria concerning the type of system to be used, configuration, spacing of lights, number of levels, etc., see the above referenced advisory circular. While L-856 and L-866 lights are typically used in a system, the L-810 may be used independently for miscellaneous obstruction lighting at the discretion of the user. When not used as part of a System C, specified in AC 70/7460-1, the L-810 has less stringent requirements. A distinction is made in this specification between single L-810 requirements and System C requirements.

(a) System A. System A is a high intensity obstruction lighting system using L-856s for day and night marking of chimneys, poles, towers, and similar structures. When an antenna or similar appurtenance is installed on top of the structure, a white L-866 light may be required at the highest point. Additionally, AC 70/7460-1 describes a System A using L-866 white lights to provide twilight/night marking for structures.

(b) System B. System B is a high intensity obstruction lighting system using L-856s for day and night marking of powerline supporting structures. Additionally, AC 70/7460-1 describes a System B using L-866 white lights to provide twilight/night marking for catenaries.

(c) System C. System C is a red obstruction lighting system utilizing L-810s and a red L-866.

(d) System D. System D is a dual obstruction lighting system using a System A or System B for day and twilight operation and a System C for night operation.

3.2 Equipment Covered. The following components are covered by this specification for obstruction lighting systems:

(a) Light units.

(b) Power supplies.

(c) Control unit (including photoelectric control).

(d) Instruction book.

3.2.1 Connecting Cables. Cables for interconnection of system components are not included in this specification; however, the instruction book shall contain full information concerning interconnecting cable requirements.

3.3 Environmental Conditions. Each component shall be designed and constructed for continuous outdoor operation under the following conditions:

(a) A temperature range of -50°C to +55°C (supplemental heat may be provided in any unit to meet the low temperature requirements).

(b) Relative humidity up to 95 percent.

(c) Exposure to rain, snow, hail and sleet (components designed for indoor mounting exempted).

(d) Windspeeds up to 150 mi/h (241 km/h) (any mounting hardware supplied is included in this requirement).

3.4 Design Requirements.

3.4.1 Light Units. The light units shall be designed to be as small and light-weight as feasible and to provide minimum wind resistance when installed. Multiple light units may be used to obtain the required horizontal light coverage at each level. Failure of any light unit shall not affect the operation of other light units.

3.4.1.1 Light Beam Adjustment. The L-856 light units shall have a method of adjustment so the center of the light beam can be easily set to any vertical elevation between 0° and +8°. 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°. If the L-866 or L-810 design is not omnidirectional, a similar beam adjustment system must be provided.

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

3.4.2 Voltage. The equipment shall operate from a single phase 60 Hz ac source. Systems A and B shall handle voltage variations of ±10 percent from the nominal value while providing the illumination specified in 3.5.1. Systems A, B, and D shall operate from at least one of the following voltages: 480, 240, 208, or 120 volts. System C shall be powered by a 240- or a 120-volt supply. The L-810 shall operate either from a 120-volt supply or from a 6.6-ampere series supply.

3.4.3 Control Unit.

3.4.3.1 System A and System B. The control unit shall control the system's flash rate, intensity, and sequence. The control unit shall have a display panel to indicate the status of the full system, of the timing circuit, and of each light unit. The control unit shall be suitable for installation at a circuit distance up to 2,500 feet (800 m) from the lowest light on a structure. Failure of the control unit shall not cause the system to be inoperative. In the event the timing circuit fails to synchronize the lights, the status panel shall indicate the failure and the lights shall continue to flash but may flash in a random order. Failure of an intensity step change circuit in the control unit shall cause all lights to operate in a higher intensity mode. An override switch shall be mounted on the control unit to manually control light intensity during maintenance or in the event of a malfunction of the automatic intensity changing circuitry.

3.4.3.2 System C. The control unit, if required, shall control the automatic on/off operation. Single L-810 units may be installed without a control unit.

3.4.3.3 System D. A combination system control unit shall meet the requirements of each subsystem control unit.

3.4.4 Transient Suppression. Transient suppression shall be provided per FAA-G-2100/1 (paragraph 1-3.3.4) for all solid state equipment. In addition, transients caused by lightning, induction, static, switching, electromagnetic interference, etc., shall be suppressed. As a minimum, equipment mounted on or connected to the tower shall withstand a 2.5-kV potential between the electrical ground and any control or power conductor for a period of 10 milliseconds (ms). L-810 units are exempted.

3.4.5 Interlock Switches. Cover-operated interlock switches shall be incorporated in any discharge light power supply. These switches shall discharge any high-voltage capacitor to 50 volts or less within 30 seconds after the housing cover is opened or removed.

3.4.6 Warning Signs. Warning signs shall be located on the equipment near exposed points having a potential of 150 volts or more to warn maintenance personnel.

3.4.7 Identification. Identification data shall be permanently affixed to each equipment unit (light fixture, power supply, control unit, etc.) and shall contain at least the following minimum information. The system designation is not applicable to single L-810 units.

(a) Name of unit (light unit, power supply, etc.).

(b) Type of fixture (L-810, L-856, or L-866).

(c) System (A, B, C, or D).

(d) Manufacturer's name and address.

3.4.8 Maintenance. For the purpose of this section, a system shall be defined as at least 12 light units, a power supply, and a control unit.

3.4.8.1 Discharge Lighting Equipment. All components in discharge lighting equipment, including the light source, shall be designed for ease of maintenance and to provide the specified performance for a period of at least 1 year without maintenance. With preventive maintenance performed on an annual basis, the system mean-time-between-failure shall be not less than 6 months.

3.4.8.2 Incandescent Lamps. Incandescent lamps shall have a rated life of no less than 2,000 hours at rated voltage. Other components of incandescent lighting equipment shall be designed to provide the required performance for a period of at least 1 year. With preventive maintenance performed on an annual basis, the system mean-time-between-failure shall be not less than 6 months.

3.4.9 Optional Items. The following items are required for qualification but need not be furnished unless requested by the customer:

(a) Remote Monitoring Pickup Points. For Systems A and B, provide terminals within the control unit to allow for remoting the operational condition of the lighting system and to signal a malfunction in the event of one or more system failures.

(b) Series L-810. Provide an L-810 fixture with 6.6-ampere series lamp instead of a 120-volt lamp. All other requirements remain unchanged.

(c) Double L-810. Provide two L-810 fixtures mounted on a single standard to meet the redundancy requirements of AC 70/7460-1. Each fixture shall meet the requirements for single L-810 lights.

(d) Locking Provision. Provide provision for locking all units, except the L-810, with a padlock or a built-in lock.

(e) Light Shields. For L-856 units, provide light shields to enhance the vertical cutoff beneath the beam.

3.4.10 Alternate Input Power. Where requested by the user, the obstruction lighting system may be designed for input voltages and frequencies other than those specified.

3.5 Performance Requirements.

3.5.1 Effective Intensity. The following tables show the required intensities for the light units when used in particular systems. The beam spread refers to the area which must achieve at least the minimum intensity of illumination. The vertical beam spread is measured at zero degree horizontally, and the horizontal beam spread is measured at zero degree vertically. The vertical beam spread establishes a range of values from which the designer may choose. All intensities listed are effective intensities measured at the specified flash rate. Intensity is measured at rated input and lamp socket voltage.

Table 1. L-856 System A

	Beam spread		Intensity	
Step	Vertical (degrees)	Horizontal(1) (degrees)	Minimum	Peak
Day	3-7	360	100,000 cd	200,000 cd minimum
Twilight	3-7	360	7,500 cd	20,000 cd ±25%
Night	3-7	360	1,500 cd	4,000 cd ±25%

Table 2. L-856 System B

	Beam spread		Intensity	
Step	Vertical (degrees)	Horizontal(1,2) (degrees)	Minimum	Peak
Day	3-7	180 or 360	50,000 cd	100,000 cd minimum
Twilight	3-7	180 or 360	7,500 cd	20,000 cd ±25%
Night	3-7	180 or 360	1,500 cd	4,000 cd ±25%

Table 3. L-866 flashing obstruction light

Step	Beam Spread		Intensity	
	Vertical(3) (degrees)	Horizontal(1) (degrees)	Minimum	Peak
Day/ Twilight	3 minimum	360	7,500 cd	20,000 cd ±25%
Night	3 minimum	360	1,500 cd	4,000 cd ±25%
Night	3 minimum	360	450 cd	1,500 cd ±25%(4)

Table 4. L-810 steady-burning obstruction light

Beam Spread		Intensity(4)	
Vertical (degrees)	Horizontal (degrees)	Minimum	Peak
10 minimum	360	14 cd	32.5 cd ±25%

(1) Multiple lights may be used to achieve coverage.

(2) The required horizontal beam spread for a particular installation is detailed in AC 70/7460-1.

(3) The bottom cutoff for the vertical beam spread must lie between -1° and +1.5°. The top cutoff is unlimited.

(4) Intensity in aviation red.

3.5.2 Flash Rate and Sequence. The flash rates shall be as specified below within a tolerance of ±5 percent.

(a) System A. All light units on a structure including a white L-866 obstruction light shall flash simultaneously at 40 flashes per minute. On the day intensity step, the effective flash duration shall not exceed 20 ms; on the twilight intensity step, the effective flash duration shall not exceed 250 ms; and on the night intensity step, the effective flash duration shall be at least 100 ms but not more than 250 ms.

(b) System B. With three light levels installed on a structure, one near the top, one near the middle of the catenary, and one near the bottom of the catenary, the flash sequence shall be such that the middle light flashes first, the top light flashes next, and the bottom light flashes last. The interval between the top light and the bottom light shall be about twice as long as between the middle light and top light. The interval between the end of one sequence and the beginning of

the next shall be about 10 times the interval between the middle and top lights. The flash duration shall be not more than 20 ms for the day and 100 ms for the twilight intensity positions and shall have an effective flash duration of approximately 100 ms for the night intensity position. Each light unit of the system shall flash at a rate of 60 flashes per minute.

(c) System C. All lights are red and are steady burning or a combination of steady burning and flashing. The lights operate at a single intensity. Incandescent flashing lights shall operate between 20 and 40 flashes per minute. Discharge flashers shall operate at 40 ±1 flashes per minute. Length of flash shall be not less than 1/2 nor more than 2/3 of the flash period. 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.

3.5.3 Intensity Change.

3.5.3.1 High Intensity Lights. System A, including a white L-866 obstruction light, and System B shall automatically change intensity when incident light on a photocell facing the north sky changes as follows. During intensity change, not more than two flashes or flash sequences shall be skipped. The design shall prevent change of the intensity step during short periods (less than 1 second) of illumination change due to lightning, stray light flashes, or abrupt shadows.

(a) From day to twilight intensity when the illumination decreases below 60 footcandles but before it has decreased to 30 footcandles.

(b) From twilight intensity to night intensity when the illumination decreases below 5 footcandles but before it has decreased to 2 footcandles.

(c) From night intensity to twilight intensity when the illumination increases above 2 footcandles but before it has increased to 5 footcandles.

(d) From twilight intensity to day intensity when the illumination increases above 30 footcandles but before it has increased to 60 footcandles.

3.5.3.2 Red Obstruction Lights. If automatic control is utilized, the System C shall turn on when the incident light on a photocell facing the north sky decreases to not less than 35 footcandles and turn off when incident light increases to not more than 58 footcandles. Single L-810s are controlled in a manner compatible with the particular installation.

3.5.3.3 Dual System. When a dual system is used, the white lights will turn off and the red lights will turn on when intensity changes from twilight to night; and the red lights will turn off and the white lights will turn on when intensity changes from night to twilight.

3.5.4 Light Color. The color of light emitted by System A and System B shall be white. Xenon gas emission meets white color requirements. The color of light emitted by System C and L-810s shall be aviation red as defined in MIL-C-25050 (ASG).

3.6 Instruction Manual. An instruction manual containing the following information shall be furnished with each system. Single L-810 units are exempted from this requirement.

(a) Complete schematic and wiring diagrams showing all components cross-indexed to the parts list.

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

(c) Installation instructions.

(d) Maintenance instructions, including theory of operation and trouble-shooting charts.

(e) Operating instructions.

4. QUALITY ASSURANCE PROVISIONS.

4.1 Qualification Requirements.

4.1.1 Qualification Request. Requests for qualification approval must be submitted in writing to the Office of Airport Standards, Attention: AAS-200, Federal Aviation Administration, Washington, D.C. 20591. Requests must include:

(a) A list of the types of equipment, along with the manufacturer's catalog numbers, for which qualification approval is requested. A list of equipment options should also be included when specified in individual equipment specifications.

(b) A copy of the proposed test procedures and the test data sheets and a statement as to whether the manufacturer proposes to conduct tests or name and location of the independent testing laboratory where the tests are to be conducted (4.1.2).

(c) A copy of the manufacturer's proposed guarantee for the equipment (4.1.4).

(d) A copy of manufacturer's quality control plan (4.1.3).

(e) A preliminary copy of the equipment instruction manual (4.1.5).

4.1.2 Qualification Testing. The equipment must pass all tests in 4.2. The manufacturer shall supply all test equipment and bear all testing costs. Tests may be conducted at the manufacturer's plant if facilities are available or at an independent test laboratory acceptable to the FAA. The FAA reserves the right to witness any or all tests and must be given 2 weeks advance notice of scheduled tests. The manufacturer must submit a certified copy of all test reports.

4.1.3 Quality Control Provisions. The manufacturer shall provide and maintain a quality control program in accordance with FAA-STD-013 except that facilities for an FAA Quality Assurance Representative are not required.

4.1.4 Guarantee. The manufacturer shall provide the following minimum guarantee for each equipment: That the equipment has been manufactured and will perform in accordance with this specification and that any defect in design, material, or workmanship which may occur during proper and normal use during a period of 1 year from date of initial operation or a maximum of 2 years from date of shipment will be corrected by repair or replacement by the manufacturer f.o.b. factory.

4.1.5 Instruction Manual. The preliminary instruction manual will be reviewed to assure compliance with 3.6, and recommended changes, if any, will be forwarded to the manufacturer. The manufacturer shall incorporate recommended changes and submit 13 copies of the final instruction manual to the FAA prior to receiving qualification approval. These instruction manuals will be used by FAA personnel to monitor equipment as delivered to prevent nonapproved modification. For single L-810s, installation instructions will be provided in place of an instruction manual.

4.1.6 Qualification Approval. Manufacturers who have met all requirements specified herein will be listed as approved suppliers in AC 150/5345-1, Approved Airport Lighting Equipment. Once equipment is on the list of approved equipment, any changes to the equipment that are not approved by the FAA will cause removal of the equipment from the list. Requests for design or component changes must be submitted to the office listed in 4.1.1 and must be accompanied by supporting documentation for the change. Prior to final approval, 13 copies of the revised instruction manual pages which reflect the proposed change must be submitted. Substitution of components which are equal or better in rating, size, and quality does not require prior FAA approval.

4.2 Qualification Tests.

4.2.1 Visual Examination. The equipment shall be visually inspected for conformance to the applicable design requirements of FAA-G-2100/1. Particular attention shall be paid to quality of workmanship.

4.2.2 Operation Test. The 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 A and 500 feet (150 m) for System B, and the controller separated an additional 2,500 feet (750 m). One additional light shall be located electrically midway between the top and bottom light units. 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 and sequence, photoelectric switching of intensity steps, operation of interlock devices, and satisfactory operation under input voltage variations. This test shall be modified to verify the specific requirements for single L-810s and System C.

4.2.3 Photometric Test. The light units shall be tested to determine compliance with the system photometric requirments. The effective intensity shall be determined as shown in the "IES Guide for Calculating the Effective Intensity of Flashing Signal Lights." Additionally, the manufacturer shall provide certification that the lens meets the requirements in 3.4.1.2 and 3.5.4.

4.2.4 Rain Test. A rain test shall be conducted on the equipment in accordance with MIL-STD-810, Method 506.1, Procedure I. The equipment shall be operated during the last 10 minutes of the test. No water shall enter the equipment which could affect operation or performance.

4.2.5 High Temperture Test. The high temperature test shall be conducted in accordance with MIL-STD-810, Method 501.1, Procedure II. The equipment shall be operated at 55°C for 4 hours to assure no degradation of system performance. The manufacturer shall demonstrate that required light output is being achieved.

4.2.6 Low Temperature Test. The low temperature test shall be conducted in accordance with MIL-STD-810, Method 502.1 Procedure I. The system shall operate for 4 hours at low temperature (-50°C). The manufacturer shall demonstrate that required light output is being achieved.

4.2.7 Wind. Evidence shall be provided, either by testing or by calculations, to demonstrate that the installed light units meet the wind requirement in 3.3d.

4.2.8 Humidity. The test shall be in accordance with MIL-STD-810, Method 507.1, Procedure I, except the maximum temperature shall be 55°C and a total of three complete cycles (72 hours) will be required. The manufacturer shall demonstrate that required light output is being achieved.

4.2.9 Certification. The manufacturer shall provide certification that the system mean-time-between-failures is not less than 6 months and shall show the method of determining mean-time-between-failures. A system is defined in 3.4.8.

4.2.10 Production Tests.

4.2.10.1 Systems A, B, and D. The production units which compose a particular system shall be interconnected and operated as specified in 4.2.2 and 4.2.3.

4.2.10.2 System C and Single L-810s. The red L-866 light units shall be energized and checked for the flash rate and peak effective intensity. If used, the photoelectric on/off control shall be tested for operation within the specified light levels. Single L-810s shall be visually inspected for proper materials and assembly.