

UNITED STATES COAST GUARD
OCEAN ENGINEERING DIVISION
WASHINGTON, DC

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SPECIFICATION G-SEC 498A

MEDIUM-INTENSITY
LIGHT EMITTING DIODE (LED)
BUOY LANTERN

1. SCOPE. This specification describes the medium-intensity light emitting diode (LED) based buoy lanterns for marine aids-to-navigation. This specification will be used for a Commercial Off The Shelf (COTS) procurement of LED lanterns.

2. Commercial Standards: The lanterns shall meet either standards listed below:

European Standard EN 61000-4-2, Electromagnetic Compatibility, Electrostatic Discharge Immunity Test, Level 1, March 1995, and:

European Standard EN 61000-4-5, Electromagnetic Compatibility (EMC), Surge Immunity Test, Level 1, March 1995 (to order see: www.cenelec.org)

or:

Radio Technical Commission for Aeronautics (RTCA)

DO-160D Environmental Conditions and Test Procedures for Airborne Equipment, Test Level Category V, 29 July 1997.

(Application for copies should be addressed to Radio Technical Commission for Aeronautics, 1140 Connecticut Ave., NW, Suite 1020, Washington, DC 20036.)

3. PERFORMANCE REQUIREMENTS.

3.1. Mechanical: The design of the lantern shall be such as to restrict the ability of birds to roost on the lantern or any of its components

3.1.1 External dimensions: The lantern shall not exceed 500 mm in height, including bird deterrents, and shall not exceed 250 mm in diameter.

3.1.2 Focal Height: The lantern shall have a minimum focal height, defined as the distance from the base to the center of the LED array, of 150 mm. Use of a spacer to raise the focal height to the minimum requirement is acceptable.

3.1.3 Mass: The complete lantern assembly shall not exceed 10 kg in mass.

3.1.4 Mounting provisions: The base of the lantern shall have three bolt holes, equally spaced on a 200 mm diameter bolt circle. The bolt holes shall be 16 ± 1 mm in diameter, and may be elongated to form closed, arced slots. The bottom of the lantern base shall be parallel to the focal plane of the lantern.

3.1.5 Electrical power lead: The lantern shall include a jacketed, one-meter long external power lead, suitable for outdoor use. The power lead shall consist of two 12 AWG stranded wire conductors with a minimum insulation rating of 600V. Color-coding shall be black for positive (+) and white for negative (-). One end of the power lead may be terminated in the lantern, or if non accessible, with a connector, mated to a corresponding connector on the lantern housing. The other end of the power lead shall be cleanly cut. The connector (if used) shall be galvanically compatible with the lantern housing. The connector make, model, part number and suggested source of supply shall be indicated in the instructions to facilitate replacement.

3.1.6 Finish: External components, less the power lead, shall have a smooth finish, and shall be uniform in color and appearance. All external metallic pieces, with the exception of anodized

aluminum electrical connectors and stainless steel hardware, if used, shall be painted. Paints shall be selected to withstand the rigors of the marine environment.

3.2 Operation: Each lantern shall be delivered fully assembled. Application of power shall result in a fully operational beacon.

3.3 Optical Performance: The optical performance requirements listed herein shall be met for both red and green light signals. Lanterns that use rapidly pulsed LEDs to provide the light signal shall operate at frequencies equal to or greater than 100 Hz. Peak and effective intensities are to be measured after values stabilize to account for intensity reduction due to LED junction heating.

3.3.1 Peak intensity: The equivalent peak intensity of the light signal shall be 60 candela or greater omnidirectionally in the focal plane after stabilization when operated at 25 ± 5 degrees Centigrade. The rated peak intensity shall be determined by the value met or exceeded by 90% of the measured values. For lanterns using rapidly pulsed LEDs, the time-dependent output of the lantern shall be recorded, and the Talbot-Plateau Law shall be used to determine the corrected rated peak intensity.

3.3.2 Effective intensity: The effective luminous intensity of the light signal, for a flash characteristic with a 0.3 second duration for the flash interval, shall be 36 candela or greater when calculated using the method of Schmidt-Clausen.

3.3.3 Degradation: The lantern shall be designed to maintain at least 80% of the effective intensity (3.3.2) over 6 years of operation when operated at night with a 30% duty cycle.

3.3.4 Uniformity of output: The lantern shall produce an omnidirectional horizontal fan beam. The peak intensity of the beam, in any direction in the focal plane, shall not vary by more than $\pm 20\%$ from the mean (this requirement may require sorting of LEDs). The intensity profile about any lens molding seams shall not be less than 60% of the mean horizontal output over an angle of not more than 2 degrees.

3.3.5 Vertical divergence: The lantern shall have a minimum vertical divergence such that the angle between the 50 percent intensity points above and below the focal plane is not less than ± 4 degrees.

3.3.6 Signal colors: The light signal provided by the lantern (separate modules for red and green light signals) shall satisfy the following chromaticity requirements, in terms of the CIE 1931 Standard Colorimetric System:

Red:	Yellow boundary	$y = 0.335$
	Purple boundary	$y = 0.980 - x$
Green:	Yellow boundary	$y = 4.50 - 12.5 \cdot x$
	White boundary	$y = 1.54 \cdot x$
	Blue boundary	$y = 0.390 - 0.171 \cdot x$

3.4 Power requirements: The lantern shall operate properly with input voltages between 10.5 and 18 VDC. The nominal input shall be 12 VDC, as provided by existing U.S. Coast Guard solar-power systems outfitted with lead-acid batteries.

3.4.1 Power consumption—On: With the LED module energized, the total power requirement of the lantern shall not exceed 9 watts.

3.4.2 Power consumption—Off: With the LED module off, whether between flashes or during daytime hours, the total power requirement of the lantern shall not exceed 0.36 watts.

3.4.3 Low-voltage operation: If the input voltage drops below 10.5 VDC the lantern shall not be damaged.

3.5 Turn-Key System: When provided 12-volt DC power from an external source, no other devices shall be necessary to produce a complete marine aid-to-navigation light signal.

3.5.1 Reverse polarity protection: The lantern shall not experience damage in the event that power is connected in reverse polarity. The lantern shall resume proper operation as soon as the correct polarity is provided.

3.5.2 Short-circuit protection: The lantern shall have short-circuit protection so that connecting one of the power leads to the lantern housing while the other is attached to either the positive (+) or negative (-) terminal shall not result in damage to the lantern. The lantern shall resume proper operation as soon as the power leads are properly connected to the input terminals.

3.5.3 Characteristic control: Each lantern shall be capable of producing the minimum characteristics, outlined below, and shall include control circuitry to permit field selection of any desired characteristic. The timing of the light signal shall be within $\pm 5\%$ of the rated values, for all the environmental conditions outlined in this document. The controls needed to set or change the characteristic shall be incorporated into the lantern, and shall not require any additional device. The characteristics which the lantern must be capable of displaying are:

Characteristic	Timing ON/OFF (sec)	Duty Cycle (%)
Fl:	Fl2.5 (0.3)	12
	Fl4 (0.4)	10
	Fl6 (0.6)	10
	Fl2.5 (1)	40
Fl():	Fl(2+1)6	15
	Fl(2)5	16
	Fl(2)6	33
Q:	Q	30
Mo():	Mo(A)	30
Iso:	Iso2	50

	Iso6		3.0/3.0	50
Occ:	Occ4		3.0/1.0	75
Fixed	Fix		—	100

3.5.4 Daylight control: The lantern shall switch on and off at sunset and sunrise, respectively. At a minimum, the lantern shall switch on whenever the ambient illumination, measured on a horizontal plane, falls below 250 ± 50 lux. The lantern shall not switch off until the ambient illumination rises above 320 ± 50 lux. The minimum value of hysteresis for the daylight control shall be 50 lux.

3.6 Environment: The commercial LED lantern shall operate under the environmental conditions outlined below.

3.6.1 Extreme temperature: Exposure to temperatures from -30 to +50 degrees C.

3.6.2 Humidity: Exposure to relative humidity from 0 to 100%, including horizontal driving rain.

3.6.3 Icing: Exposure to ice loading up to 22 kg per square meter.

3.6.4 Wind speed: Exposure to wind speeds up to 140 knots.

3.6.5 Salt air and seawater spray: Continuous exposure to salt air and seawater spray.

3.6.6 Immersion: After total immersion in seawater to depths of 1 meter for periods of up to 1 hour.

3.6.7 Ultraviolet exposure: Continuous exposure to ultraviolet light for the duration of the advertised service life of the lantern, as is typically encountered at sea level at 20° North latitude.

3.6.8 Shock and vibration: Continuous exposure to the shock and vibration experienced on marine aids-to-navigation, including buoys and wooden, single-pile structures.

3.6.9 Electromagnetic interference: The lantern shall not be susceptible to interference from radiating devices normally found in the marine environment. This includes signals from VHF radio and marine radar. Lanterns shall meet the commercial requirements listed in section 2 of this specification.

3.6.10 Static discharge: The lantern shall incorporate protection from static discharges and induced, transient voltages on the power leads, as may occur due to nearby lightning strikes. Lanterns shall meet the commercial requirements listed in section 2 of this specification.

3.6.11 Moisture Intrusion: The lantern shall be sufficiently sealed to protect the LEDs from moisture (moisture intrusion has been shown to cause premature failure of LED junctions). The lantern shall contain a hydrophobic vent to equalize pressure caused by thermal cycling.

3.7 Preventive maintenance requirements: The lantern shall be maintenance-free, other than periodic cleaning of external surfaces.

3.8 Instruction manual: Each LED lantern shall be supplied with an instruction manual detailing the installation, operation and troubleshooting of the lantern.

4 VERIFICATION. Standard commercial literature shall be included in the bid package to verify compliance with the COTS requirement. Test documents to show verification of the requirements may be included.

5 PACKAGING: The lanterns shall be packaged individually in accordance with standard commercial practice, suitable for reshipment.

6 MARKING: The lanterns shall clearly marked with the contents (example: Red LED lantern), manufacturer, weight, and National Stock Number (NSN to be assigned after contract award).

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