SAE INTERNATIONAL

AEROSPACE STANDARD

AS4492™ REV. A

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Revised 2020-08

Superseding AS4492

(R) Survivor Locator Lights

RATIONALE

Technical Standard Order TSO-C85 was originally developed around specific products each with specific performance characteristics that were limited by the designs and the components available at that time. These original product designs, though improved in various ways, are now over 40 years old and are still the basis of both TSO-C85 and AS4492. Advancing technologies in materials, batteries, and light sources (specifically LEDs) provide an opportunity to improve survivor location light performance, reliabililty, and cost effectivity. This revision of AS4492 is intended to provide for an optional approach for the Type I (steady-type) and Type II (flashing) lights, which take advantage of the latest advantages in LED and battery technology.

This revision of AS4492 is additionally intended to provide compliance guidelines addressing changes in the minimum performance standards (MPS) for survivor locator lights from the most recent version of FAA Technical Standard Order TSO-C85b/EASA Technical Standard Order ETSO-C85b.

TABLE OF CONTENTS

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For more information on this standard, visit
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1. SCOPE

This document covers survivor locator lights as follows:

a. Steady type lights (Type I)

b. Flashing-type lights (Type II)

1.1 Purpose

This document provides minimum performance and design standards to be applied to battery-powered, water-activated emergency lights intended to be fitted to the individual and multiplace flotation devices to mark the location and aid in the marshalling of aviation accident survivors in bodies of water.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific examption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP6253	LEDs and Aircraft Applications
AS25050	Colors, Aeronautical Lights and Lighting Equipment, General Requirements for
SAE J1330	Photometry Laboratory Accuracy Guidelines

2.1.2 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

14 CFR 25	Airworthiness Standards: Transport Category Airplanes
FAA TSO-C85	Survivor Locator Lights
FAA TSO-C142	Non-Rechargeable Lithium Cells and Batteries

2.1.3 EASA Publications

Available from European Aviation Safety Agency, Konrad-Adenauer-Ufer 3, D-50668 Cologne, Germany (for visitors and for mail over 1 kg) and Postfach 10 12 53, D-50452 Cologne, Germany (for mail 1 kg or less); Tel: +49 221 8999 000, www.easa.europa.eu.

CS-25	Certification Specification for Large Aeroplanes
EASA ETSO-C85	Survivor Locator Lights
EASA ETSO-C142	Non-Rechargeable Lithium Cells and Batteries

2.1.4 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

RTCA DO-227A Minimum Operating Performance Standards for Lithium Batteries

RTCA DO-268 Concept of Operations, Night Vision Imaging Systems for Civil Operators

RTCA DO-275 Minimuim Operational Performance Standards for integrated Night Vision Imaging System Equipment

2.1.5 IES Publications

Available from Illuminating Engineering Society, 120 Wall Street, Floor 17, New York, NY 10005-4001, Tel: 212-248-5000, www.ies.org.

IES LM-79-80 Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products

IES LM-80-08 Approved Method: Measuring Lumen Maintenance of LED Light Sources

2.1.6 NIST Publications

Available from NIST, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, Tel: 301-975-6478, www.nist.gov.

Ohno, Y., Couzin, D., and Dennison, A., “Modified Allard Method for Effective Intensity of Flashing Lights”

Ohno, Y., “Physical Measurement of Flashing Lights - Now and Then”

2.1.7 International Association of Marine Aids to Navigation and Lighthouse Authorities Publications

Available from IALA-AISM Headquarters 10 rue des Gaudines 78100, St Germain en Laye, France, www.iala-aism.org.

IALA Recommendation E-200-4 (Ed. 1: 2008) On Marine Signal Lights: Part 4 - Determination and Calculation of Effective Intensity

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAA Report, “Experimental Effective Intensity of Steady and Flashing Light Emitting Diodes for Aircraft Anti-Collision Lighting,” dated August 2013

Title 14 USC §25 Appendix F, Part I, 2016

2.3 Definitions

2.3.1 SURVIVOR LOCATOR LIGHT

A device consisting of parts and components which may include, but are not limited to, a light source (e.g., electrical, gas, or chemically generated, self-luminous), a power source (e.g., a primary or reserve type battery), interconnecting electrical wires, rigging/activation means, and integral attachment/security means.

2.3.2 HOST EQUIPMENT

Individual life preservers, life rafts, and slide/rafts and other survival equipment to which a survivor locator light may be fitted.

2.3.3 PRIMARY BATTERIES

Non-rechargeable batteries with self-contained, stored potential electrochemical systems requiring only closing of an electrical circuit for operation.

2.3.4 RESERVE BATTERIES

Batteries that are chemically inert and unable to generate electrical energy until introduction of an external electrolyte (in this case, fresh water and sea water).

2.3.5 LIGHT-EMITTING DIODE (LED)

A solid state device capable of converting electrical power to visible light.

2.3.6 LUMINOUS INTENSITY

The luminous flux density (light radiating power) per solid angle as measured in a given direction relative to the emitting source. For visible light, the value is “weighted” with the spectral intensity of the human eye (photopic response). Luminous intensity measurements are expressed in candelas (cd).

2.3.7 EFFECTIVE INTENSITY

Effective intensity is defined as luminous intensity (cd) of a steady light having the same relative spectral distribution as the flashing light, which would have the same luminous range (or visual range in aviation terminology) as the flashing light under identical conditions of observation.

NOTE: This term is intended to account for the temporal response of the human visual system, where pulses of shorter duration and high peak intensities are more conspicuous than slower pulses with low peak intensities despite having the same time-integrated intensity (candela second).

2.3.8 ENHANCED VISION SYSTEM (EVS)

An airborne system which provides an image of the scene in order to provide an image in which the scene and objects in it can better be detected.

2.3.9 NIGHT VISION IMAGING SYSTEM (NVIS) AND AVIATOR NIGHT VISION IMAGING SYSTEM (ANVIS)

Systems that allow images to be produced in levels of light approaching total darkness.

2.3.10 NIGHT VISION GOGGLES (NVG)

A system that allows images to be produced in levels of light approaching total darkness.

3. MINIMUM DESIGN STANDARDS

3.1 Configuration/Design

The survivor locator light shall be designed and configured in such a way as to preclude harm to the survivor or adversely affect the operation, performance, or physical integrity of host equipment while packed or in active use; special care shall be taken to avoid sharp edges or protrusions. The design of the survivor locator light and its components, including any electrical wires, shall be such to minimize snagging when used on the host equipment (e.g., when it is removed from its packaging; deployed; donned; inflated; and when in use, including evacuation from the aircraft).

3.2 Compression Loading

The survivor locator light should be designed to preclude damage to the device when installed on host equipment that is packaged under highly compressed conditions, such as life preservers, life rafts, evacuation slide/rafts, etc.

3.3 Materials

Materials used in the survivor locator light shall be compatible with materials and processes used in the construction of host equipment and shall not contribute to the degradation of same. Materials used in the manufacture of the survivor locator light, including molding materials, bonding and sealing agents, and optical materials, shall be selected to preclude premature degradation over the service life of the device as defined in 4.2.

3.4 Flammability

Materials used in the manufacture of the survivor locator light shall meet the applicable requirements of 14 CFR Part 25, Appendix F, Part I (Amendment 25-142, effective April 18, 2016).

3.5 Light Characteristics

3.5.1 General Requirements

Survivor locator lights may be steady on (Type I) or flashing (Type II) as illustrated in Figure 1. Emitted light shall be white (in the spectral range of 380 to 780 nn) or yellow-green (in the spectral range of 530 to 560 nn), per AS25050. If the emitter is LED technology, a minimum color temperature of 5000 K is required. The device shall be capable of functioning at or above the minimum light intensities specified in 3.5.3 and 3.5.4 while the integral battery is immersed in fresh water and sea water at 2 °C (+35.6 °F), uninterrupted, for a minimum period of 8 hours under the battery end-of-life conditions defined in 4.2.

3.5.2 Night Vision Imaging System Compatibility of Alternative Emission Sources

The widespread use of night vision technologies including EVS, NVIS, and ANVIS (the latter two known as NVGs) by military, law enforcement, and other entities that may be involved in Search and Rescue (SAR) operations, indicate that near infrared (IR) emitters should be considered as a secondary emission source in addition to white.

Infrared (IR) light sources radiating in the range of 600 to 900 nanometers range will be compatible with current ANVIS technology with Class B minus-blue filters.

3.5.3 Steady-Type Lights (Type I)

The steady-type survivor locator light shall be shown by test to provide a minimum luminous intensity of 1.0 cd over the operating regime established in 3.5.1. The minimum light output shall be provided within a minimum 1 degree beam width centered on the horizon (-10 degrees/+30 degrees) over a minimum of 330 degrees of arc in the horizontal plane with gaps of no more than 5 degrees each, and totaling no more than 30 degrees overall, and within a minimum 1 degree beam width centered on the vertical (±10 degrees).

3.5.4 Flashing-Type Lights (Type II)

The flashing-type survivor locator light shall be shown by test to provide a minimum effective luminous intensity of 1.0 cd over the operating regime established in 3.5.1, where effective luminous intensity is calculated according to 3.5.5. The minimum light output shall be provided through a minimum of 180 degrees of arc centered on the vertical (±10 degrees) over a minimum of 330 degrees of arc in the horizontal plane with gaps of no more than 5 degrees each, totaling no more than 30 degrees overall. The flash rate shall be 60 flashes per minute ± 10 flashes per minute.

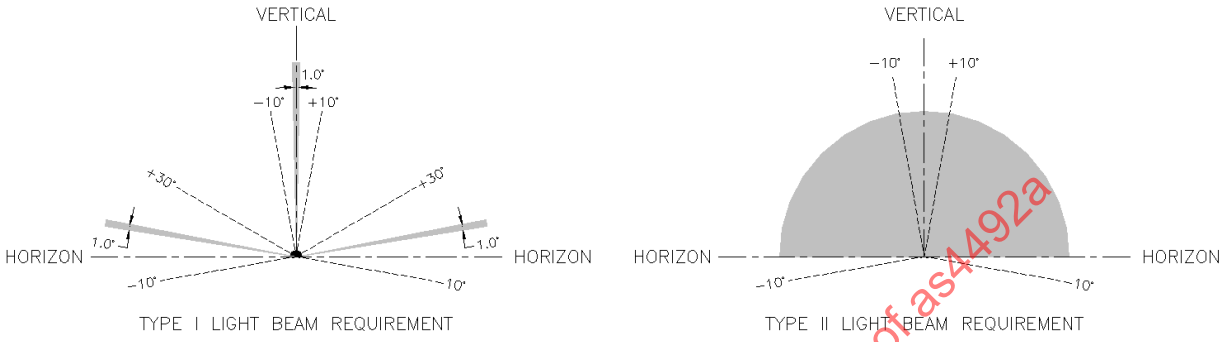

Figure 1 - Beam requirements, Type I and Type II lights

3.5.5 Effective Luminous Intensity Calculation for Flashing (Type II) Lights

Effective luminous intensity should be measured differently for pulse wave modulated (PWM) or pulsed signals than for signals with a single flash, non-PWM configuration, as follows:

3.5.5.1 PWM and/or Rapidly Repeating Signals within a Single Flash

Measure effective luminous intensity for these types of signals using the Modified Allard Method in accordance with the NIST and IALA-AISM references in Section 2. Guidance for the application of this method is found in the IALA-AISM reference.

3.5.5.2 Single Flash with Rectangular, Trapezoidal, or Gaussian Flash Profile

Measure effective luminous intensity for these types of signals using the Blondel-Rey Method in accordance with with the NIST and IALA-AISM references in Section 2. Guidance for the application of this method is found in the IALA-AISM reference.

3.6 Power Source (Battery)

3.6.1 General Requirements

The power source for the survivor locator light shall be based on either a primary (nonrechargeable) battery cell or a reserve battery. The battery shall be water activated and be capable of operation in fresh water or sea water. Both primary and reserve batteries shall be designed to meet the minimum performance standards (MPS) of the applicable governing specifications of the battery technology type. If non-rechargeable lithium batteries are used, they shall comply with TSO-C142/ETSO-C142.

3.6.2 User Protection

Due to the proximity of survivor locator lights to the head of survivor when fitted on individual life preservers, no battery technology shall be used which will expose the survivor or the host equipment to injurious effects of explosion, flame, high exothermic heat radiation, or the discharge of toxic or incapacitating effluents under a reasonable set of operational eventualities including, but not limited to, one or a combination of the following relating to individual cells or the battery packaging:

a. Rupture

b. Puncture

c. Crushing

d. Short circuit

e. Exposure to fresh water and sea water

3.6.3 Effluent Venting and/or Containment

The design of primary battery packaging should include provisions for venting and/or safe containment of battery effluents including gases, fluids, and other solid matter generated during normal discharge of the battery or as a result of the operational eventualities outlined in 3.6.2.

3.6.4 Circuit Protection

In the case of primary batteries, positive means to prevent short-circuits and to preclude damage that might be caused in such eventuality shall be provided; a positive means to prevent inadvertent activation of the light shall also be provided. Additional design consideration shall be given to venting of gases generated within the cell and protection of the user and the host equipment from outgassing or cell leakage.

3.6.5 Reserve Batteries

In the case of reserve batteries, a positive means of protecting the battery from the introduction of moisture and resultant deterioration shall be provided while ensuring that the light activation requirements of 3.7.3 are met.

3.7 Light Activation

3.7.1 General

Activation of the survivor locator light shall be automatic upon contact with or immersion in fresh or sea water. Alternatively, the activation means shall be configured, rigged, and/or located on the host equipment in such a way as to provide for automatic activation upon entry into the water with the host equipment properly donned or deployed.

3.7.2 Primary Batteries

Activation of primary batteries shall be accomplished upon contact with or immersion in fresh or sea water. Activation shall be accomplished with a reliable mechanical or electrical water-sensor. Primary batteries shall be designed to ensure that the light remains activated once automatic activation has occurred. This should be accomplished by an electrical latching circuit or other means. Switches which include delayed-action devices and/or moisture barriers shall be shown to provide for automatic activation of the device, with light output meeting the established minimums within the times provided in Table 1.

3.7.3 Reserve Batteries

Activation of reserve batteries shall be accomplished when the reserve battery container is immersed in fresh or sea water. The reserve battery, along with any passive moisture barriers, shall be shown to be capable of developing sufficient power to meet minimum required light output within the activation times specified in Table 1. If the battery is provided with a mechanical moisture protection device or means, such as plugs, and their removal is necessary to provide for activation of the survivor locator light, these devices and/or means shall be designed in such a way and demonstrated that they can be rigged so as to be automatically removed from the battery as the host equipment on which the survivor locator light is installed is unpacked, deployed, or inflated.

Table 1 - Maximum light activation time to minimum required illumination level

Sea Water	1 minute at water temperature of +2 °C (+35.6 °F) and higher
Fresh Water	2 minutes at water temperature of +2 °C (+35.6 °F) and higher

3.8 Service Life Limitations

3.8.1 General

Service life limitations for the survivor locator light, including unitary, self-contained devices and those with separate and/or separable lighting modules and power sources, shall be established by the manufacturer in accordance with this section. Service life limitations, if any, shall be prominently marked on that portion of the device that contains the service life limited component. If the service life is indefinite or “on condition,” the manufacturer shall provide continuing airworthiness requirements.

3.8.2 Primary Batteries

Primary batteries for survivor locator lights shall have a rated service life equal to no more than 80% of that recommended by the primary cell manufacturer, but in no case more than the average time since manufacture at which self-discharge rates or other cell degradation mechanisms reduce available cell energy to the point that the light intensity and duration requirements of this document cannot be met. Tests for luminous intensity and duration, as may be required to show conformance to this document, shall be conducted in accordance with 4.1 and 4.2.

3.8.3 Reserve Batteries

The service life limitations of survivor locator lights with reserve batteries will be specified by the manufacturer. The service life may be specified as defined period of time, or classified as “indefinite” or “on condition.”

3.8.3.1 Service Life Classification

The service life of reserve batteries may be classified as “indefinite” or “on condition” only if the following requirements are met:

a. The chemical components of the reserve battery are inert prior to the introduction of fresh or sea water through immersion.

b. The battery design is such that the chemical components are adequately protected from degradation due to moisture intrusion and humidity.

c. The chemical components of the reserve battery are shown not to be susceptible to or are properly protected against any other known degradation mechanisms including, but not limited to, aging (e.g., embrittlement), shock, and vibration.

d. The manufacturer specifies the continuing airworthiness requirements necessary to verify battery serviceability to meet the minimum requirements of this standard, including inspection interval.

3.8.3.2 Service Life Alternative Method

Where the service life is specified as a period of time since manufacture, that service life cannot exceed the point where testing has shown that self-discharge mechanisms or other degradation mechanisms (such as embrittlement and humidity) reduce the ability of the cell to meet the minimum requirements of this standard.

3.9 Attachment Considerations

The design of the survivor locator light and any detached and/or connected components, such as battery packs, should take into account provisions for secure attachment to host equipment such that when properly installed, the light and any remote parts cannot be removed except by deliberate action. Special consideration shall be given to attachment security under conditions related to evacuation from the aircraft, entry into the water, entry onto flotation platforms, and rescue.

3.10 Waterproofness and Humidity Protection

The survivor locator light, including separate subassemblies such as batteries and light modules that may be connected by wires, shall be shown to meet the humidity resistance and waterproofness requirements of 4.6 and 4.10. (Note: In the case of survivor locator lights incorporating reserve batteries, these requirements may be shown with the device configured for long-term storage in the host equipment; e.g., with the waterproofness plugs inserted. In this case, the light activation requirements of 3.7 and applicable sub-sections still apply.)

4. TEST/ANALYSIS METHODS

In addition to the requirements of Section 3, the following tests and analysis methods are required for qualification of survivor locator lights. When testing is required, the tests are applicable to both primary and reserve battery power units, except as noted. Each test is to be conducted on a minimum of three randomly selected test articles. Test articles are to be production units or representative of production units in all respects. The test articles must be shown to activate per 3.7.1 and illuminate per 3.5.1 automatically upon immersion in fresh water at +21.1 °C ± 1.6 °C (70 °F ± 3 °F) immediately after each test (except the lighting performance verification of 4.1 and 4.2 and the waterproofness test of 4.10).

4.1 Lighting Performance Verification

4.1.1 Intensity Requirements

The luminous intensity requirements of 3.5.3 (Type I, steady-on) and effective luminous intensity requirements of 3.5.4 (Type II, flashing) shall be demonstrated using standard photometric measuring techniques and guidelines specified in SAE J1330.

4.1.2 Photometric Measurements

Photometric measurements using a Goniophotometer shall be demonstrated using guidelines of IESNA LM-79-80 and LM-80-08.

4.1.3 Intensity Requirements

Luminous intensity testing shall be conducted at the critical end-of-life voltage input determined in 4.2. For this testing, this critical end-of-life voltage shall be applied to the lighting element of the survivor locator light by a regulated DC power supply with an accuracy of at least ±0.005 VDC.

4.2 Determination of Battery End-of-Life Conditions

Battery end-of-life conditions for luminous intensity testing shall be determined in accordance with the direct test method of 4.2.1 or the alternative method of 4.2.2, unless another method is accepted by the approving authority. (Note: An example of this determination for one type of battery cell is embedded in the following sections, and a summary of this determination is provided in Table 2. The technical information used in these determinations are for example only and do not necessarily represent actual battery data.)