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Standard Specification for Design and Installation of an Infrared (IR) Searchlight System (USA)¹

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INTRODUCTION

This specification establishes the exposure limits and safe operating guidelines for infrared (IR) radiating devices to be mounted on N registered aircraft or any aircraft which is flown or operated in the United States or its territories. This specification applies to devices such as searchlights and landing lights or other IR radiating devices that emit incoherent IR energy. For IR systems that emit coherent IR radiation, refer to FAA AC 20-183. This specification does not establish the requirements for mounting to a specific aircraft and does not authorize the installation onto an aircraft. Specific installation requirements for each airframe type shall comply with Federal Aviation Administration (FAA) regulations and guidelines and are in addition to the requirements set forth in this specification.

The American Conference of Governmental Industrial Hygienists (ACGIH) has established threshold limit values (TLVs) for IR radiation exposure.² The TLVs represent a safe exposure limit without physical harm, even with daily exposure. In general terms, the components of the TLV are a function of the intensity of the IR radiation (within a specified band), the distance to (or from) the radiating source, over a period of time (exposure).

For this specification, the safe exposure time has been set at 100 seconds to reach the TLV. Therefore, the safe operating distance is established by determining the maximum output radiation of the device such that 100 seconds of exposure does not exceed one TLV as established by ACGIH.

1. Scope

1.1 This specification establishes the manufacturing design, manufacturing quality system and installation requirements for airborne infrared (IR) searchlight equipment, systems, and devices. This specification applies only to IR devices that produce incoherent IR radiation and affixed to an aircraft which is N registered or operated and flown within the United States and its territories.

1.2 This specification establishes the minimum and maximum system performance and provides guidelines for an operator to develop functional operation requirements to ensure IR safety.

¹ This specification is under the jurisdiction of ASTM Committee F39 on Aircraft Systems and is the direct responsibility of Subcommittee F39.04 on Aircraft Systems.

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² *Light and Near-Infrared Radiation: TLV(R) Physical Agents*, 7th ed., American Conference of Governmental Industrial Hygienists, 2015, www.acgih.org.

1.3 This specification covers IR device emissions in support of night vision goggles or other devices such as electro-optical/infrared (EO/IR) sensors capable of detecting IR radiation.

1.4 This specification covers IR device emissions that may pose a hazard to the flight crew, aircraft, and bystanders.

1.5 This specification covers IR device emissions and related safety controls such as duration, beam width, radiant intensity, and wavelength.

1.6 This specification encourages an Original Equipment Manufacturer (OEM) to maintain a robust quality assurance program and a well-documented configuration control process at the component level and continued through installation at the system level.

1.7 The OEM shall include the warnings, exposure limitations and corresponding data, and installation instructions described within this specification in their operation and installation manuals. These manuals shall be provided with the product or device.

1.8 *Units*—The values stated in SI units are to be regarded as the standard. No other units of measurement are included in this standard.

1.9 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.10 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 FAA Standards:³

FAA AC 21-16(G) RTCA Document DO-160 Versions D, E, F, and G Environmental Conditions and Test Procedures for Airborne Equipment, or latest versions available
FAA AC 20-115C Airborne Software Assurance
FAA AC 20-183 Laser Airworthiness Installation Guidance
FAA 8110.4C Type Certification

2.2 IEC Standard:⁴

IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems

2.3 RTCA Standards:⁵

RTCA/DO-160 Versions D, E, F, G, or latest Environmental Conditions and Test Procedures for Airborne Equipment
RTCA/DO-178 Software Considerations in Airborne Systems and Equipment Certification
RTCA/DO-254 Design Assurance Guidance for Airborne Electronic Hardware

2.4 SAE Standard:⁶

SAE/ARP4761 Guidelines and Methods for Conducting the Safety Assessment Process on Civil Airborne Systems and Equipment

2.5 Federal Standards:⁷

14 CFR Part 27 Airworthiness Standards: Normal Category Rotorcraft
14 CFR Part 29 Airworthiness Standards: Transport Category Rotorcraft
14 CFR Part 21 Section 21.307 and 21.308 Certification Procedures for Products and Articles, Quality System and Quality Manual
MIL-STD 3009 Lighting, Aircraft, Night Vision Imaging System (NVIS) Compatible

³ Available from Federal Aviation Administration (FAA), 800 Independence Ave., SW, Washington, DC 20591, <http://www.faa.gov>.

⁴ Available from International Electrotechnical Commission (IEC), 3, rue de Varembe, 1st Floor, P.O. Box 131, CH-1211, Geneva 20, Switzerland, <http://www.iec.ch>.

⁵ Available from RTCA, Inc., 1150 18th St. NW, Suite 910, Washington, DC 20036, <http://www.rtca.org>.

⁶ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

⁷ Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

NOTE 1—For all referenced documents, the latest version of the released document shall be used.

3. Terminology

3.1 Definitions:

3.1.1 *beam width, n*—beam diameter or beam width of an electromagnetic beam is the diameter along any specified line that is perpendicular to the beam axis and intersects it.

3.1.1.1 *Discussion*—The beam diameter or beam width is measured at 10 % of the peak intensity.

3.1.2 *effective spectral radiance, n*—integrated radiance of an IR device per unit wavelength weighted by the hazard function and the measurement is expressed in units of (W/cm²·sr) and used to establish the threshold limit values (TLVs).

3.1.3 *exposure duration, n*—time the infrared (IR) source is directly viewed or directed toward a human target.

3.1.3.1 *Discussion*—The exposure duration is a function of the intensity and wavelength of radiation over time. The American Conference of Governmental Industrial Hygienists (ACGIH) has established safe exposure limits (TLVs) that define exposure to an IR source without permanent physical damage.

3.1.4 *eye safe distance, n*—distance and duration of unobstructed exposure to the direct IR beam at effective spectral radiances.

3.1.5 *intended function, n*—through the emission of IR, facilitates the utilization of night vision equipment (cameras or goggles, or both).

3.1.6 *wavelength, n*—for an electromagnetic wave, the distance in the direction of propagation between nearest points at which the electric vector has the same phase.

3.1.6.1 *Discussion*—The wavelength unit generally used in spectrophotometry related to colorimetry is the nanometer (nm). Unless otherwise stated, values of wavelength are generally those in air.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *infrared light, IR, n*—in this specification, refers to the nonvisible portion of the light spectrum that may be either filtered or direct emission, adjacent to the red end of the visible spectrum, with wavelengths from 700 to 3000 nm.

4. Performance Requirements

4.1 The minimum safe operating distance is established by analyzing the total radiated IR energy such that the TLV is not exceeded during 100 seconds of exposure.

4.2 The IR emitting device shall be tested to quantify the IR emissions. The testing laboratory (or Original Equipment Manufacturer (OEM)) shall be capable of documenting that results obtained which represent the maximum values that the equipment is capable of emitting throughout its life cycle and under worst-case conditions. Test equipment and standards should be traceable to an accredited authority such as National Institute of Standards and Technology (NIST). Worst-case conditions are those in which the device may produce more energy than the intended or anticipated levels because of component failure or any other operating or failure mode.