



Designation: F3238 – 17 (Reapproved 2023)

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

This standard is issued under the fixed designation F3238; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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.

Current edition approved July 15, 2023. Published July 2023. Originally approved in 2017. Last previous edition approved in 2017 as F3238 – 17. DOI: 10.1520/F3238-17R23.

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.

4.2.1 After initial testing and product verification, OEMs are required to test subsequent production units under the guidelines of their respective Quality System as described in Section 5.

4.2.2 Changes or modifications to the device or end product require a new test unless the OEM establishes that such product or device revisions represent no change to the IR emission values or monitoring and control functions. New test data or the manufacturer's statement of similarity and compliance to previous testing shall be sent to each supplemental type certificate (STC) and PMA holder for the device. The data shall be made available within 30 days of a revision change and before release for installation on an aircraft.

4.2.3 For serial production, the test results for each device shall accompany the product when it is shipped or leaves the OEM's facility, along with other pertinent data and certifications required for safe installation and continued airworthiness.

5. OEM / Manufacturing – Serial Production Quality System

5.1 For serial production of IR emitting devices, the OEM shall have a Quality System which meets the requirements of CFR Part 21 Section 21.307 and 21.308, or,

- 5.1.1 An approved ASTM Quality System, or,
- 5.1.2 ISO 9000 or AS 9000 Certification.

6. Installation Requirements

6.1 The installer shall ensure that safe operating requirements for the IR device are met such that there are no hazards for the flight crew, ground/maintenance personnel, or bystanders.

6.1.1 A keyed lockout switch shall be installed which disables the IR function of the IR device such that the IR function may only be activated by authorized personnel. Authorized personnel will include only those specifically trained in the safe operation of the IR function. This switch shall be placarded as such during the installation of the IR searchlight or device. This switch is only to be used by trained and authorized maintenance personnel using established operating guidelines as established by the aircraft operator.

NOTE 2—This specification does not establish safe ground operating procedures for maintenance personnel. These procedures shall be developed and implemented by the air operations unit or facility.

6.1.1.1 Safe operation training guidelines shall include the following topics at a minimum:

- (1) Potential hazards involved with the use of IR devices,
- (2) IR exposure limits and safe operating distances for each IR device installed or operated,
- (3) How to protect the flight crew and bystanders from hazardous IR exposure, and
- (4) Processes and procedures for periodic maintenance and repairs of the IR device.

6.1.2 A discrete visual annunciator is required when the device is in the IR operating mode. This is required since the IR energy is invisible to the naked eye. The discrete annunciator should be located on the hand control that operates the IR emitting device and near the pilot instruments and shall be

night vision imaging system (NVIS) compliant (MIL-STD-3009). The operator and pilot should have visual annunciation of the IR device.

NOTE 3—The intent of this provision is to ensure that the pilot and flight crew are aware that the device is operating in the IR mode.

6.1.3 *Recommended*—The preferred method of lockout for the IR device is via a link to the radar altimeter. Activation of the system should not be possible when the altimeter altitude lockout is active (below the minimum safe altitude or target distance). If the radar altimeter is not available or impractical for the installation, the alternate means of compliance is by installation of an arm/disarm switch. The arm/disarm switch shall be accessible to the flight crew and secured with a keyed lockout.

6.1.4 The IR mode may not be selectable exclusively via software unless the software is developed using RTCA/DO-178 with Design Assurance Level B or higher. If in normal operation the device has an IR mode select or IR activation that is operated exclusively via software and is not RTCA/DO-178B compliant, the device shall also be controllable by an analog method that overrides this functionality in the event of an in-flight emergency or device malfunction (hazard).

6.1.5 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 FAA regulations in addition to the requirements set forth in this specification.

6.1.6 *Environmental Qualification*—Ensure the environmental qualification of the installed equipment is appropriate for the intended aircraft installation environment. FAA guidance may be found in FAA AC 21-16(G), RTCA/DO-160 Versions D, E, F and G, or latest.

6.1.7 The installer and operator shall ensure that any repairs or replacement spare parts are only performed by authorized repair facilities and that the use of spare parts meets the OEM specifications.

7. Hazard, Malfunction, and Failure Assessment

7.1 This specification is to be used as a means to show compliance with requirements for certification of IR emitting devices. The hazard, malfunction, and failure assessment for an IR radiating device is in addition to those required for a normal TC, STC, or other approved installation under FAA regulations.

7.2 *Equipment Malfunction*—IR device malfunction resulting in an aircraft crewmember's or passenger's eye or skin being exposed to invisible IR energy exceeding the TLV is considered no less than a hazardous functional failure condition and could be catastrophic if continued safe flight is not possible because of the severity of the damage to a pilot's eye or skin. The system safety assessment of the system or device being installed on the aircraft shall assess and document the rationale for a hazardous functional failure condition classification. If there is no direct or reflected path into the cockpit or cabin because of the location of the IR searchlight system and physical shielding provided by the aircraft structure, this failure condition does not apply.