



AEROSPACE RECOMMENDED PRACTICE

ARP5293™**REV. B**

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Superseding ARP5293A

Safety Considerations for Lasers
Projected in the Navigable Airspace

RATIONALE

Update to reflect current terminology, definitions, and applicable documents.

FOREWORD

The SAE G-10T Committee includes representation from a variety of different entities, public and private, to identify the issues, technologies, and operational capabilities of outdoor laser use in navigable airspace.

This document describes the issues, duties, and training of laser proponents specific to the use of lasers in navigable airspace.

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1. SCOPE

This document applies to laser proponents involved with the use of laser systems outdoors. It may be used in conjunction with AS4970, ARP5535, ARP5572, and the ANSI Z136 series of laser safety standards.

1.1 Purpose

The purpose of this document is to describe the issues, duties, and training of laser proponents specific to the use of lasers in navigable airspace.

1.2 Field of Application

AS4970 and ANSI Z136.6 provide guidance and information for the evaluation of laser operations in navigable airspace.

Due to operational/mission requirements, some laser beams exceed the maximum permissible exposure (MPE) limits or visual interference levels as defined in FAA Order 7400.2, ANSI Z136.1, and ANSI Z136.6. For this reason, mitigation and/or control measures may be required.

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 exemption has been obtained.

2.1.1 SAE Publications

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

ARP5535	Observers for Laser Safety in the Navigable Airspace
ARP5572	Control Measures for Laser Safety in the Navigable Airspace
ARP6378	Guidance on Mitigation Strategies Against Laser Illumination Effects
AS4970	Human Factor Considerations for Outdoor Laser Operations in the Navigable Airspace
AS6029	Criteria for Laser Control Measures for Aviation Safety

2.1.2 ANSI Publications

Copies of these documents are available online at <https://webstore.ansi.org>.

ANSI Z136.1	American National Standard for Safe Use of Lasers
ANSI Z136.6	American National Standard for Safe Use of Lasers Outdoors

2.1.3 FAA Publications

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

FAA AC 70-1 Outdoor Laser Operation(s)

FAA AC 70-2 Reporting of Laser Illumination of Aircraft

FAA Form 7140-1 Notice of Proposed Outdoor Laser Operation(s)

FAA Order 7400.2 Procedures for Handling Airspace Matters. [VI] Part 6 (Miscellaneous Procedures), Chapter 29 (Outdoor Laser Operations)

2.1.4 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at www.ecfr.gov.

14 CFR §91.11 Prohibition on Interference with Crewmembers

21 CFR §1010 Performance Standards for Electronic Products: General

21 CFR §1040 Performance Standards for Light-Emitting Products

2.1.5 U.S. Food & Drug Administration Publications

Copies of these documents are available online at www.fda.gov.

FDA 86-8260 Compliance Guide for Laser Products - U.S. Department of Health and Human Services

2.1.6 ICAO Publications

Available from International Civil Aviation Organization, 999 Robert-Bourassa Boulevard, Montréal, Québec H3C 5H7, Canada, Tel: +1 514-954-8219, www.icao.int.

ICAO Doc 9815 Manual on Laser Emitters and Flight Safety

2.2 Definitions

The definitions of the terms listed below are based on a pragmatic, rather than a basic, approach. The terms defined are therefore limited to those actually used in this manual. This list is not intended to constitute a dictionary of terms used in the laser field as a whole.

AFTERIMAGE: An impairment in the form of a temporary perception of an image in the visual field after exposure to a bright source.

DISTRACTION: The redirection of attention from primary tasks due to sudden exposure to a stimulus, such as a bright light source.

FLASHBLINDNESS: A temporary biological visual impairment that reduces visual sensitivity after exposure to bright light.

GLARE: A visual impairment due to a bright light source.

LASER SAFETY OFFICER (LSO): A designated person who has authority and responsibility to monitor and enforce the control of laser hazards and affect the knowledgeable evaluation and control of laser hazards.

LASER SAFETY SPECIALIST (LSS): An individual who has formal training or equivalent professional experience to calculate or determine laser hazards and appropriate control measures.

MAXIMUM PERMISSIBLE EXPOSURE (MPE): The level of laser radiation to which an unprotected person may be exposed without adverse biological changes in the eye or skin.

NATIONAL AIRSPACE SYSTEM (NAS): The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information, and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.

NAVIGABLE AIRSPACE: For the purpose of this document, navigable airspace is that airspace that can contain aircraft. Navigable airspace is generally considered as airspace that is at least 500 feet from ground or any structure unless operated in remote, sparsely populated areas. In heavily populated areas, aircraft are required to allow more distances from structures. Near airports or heliports, navigable airspace extends to the runway. Helicopter operations may require additional considerations since they are often flying below 500 feet.

NOMINAL HAZARD ZONE (NHZ): The NHZ describes the space within which the level of the direct, reflected, or scattered radiation during operation could exceed the applicable MPE. Exposure levels beyond the boundary of the NHZ are below the applicable MPE level.

NOMINAL OCULAR HAZARD DISTANCE (NOHD): The distance along the axis of the laser beam beyond which the appropriate ocular MPE is not exceeded.

SAFETY OBSERVER: A designated person who is responsible for monitoring the safe operation of a laser and who can immediately terminate the laser beam if necessary to ensure safety.

3. BACKGROUND

Since the early development of laser technology, it has been understood that lasers can pose serious hazards. Some laser beams can be well collimated and can create hazardous irradiance or radiant exposure levels at great distances from the laser source. Additionally, the ability of the human eye to focus collimated laser energy when exposed, and the potential use of magnifying optics, can significantly increase the distances from which lasers can pose a hazard. For lasers that emit in the visible spectrum, the distance to which exposure can cause temporary visual interference that could result in very hazardous situations (e.g., a pilot trying to land a plane who is unable to see the runway) is far greater.

Furthermore, as laser technology has advanced, there are an ever-increasing number of uses for lasers. Many of these applications are outdoors. The result is that the use of lasers outdoors is increasing, and many of these uses can produce hazards at great distances.

Various federal, state, and local regulations, as well as consensus standards, define requirements and best practices to protect people. The Food and Drug Administration (FDA) has regulatory authority over laser products in the United States. The laser proponent is required to ensure that the use of lasers complies with all applicable regulations. Additionally, it is good safety practice for laser proponents to adhere to applicable non-regulatory guidance (e.g., FAA Advisory Circular AC 70-1, ANSI Z136.1, ANSI Z136.6, AS6029, and ARP5572).

4. LASER SAFETY TRAINING REQUIREMENTS

The use of lasers outdoors poses many unique training needs for laser safety personnel. This training may be in the form of a formal course or may be administered through specific standard operating procedures (SOPs) and literature supplied by the laser safety officer (LSO). Additional information on laser safety training requirements can be found in ANSI Z136.1 and ANSI Z136.6.

4.1 Laser Safety Officer

In order to accomplish their duties, the LSO must be trained or have access to someone who has been trained to a level appropriate to allow them to perform their duties. The following training topics are suggested for an LSO:

- Hazards, control measures, evaluation procedures, and medical surveillance requirements unique for the use of lasers outdoors
- Organizational laser safety policy
- Applicable standards and regulations (federal, state, and/or local)
- Airspace and aircraft considerations
- Government notification/coordination requirements
- Laser safety specialist (LSS) services
- Incident investigation and reporting
- Preparing SOPs and training instructions for laser users
- Recordkeeping of laser operations

4.2 Authorized Laser Operator

Laser operators shall receive training commensurate with the specific lasers with which they will be associated. Operators of Class 3B and Class 4 lasers shall receive specialized training for the lasers they will operate, including:

- Specific laser control measures
- Applicable SOPs (including emergency contingency procedures)
- Environments and conditions in which lasers may or may not be used
- Communication requirements
- Applicable standards and regulations (federal, state, and/or local)

4.3 Laser Safety Observer

For some laser systems, the safety observer may be the only practical control mechanism. For lasers that are operated for long periods of time and/or that can be hazardous at extremely long distances, it is important that the LSO not rely solely on safety observers to detect aircraft. For further explanation of training requirements for safety observers, refer to ARP5535.