Laser emissions which may endanger the safety of aircraft

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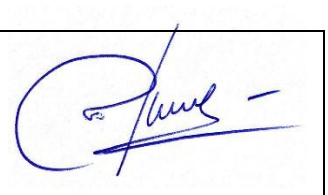
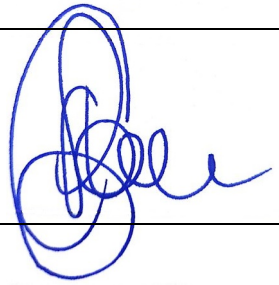
Document Approval

Prepared by:	Stephen J Muscat	Inspector (ANS & ADR)	
Approved by:	Capt. Charles Pace	Director General for Civil Aviation	

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1. REVISION HISTORY

Version	Date	Change
1	01 August 2018	Initial Issue.

2. Introduction

In recent years, laser shows at outdoor events have become increasingly popular. These activities make use of a generated light source to produce intense and directional beams of light and create special lighting effects. While these shows are spectacular, some events taking place close to Luqa International Airport potentially create a hazard to aircraft operations.

Likewise, the misuse of hand held laser devices which are being used to target aircraft is a growing menace to aviation. Indeed, data gathered through occurrence reporting continues to show that this threat is growing and spreading wide across Europe.

3. Purpose and applicability

The purpose of this Aerodrome Standards Advisory Document (ASAD), is to provide general information and advice on measures to protect aircrew of civil aircraft from accidental laser beam strikes, on or in the vicinity of an aerodrome. This guidance should be used in the planning and control of advertising, entertainment, and similar visual displays using laser light.

This document is applicable to aerodrome operators, air navigation services providers, and operators of laser shows. It is unlikely, however, that this ASAD will prevent willful or malicious laser attacks against aircraft by those intent on causing disruption.

4. Related regulatory provisions

It is unlawful, for any person to project, or cause to project, a laser or other directed light source at an aircraft in such a manner as to create a hazard to aviation safety, damage to the aircraft, or injury to persons on board that aircraft. This is enforced by Article 77, of the Air Navigation Order (SL.499.09).

5. Glossary

Irradiance (E): The power per unit area expressed in watts per square centimetre (W/cm^2) or watts per square metre (W/m^2). Small values may be expressed as micro watts per square centimetre ($\mu W/cm^2$) or nano watts per square centimetre (nW/cm^2), 10^{-6} and 10^{-9} respectively.

Laser: a) An acronym for light amplification by stimulated emission or radiation.
b) A device that produces an intense, coherent, directional beam of optical radiation by stimulating emission of photons by electronic or molecular transition to lower energy levels.

Maximum Permissible Exposure (MPE): The internationally accepted maximum level of laser radiation to which human beings may be exposed without risk of biological damage to the eye or skin.

Protected Flight Zones: Airspace specifically designated to mitigate the hazardous effects of laser radiation.

a) Laser-beam critical flight zone (LCFZ). Airspace in the proximity of an aerodrome but beyond the laser-beam free flight zone (LFFZ) where the irradiance is restricted to a level unlikely to cause glare effects.
b) Laser-beam free flight zone (LFFZ). Airspace in the immediate proximity to the aerodrome where the irradiance is restricted to a level unlikely to cause any visual disruption.
c) Laser-beam sensitive flight zone (LSFZ). Airspace outside, and not necessarily contiguous with, the LFFZ and LCFZ, where the irradiance is restricted to a level unlikely to cause flash-blindness or after-image effects.
d) Normal flight zone (NFZ). Airspace not defined as LFFZ, LCFZ, or LSFZ but which must be protected from laser radiation capable of causing biological damage to the eye.

6. Protecting aircraft from the hazards of lasers

Lasers can produce a beam of light of such intensity that permanent damage to human tissue, in particular the retina of the eye, can be caused instantaneously, even at distances of over 10km. At lower intensities, laser beams can seriously affect visual performance without causing physical damage to the eyes. Protection of pilots against accidental laser beam strike has become a serious factor in aviation safety with the advent of the laser light display for entertainment or commercial purposes.

To protect the safety of aircraft against the hazardous effects of laser emitters, the following protected zones have been established around Luqa International Airport:

a. A laser beam free, flight zone (LFFZ),
b. A laser beam free, critical flight zone (LCFZ), and
c. A laser beam sensitive, flight zone (LSFZ)

Figures 1, 2, and 3, may be used to determine the exposure levels and distances that adequately protect flight operations at Luqa International Airport.

The restrictions on the use of laser beams in the three protected flight zones, LFFZ, LCFZ, and LSFZ, refer to visible laser beams only. Laser emitters operated by aviation authorities in a manner compatible with flight safety are excluded from these restrictions. Typical examples of lasers used to support aviation include some cloud base or visibility measurement equipment, some bird harassing devices, and some aircraft docking guidance systems. Malta International Airport plc is to ensure that these lasers (if utilised) have the beam aimed in such a direction, and/or that the times of operation are controlled, to ensure no hazard is posed to aircraft operations. In all navigable airspace, the irradiance level of any laser beam, visible or invisible, is expected to be less than or equal to the maximum permissible exposure (MPE) unless such emission has been notified to the Director General – Civil Aviation Directorate and permission obtained. The protected flight zones are established in order to mitigate the risk of operating laser emitters in the vicinity of Luqa International Airport. The dimensions indicated for the various zones have been recommended by ICAO as adequate for ensuring safe operation of aircraft in the vicinity of aerodromes.

a) *Laser Beam Free Flight Zone.*

Within this zone the intensity of laser light shall be restricted to a level that is unlikely to cause any visual disruption. The irradiance should not exceed 50 nW/cm^2 unless some form of mitigation is applied. The level of brightness thus produced is indistinguishable from background ambient light.

b) *Laser Beam Critical Zone.*

Within this zone the irradiance should no exceed 5 $\mu W/cm^2$ unless some form of mitigation is applied. Although capable of causing glare effects, the irradiance will not produce a level of brightness sufficient to cause flash-blindness or after-image effects.

c) *Laser Beam Sensitive Zone.*

Within this zone the irradiance should not exceed 100 $\mu W/cm^2$ unless some form of mitigation is applied. The level of brightness thus produced may begin to produce flash blindness or after-image effects of short duration; however, this limit will provide protection from serious effects.

d) *Normal Flight Zone.*

The NFZ is any navigable airspace not defined as LFFZ, LCFZ, or LSFZ. The NFZ should be protected from laser radiation of causing biological damage to the eyes.

Figure 1. Laser-Beam Free Flight Zone - Multiple Runways

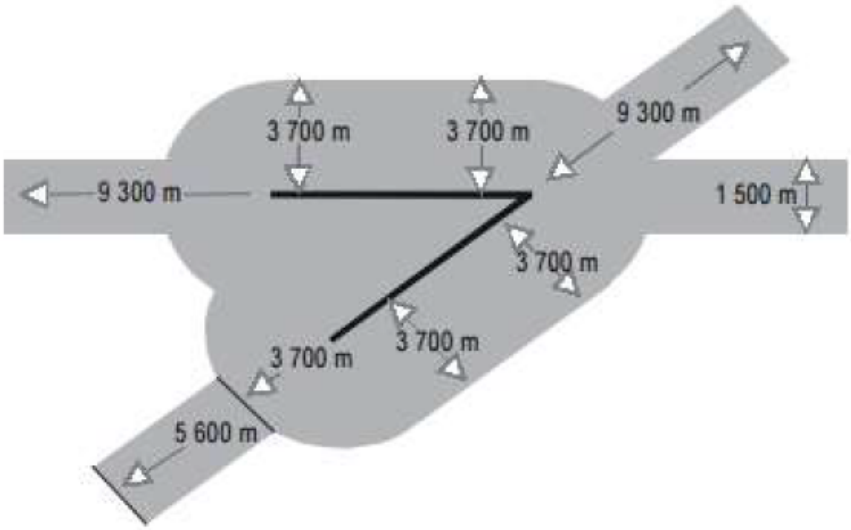


Figure 2. Laser-Beam Protected Flight Zones

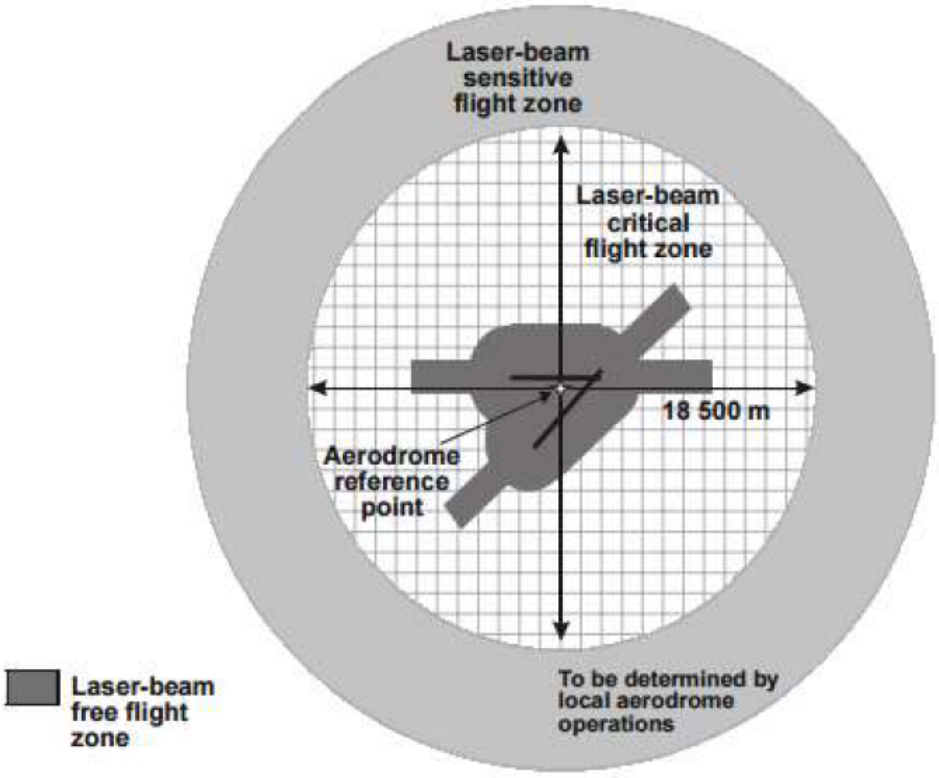
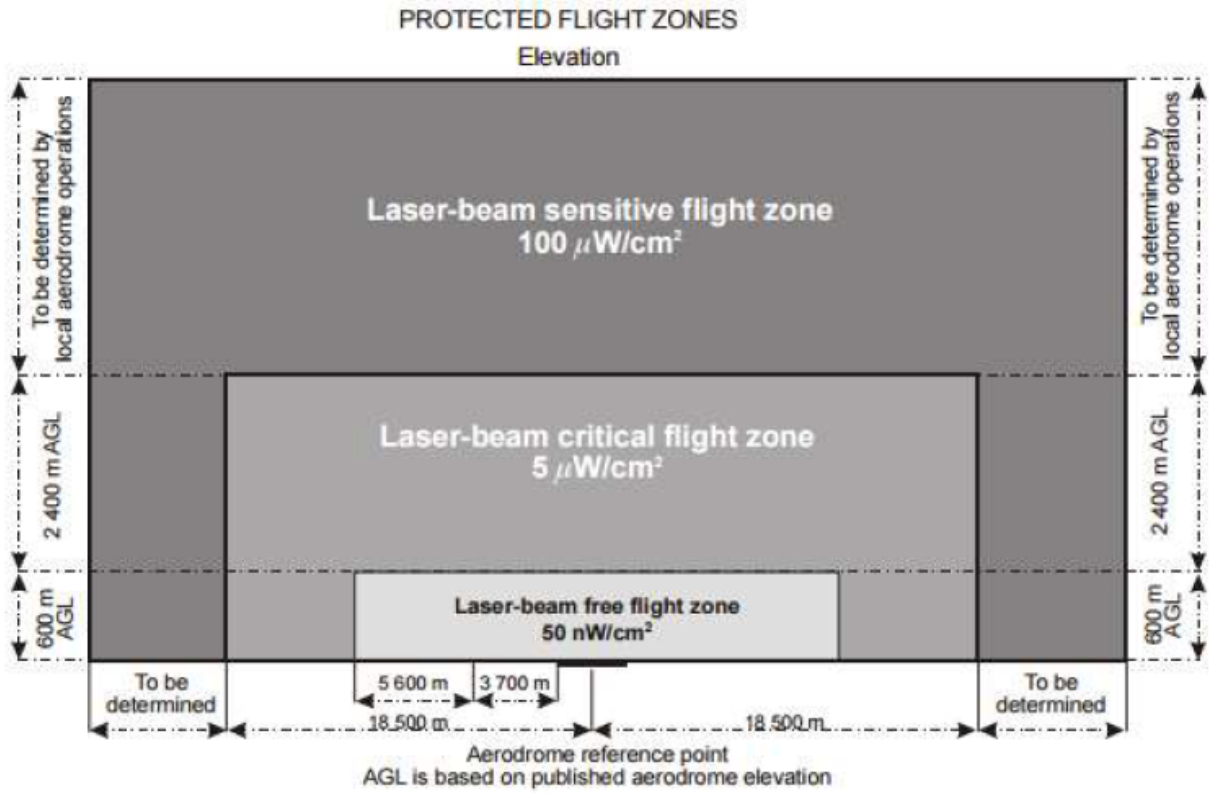


Figure 3. Laser-Beam Protected Flight Zones with Indication of Maximum Irradiance Levels for Visible Laser Beams



7. Notification to project directed bright lights into Maltese airspace

Any person who intends to project directed bright lights (including lasers) into the airspace over Malta that may create a hazard to aviation, must notify the Director General for Civil Aviation (DGCA) in advance of the projection. Appendix A includes a list of the information that should be included in the notification to the DGCA. The notification should be sent on email: civil.aviation@transport.gov.mt , at least fifteen (15) working days prior to the event.

8. Responsible Unit

The Air Navigation Services and Aerodromes Unit within Transport Malta's Civil Aviation Directorate (TM-CAD) is the Unit responsible for the protection of the airspace including the prevention of dangers to civil aviation resulting from lasers.

9. References

S.L.499.09. Air Navigation Order.

Eurocontrol SRC DOC 7: Outdoor Laser Operations in the Navigable Airspace

ICAO Doc 9815: Manual on Laser Emitters and Flight Safety.

APPENDIX A – GUIDANCE FOR NOTIFICATION

The information provided by the person making the notification will be used by TM-CAD to evaluate the safety of a proposed laser operation. As a minimum, the information listed below should be provided in the initial notification, nevertheless the Director may request further details as s/he deems fit.

a) *Applicant contact information:*

Identify the name, address, phone, and E-mail of the applicant. This is the party primarily responsible for the laser safety of the intended operation. In some cases, the applicant is a manufacturer or a government agency, and the laser is located at a different site. In such case, list both the contact information for the applicant and the site location.

b) *General Information:*

Name: Identify the event name (for temporary shows) or the facility name (for permanent installations).

Geographic location: Identify the latitude and longitude of the laser source. Identify the ground elevation at site. If the laser is on a building or other elevated structure, specify the laser's height above the ground.

Date(s) and time(s) of laser operation: *Testing and alignment:* Specify the proposed date(s) and time(s) during which testing and alignment procedures will take place. *Operation:* Specify the proposed date(s) and time(s) during which laser light will penetrate the Laser Beam Protection Zone.

c) *Brief description of operation:*

Provide a general overview of the proposed operation and a general description of each of the lasers involved. If a particular set-up operates with more than one laser, with different beam characteristics (power settings, pulse modes, divergence, maximum beam elevation, etc.) or has multiple output devices (e.g. projector heads), then each should be listed separately. You may need to add attachments such as maps, diagrams and details of control measures. Include whatever materials you feel are necessary to assist TM-CAD to sufficiently evaluate your proposal.

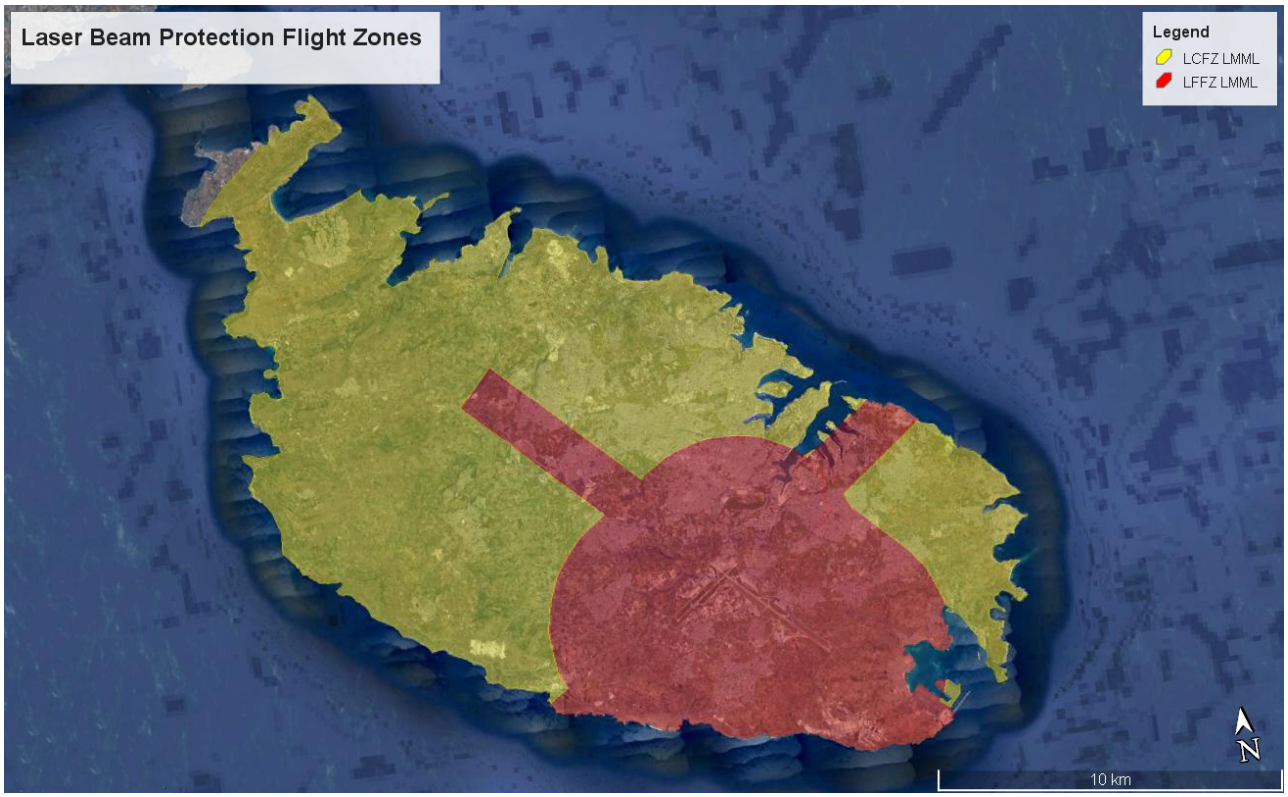
d) *Brief description of control measures:*

Describe the control measure(s) used to protect the airspace, e.g., termination on a building (where the beam path is not accessible by any type of aircraft), use of observers, use of radar and imaging equipment, physical methods of limiting the beam path, etc. The more that the operation relies on the control measures to ensure safety, the more detailed the description should be.

e) *Designated contact person:*

Provide the name and contact information for the designated contact person. This is the person responsible for the laser generation equipment and whom the TM-CAD will contact if additional information is required. This should be the person with the most knowledge about laser safety at this event.

APPENDIX B – LASER PROTECTION ZONES IN MALTESE AIRSPACE



The airspace above Comino and Gozo is considered as a Laser Beam Sensitive Flight Zone (LSFZ).