

Revision 1

Laser Strikes on Illumination of Aircraft

13 October 2022

General

Civil Aviation Authority (CAA) advisory circulars (ACs) contain information about standards, practices, and procedures that the Director has found to be an **Acceptable Means of Compliance (AMC)** with the associated rule.

Consideration will be given to other methods of compliance that may be presented to the Director. When new standards, practices, or procedures are found to be acceptable they will be added to the appropriate AC.

Purpose

This AC describes an acceptable means of compliance with standards regarding the hazards of laser illumination of aircraft and the steps to be taken to minimise the risks to aviation safety.

Related Rules

This AC relates specifically to Civil Aviation Rule Part 91 Subpart A - *General*, and Part 91 Subpart C – *General Flight Rules*, and Part 12, Subpart B, *Notification, Investigation, and Reporting, of Occurrences*.

Change Notice

Revision 1 replaces the initial issue of this AC, dated 21 May 2009.

This Revision changes terminology to “laser strike”, from the previous “laser illumination incident” and adds a section on New Zealand regulations on lasers, which have been instituted since this AC was last published. It also removes references to the CAA800 form, as this is being phased out, in favour of the CAA005 form.

Lastly, it updates references and contact details, corrects typos and other minor errors and takes the opportunity to add a Version History. ~~Initial issue~~

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Version History

History Log

Revision No.	Effective Date	Summary of Changes
0	21 May 2009	Initial issue.
1	13 October 2022	<p>Updates technical information.</p> <p>Changes terminology from “laser illumination” to “laser strike”.</p> <p>Adds a section on New Zealand regulations on lasers, which have been instituted since this AC was first published in 2009.</p> <p>Removes references to the CAA800 form, as this is being phased out, in favour of the CAA005 form.</p> <p>Updates references and contact details.</p> <p>Corrects typos and other minor errors.</p> <p>Adds a Version History.</p>

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LASER ILLUMINATION OF AIRCRAFT

1. Introduction

- 1.1. The incidence of aircraft being illuminated, particularly at night, by laser-generated light has been trending upwards since portable laser pointers became freely available to purchase. ~~appears to be on the increase. It has not been confined to the illumination of aircraft on normal flight paths, but also includes the deliberate illumination of aircraft involved in police duties. Laser technology has improved over the years, and it is now possible to purchase high-power lasers that can be used to cause serious problems for the safe operation of an aircraft through the distraction and possible incapacitation of the pilots.~~
- 1.2. Even when directed at aircraft from several kilometres away, high-power laser pointers can dazzle pilots and cause temporary flash blindness, with significant safety risks to the aircraft. The most severe cases can also cause prolonged eye injury for the pilot.
- 1.3. Laser power output has also increased over recent years ~~technology has improved over the years, and it is now possible to possess purchase high-powered laser pointers that can be directed at aircraft and used to cause serious problems for pilots and the safe operation of an aircraft. through the distraction and possible incapacitation of the pilots~~
- 1.4. This AC provides information to operators and pilots regarding:
 - 1) actions that should be taken by crews if their aircraft is illuminated by a laser during flight or ground operations. ~~Guidance is also provided on~~
 - 2) recommended mitigations while in flight, and
 - 3) ~~reporting and follow-up actions~~ pilot/operator obligations to report laser strike incidents to the local Air Traffic Control (ATC) unit and CAA.
- 1.5. A laser strike, i.e., an illumination of an aircraft by a laser, is an aircraft incident. As a consequence, operators are obligated to report any laser strike occurrences¹, as per rule 12.55, *Notification of incidents*.

2. Laser types that pose hazards

- 2.1. Lasers fall into five general categories: Class I, Class II, Class IIIa, Class IIIb and Class IV. The higher the Class number a laser has, the greater the hazard it presents. While all laser pointers pose a health risk to the human eye, Class I, II and IIIa laser pointers, that have typical output of less than 1 to 5 milliwatts (mW), are generally considered low risk. As outlined in Section 3, however, lasers with output greater than 1 mW cannot be imported into NZ without approval from the

¹ Note that the term "occurrence" includes accidents and incidents, as per rule 12.3.

Ministry of Health. The red laser pointers commonly seen in classrooms and conference venues are low-powered devices of less than one milliwatt (mW). These are normally a 'Class 2' laser device (the higher the class number, the greater the hazard), with insufficient power to cause actual physical harm, although they still require care in their operation and use.

Note: While ICAO² uses Roman numbers, US sites³ tend to refer to Class 2, Class 3 etc, with the result that a Class IIIa in ICAO is a Class 3R laser in some other sources. The New Zealand Ministry of Health uses both.

- 2.2. The red laser pointers commonly seen in classrooms and conference venues, low-powered devices of less than 1 mW, are normally a Class II laser device with insufficient power to cause actual physical harm, although they still require care in their operation and use. Green laser pointers, however, are readily available with a maximum power rating of 5 mW, and are classified as a 'Class IIIa or 3R laser device'. (more hazardous than Class 2).
- 2.3. The colour of the laser is also a factor. The eye's maximum sensitivity to visible light is around the wavelength of a green laser, and so the eye will interpret a green laser light of a given power as being up to 30 times brighter than a red laser of the same power. Direct eye exposure to a Class IIIa 3R laser beam can result in temporary visual impairment.
- 2.4. Some effort would be required to inflict actual eye damage with a 5 mW green laser pointer as both the low power and the eye's natural defence (blinking reflex) would combine to limit potential damage.
- 2.5. However, some vendors are now advertising higher-powered (from 10 to 400 mW) green laser pointers – these are definitely harmful and can cause permanent eye damage. In recent years, even more powerful lasers have come on the market.
- 2.6. The severity and duration of the vision impairment varies significantly, depending on the intensity and wavelength of the light, the individual's current state of light (or dark) adaptation, and even the person's skin pigmentation (eye colour). The effects of exposure to a laser beam include:
 - **Distraction:** The dazzling effect on the eye can be a major distraction, particularly in situations of high workload (e.g. take-off, approach, and landing or if the aircraft is operating at low level, such as a Police or rescue helicopter).

² <https://www.icao.int/MID/Documents/2017/RASG-MID6/RSA%2012-%20Revised-%20Laser%20Attacks%20Safety%20Guidelines.pdf>

³ <https://www.lasersafetyfacts.com/>

- **Temporary Visual Impairment:** Adverse visual effects that include:
 - glare (a temporary disruption in vision caused by bright light within an individual's field of vision);
 - flash-blindness (the inability to see, caused by bright light entering the eye) that persists after the illumination has ceased, and
 - after-image (an image that remains in the visual field after exposure to a bright light).
 - **Eye Injury:** Temporary or permanent damage to the eye caused by exposure to laser light. Normally the result of direct exposure to prolonged or high-power laser light.
- 2.7. Even without lasting damage to the eyes, laser strikes on illumination of aircraft can cause distraction, disorientation, and discomfort for pilots resulting in a potentially hazardous situation during critical phases of flight.

3. How lasers are regulated in New Zealand

- 3.1. The Ministry of Health has determined that laser pointers with a power output of more than 5 mW pose a greater risk of eye damage while those in excess of 500 mW, typically Class IIIb and Class IV lasers, will burn skin and damage eyes.
- 3.2. Anyone who wishes to import, hold or supply lasers in New Zealand with a power output of more than 1 mW must obtain authorisation from the Director-General of Health.
- 3.3. Lasers with a power output of more than 1 mW are also on the New Zealand Customs Service list of Prohibited items so, if imported without authorisation, are likely to be seized by Customs.
- 3.4. The Ministry of Health webpages listed in Section 8, below, provide information on how to apply and how to work out if a device needs approval.

4. How pilots can mitigate effects of a laser strike Pilot Mitigation Strategies

- 4.1. The time and place of an unauthorised targeted (or inadvertent) laser strike on illumination of an aircraft by a laser is difficult to predict, although there is evidence that aircraft operating in certain locations, particularly around airports, are increasingly likely to be targeted subject to unauthorised illumination.
- 4.2. Whenever practicable, pilots should consider avoiding any area where a laser strike has been reported by preceding aircraft. Flights within areas of recently reported laser or bright light activity should be avoided. Pilots operating in controlled airspace should obtain an ATC clearance before deviating from their cleared flight path, having first dealt with their immediate safety concerns.
- 4.3. In the event that if a pilot encounters a laser strike an unauthorised laser illumination of an aircraft, they should the following actions are recommended:

- i. ~~Do~~ Not stare directly into the laser beam – avert or shield the eyes if possible.
- ii. If the vision of one pilot in a two-pilot crew your vision is affected, hand over control (as long as assuming a two-pilot crew, and that the other pilot has not been affected).
- iii. ~~Crews~~ If manually flying aircraft fitted with modern autopilots and Flight Management Systems (FMS), might need to consider autopilot re-engagement, and use of FMS to aid flight path control.
- 4) ~~Turning~~ Turn up cockpit lighting, as this may assist in overcoming the ‘flash’ after-effects (and peripheral vision may still be effective).
- 5) ~~Do~~ Try not to rub their eyes after exposure.
- 6) If any lingering effect is experienced, seek medical attention after landing.

Note: Actions in 4.3(ii) and (iii) should be carried out in a manner consistent with aircraft/ operator Standard Operating Procedures (SOPs).

- Report the occurrence immediately to ATC, and as soon as possible through your normal reporting channels.

¹~~Consistent with aircraft/operator Standard Operating Procedures.~~

5. Reporting a Laser Strike Illumination Incident to an ATC unit

5.1. As soon as possible following a laser strike illumination occurrence, the flight crew should report the incident by radio to the appropriate ATC unit. Expedious Timely reporting will allow ATC to alert other pilots to the hazard more quickly and increase the chances of will assist the Police in locating the source of the laser strike transmission(s).

5.2. The initial radio report to ATC should include the following:

- i. Aircraft call sign
- ii. Nature of report (laser strike illumination)
- iii. Aircraft position at time of occurrence
- iv. Aircraft altitude at time of occurrence
- v. Colour of laser
- vi. Location of origin of light source or relative direction and estimated distance from aircraft⁴, and

⁴ Pilots should avoid looking directly at the source (as the priority is to minimise exposure effects).

- vii. Any other information that might assist law enforcement.

~~²Pilots should avoid looking directly at the source (priority is to minimise exposure effects)~~

5.3. All ATC units advised of a laser strike will provide relevant information to any following aircraft.

5.4. In accordance with the Manual of Air Traffic Services, the ATC unit involved will also contact the Police as soon as possible and provide them with a detailed report to help in locating the source of the laser.

6. Reporting a laser strike to CAA Follow-up Actions

~~All ATC Units advised of a laser illumination occurrence will provide relevant information to any following aircraft. In accordance with the Manual of Air Traffic Services, the ATC Unit involved will also contact NZ Police as soon as possible and provide them with a detailed report to assist in locating the source of the laser.~~

6.1. ~~An unauthorised illumination~~ A laser strike of an aircraft by a laser constitutes an aircraft incident, and therefore so a pilot who experiences experiencing a laser strike illumination occurrence is required to submit details of the incident to CAA the Authority either:

- i. if a serious incident (e.g. causing flight crew incapacitation), in accordance with [rule 12.55, Notification of incident](#), or
- ii. in accordance with [rule 12.57, Details of incident](#).

6.2. ~~In addition to the requirements of Part 12 for notifying and reporting incidents, pilots experiencing a laser strike illumination of an aircraft are also requested to complete a "Laser Beam Exposure Questionnaire" (form CAA 800) and submit it to the CAA, either directly or through normal company channels (as appropriate). Form CAA 800 is available on the CAA website <http://www.caa.govt.nz/Forms/CAA800.pdf>.~~

6.3. The information provided will help assist the CAA and other agencies identify in identifying the key risk areas and determine determining appropriate mitigation and solutions in concert with other agencies.

7. Recommendations for Operators

7.1. All air operator certificate (AOC) holders should consider including specific materials to ensure that their exposition contains guidance information for crews on the immediate actions to be taken to mitigate the effects if their aircraft is targeted by a laser strike illumination. The guidance should also include follow-up action, including the need to report the incident. Crew members should be

encouraged to seek medical attention if the eye exposure to a laser is **lasting** ~~of more than transient duration~~ or if there are any lingering effects.

8. Related Information

8.1. ~~There are a number of very informative documents and articles on the hazards of lasers for aviation.~~ The links below contain information about controls on the importation, supply and acquisition of laser pointers in New Zealand, including a guide to how to tell if a device is a high-power laser pointer:

- <https://www.health.govt.nz/our-work/environmental-health/high-power-laser-pointers>
- <https://www.health.govt.nz/our-work/environmental-health/high-power-laser-pointers/questions-and-answers-new-controls-high-power-laser-pointers>
- <https://www.customs.govt.nz/business/import/import-prohibited-and-restricted-imports/prohibitions-and-restrictions/>

8.2. The relevant Health and Customs regulations are available at:

- [Health \(High-power Lasers pointers\) Regulations 2013](#) which restricts the supply of high-power laser pointers to those who are authorised suppliers and also restricts the acquisition of such devices to those who are authorised recipients.
- [Customs Import Prohibition \(High-power Laser Pointers\) Order 2019](#) which restricts the importation of high-power laser pointers to those people who have received consent from the Director-General of Health to import them.

8.3. Lasers are also covered in the [Summary Offences Act \(1981\), section 13B](#) which details fines, imprisonment or forfeiture rules for possession of high-power laser pointers, and the [Aviation Crimes Act 1972 section 5\(c\)](#) which authorises Police to prosecute individuals using lasers to target aircraft.

8.4. ~~There is more general information in the Vector articles below:~~ ~~The following references provide some further suggested reading material:~~

- [A new hazard –bird-scaring lasers](#), Autumn 2021
- [Report Laser Strikes](#), March/April 2018
- ~~Jan/Feb 2008: Laser Incidents in New Zealand Aviation (link from CAA website)~~

And on the CAA website:

- <https://www.aviation.govt.nz/about-us/media-releases/show/Police-and-commercial-pilots-appeal-to-put-an-end-to-laser-strikes>

- <https://www.aviation.govt.nz/about-us/media-releases/show/use-christmas-laser-lights-safely>
- <https://www.aviation.govt.nz/safety/aviation-concerns/>
- ~~[FAA AC No:70-2](#): FAA reporting requirements for laser illumination incidents. (link from FAA website: www.faa.gov)~~
- ~~[DOT/FAA/AM-06/23](#): A US review of recent laser events in aviation from a medical perspective. A study by the US Office of Aerospace Medicine. (Report available from FAA website: www.faa.gov)~~
- ~~[CRS Web RS22033](#): Lasers aimed at aircraft cockpits. A report for US Congress prepared by the Federation of American Scientists. (www.fas.org)~~