Appendix 3. Classes of laser

Lasers are classified on the basis of their accessible emission. It is the manufacturer's responsibility to classify the laser, but a user who significantly modifies a laser takes on the role of manufacturer including the responsibility to reclassify (or confirm the original classification).

For each laser class there is an Accessible Emission Limit (AEL), generally expressed in Watts or Joules, and a number of conditions of measurement under which a laser's output is to be measured for comparison with the AEL. Full details are provided in EN 60825-1: 2007 Safety of laser products: Part 1.

A3.1 Class 1

Class 1 laser products are safe in normal use under reasonably foreseeable conditions. There are two types of Class 1 laser products:

A3.1.1 Intrinsic Class 1

The laser output is safe because the output of the laser source is too low to cause harm, even if magnifiers or other such optical devices are used to modify the laser beam or assist viewing. This Code places no requirements on the use of intrinsic Class 1 lasers.

A3.1.2 Embedded laser product: safe by engineering design

Embedded laser products are ones that because of engineering safety features have been assigned a class lower than they would otherwise have. In general this means that the laser radiation is totally enclosed, preventing it becoming accessible to the user in normal operation.

In this Code the term 'Embedded' is restricted to products that are Class 1 but contain a Class 3B or Class 4 laser that is accessible in the service or maintenance operations specified by the manufacturer.

The use of Embedded laser products in general is dealt with in this Code because: (i) a degree of maintenance and care in the use of the product is required to preserve its safety; and (ii) the laser hazard may be exposed during maintenance and servicing of the product.

However, this Code places no requirements on the use of embedded laser products that are Class 1 consumer products, including desk top laser printers, LED printers and photocopiers, CD and DVD players and recorders provided they are serviced off site.

A3.2 Class 1M

Class 1M laser products typically emit well collimated beams of diameter greater than the pupil size of the eye (7 mm maximum) and are safe for 'naked eye' viewing (i.e. without the use of viewing aids) by virtue of the fact that the eye will only collect a fraction of the total laser output.

The applicability of Class 1M is restricted to laser wavelengths in the range 302.5 nm to 4 µm. This is deemed to be the reasonably foreseeable transmission range of optical viewing aids and corresponds approximately to the transmission window of fused quartz.

Class 1M lasers products are regarded as low risk in this Code.

A3.2.1 Class 1M (collimated beam)

Class 1M laser products emitting laser beams that are of larger diameter than the pupil size of the eye (7 mm maximum) are safe for 'naked eye' viewing (i.e. without the use of viewing aids) by virtue of the fact that the eye will only collect a small fraction of the total laser output. However, viewing with a telescope or binoculars collects light over a much greater diameter than 7 mm and can therefore be unsafe.

A3.3 Class 2

Class 2 laser products emit low levels of visible radiation (i.e. in the wavelength range 0.4 to 0.7 µm) and are safe in normal use by virtue of the natural aversion response of the eye to bright light, which is deemed to limit the duration of exposure to 0.25 s. Nevertheless they present a severe dazzle hazard. For a Continuous Wave (CW) laser the Class 2 AEL is 1 mW.

Class 2 laser products are regarded as Low Risk in this Code.

A3.4 Class 2M

Class 2M laser products typically emit well collimated beams of visible radiation (i.e. in the wavelength range 0.4 to 0.7 µm) of diameter greater than the pupil size of the eye (7 mm maximum) and are safe for 'naked eye' viewing (i.e. without the use of viewing aids) by virtue of the natural aversion response of the eye to bright light and the fact that the eye will only collect a fraction of the total laser output. They are safe in normal use provided that:

(i) the observer does not stare into the beam; and

(ii) lenses and/or mirrors are not used to reduce the laser beam diameter and then re-collimate the beam; and (iii) telescopic optical devices are not used to assist viewing. Control of such viewing aids and optical arrangements is generally sufficient to ensure safety.

Class 2M lasers products are regarded as low risk in this Code. Nevertheless, they present a severe dazzle hazard.

A3.4.1 Class 2M (collimated beam)

Class 2M laser products emitting laser beams in the wavelength range 0.4 to 0.7 µm that are of larger diameter than the pupil size of the eye (7 mm maximum) are safe for 'naked eye' viewing (i.e. without the use of viewing aids) by virtue of the natural aversion response of the eye to bright light and the fact that the eye will only collect a small fraction of the total laser output. However, viewing with a telescope or binoculars collects light over a much greater diameter than 7 mm and can therefore be unsafe.

A3.5 Class 3R

Class 3R laser products are unsafe for direct viewing of the laser beam, whether in aided or unaided viewing, but for which the risk is still regarded as low.

The AEL for Class 3R is 5 times greater than for Class 1 or, for visible beam lasers, 5 times greater than for Class 2. This means that direct ocular exposure to the output of a Class 3R laser carries a low (i.e. not entirely negligible) risk of injury. This contrasts with Class 1M and 2M lasers for which naked eye viewing is safe but with viewing aids the risk of injury can be high.

The applicability of Class 3R is restricted to laser wavelengths greater than 302.5 nm, since for shorter wavelength ultraviolet the 5 times excess is deemed too great a factor for the exposure to be low risk.

Class 3R lasers products are regarded as Low Risk in this Code.

A3.6 Class 3B

Class 3B laser products are medium power devices for which direct ocular exposure is unsafe, but for which the diffuse reflection is safe under certain conditions (i.e. a minimum viewing distance of 130 mm and a maximum viewing time of 10 seconds). The beam also presents a minor skin hazard, especially when focused. For a CW laser in the visible or infrared wavelength range the Class 3B AEL is 500 mW.

Class 3B laser products are regarded as High Risk in this Code.

A3.7 Class 4

Class 4 laser products are high power devices for which even the diffuse reflection is generally hazardous. They may also cause skin burns and may present a fire hazard. There is no AEL for Class 4.

Class 4 laser products are regarded as High Risk in this Code.