

37 Artificial Optical Radiation Safety

Scope

1 Artificial optical radiation (AOR) is electromagnetic radiation emitted by non-natural sources in the wavelength range 100 nm to 1 mm. It includes coherent (laser) and non-coherent (broadband) optical radiation but not all of this radiation is in the visible region¹. Hazards from exposure to optical radiation are wavelength dependent, and it is convenient to breakdown the spectrum broadly into three regions namely ultra-violet (UV) radiation; visible radiation; and infra-red (IR) radiation. Both the UV and IR regions may be further broken down into 3 subdivisions. This Chapter details the requirements for the keeping, using and disposal of equipment emitting AOR, or equipment containing components which emit AOR.

Table 1 Optical radiation wavelength regions

Optical radiation wavelength regions		
Region	CIE Definition λ (nm)	ICNIRP/IEC/ACGIH definition λ (nm)
UV-C	100 - 280	180 - 280
UV-B	280 - 315	280 - 315
UV-A	315 - 380	315 - 400
Visible	380 - 760	400 - 700
IR-A	760 - 1400	700 - 1400
IR-B	1400 - 3000	1400 - 3000
IR-C	3000 - 1000000	3000 - 1000000

NOTES

- (1) CIE - International Commission on Illumination.
- (2) ICNIRP - International Commission on Non Ionising Radiation Protection.
- (3) IEC - International Electro-technical Committee.
- (4) ACGIH - American Congress of Government Industrial Hygienists.

¹ Generally, AOR is not considered to be a type of ionising radiation. However, parts of the ultraviolet (UV) spectrum furthest from the visible region have some ionising properties.

Statutory Requirements

2 The Control of Artificial Optical Radiation at Work Regulations 2010 (CAOR 10) applies directly. The regulations are based on the limit values incorporated in the guidelines issued by the International Commission on Non-Ionising Radiation Protection (ICNIRP). This legislation applies to both coherent (laser) and non-coherent (broadband) optical radiation that is not of natural origin. These regulations rely on protection under existing regulatory provisions², where appropriate, and will essentially only have an impact in those areas where hazardous sources of artificial optical radiations are being used and the risks are not already being appropriately managed.

3 The general provisions of the Health and Safety at Work etc. Act 1974, and the Management of Health and Safety at Work Regulations 1999, also apply.

MOD Mandatory Guidance

4 There is no MOD mandatory guidance on exposure to artificial optical radiations except in this document and, in relation to lasers, DSA03-OME Part 5 (JSP 390) – Defence Code of Practice (DCOP) and Guidance Notes for Lasers which details the keeping, use and disposal of equipment involving lasers.

Duties

5 Duties as detailed in Chapter 39 apply. In addition, the following duties also apply.

Laser Safety Officer (LSO)

6 A Laser Safety Officer (LSO) is to be appointed by establishments to co-ordinate laser safety arrangements at the unit or establishment and to ensure that adequate radiation protection arrangements are made to prevent exposure to potentially harmful laser radiation. An LSO must be appointed by units or establishments where class 3R, 3B or 4 lasers are used. An LSO should also be appointed where class 1M and 2M lasers are used in areas where such lasers could foreseeably be viewed using enhanced optics such as binoculars. Duties of the LSO are given in DSA03.OME Part 5 LASERS Defence Code of Practice (DCOP).

Sources of Artificial Optical Radiation and Their Hazards

7 The majority of light sources can be considered safe, with no further action being required, such as the following:

- a. all forms of ceiling-mounted lighting used in offices etc that have diffusers over bulbs or lamps;
- b. all forms of task lighting including desk lamps and tungsten-halogen lamps fitted with appropriate glass filters to remove unwanted ultraviolet light;
- c. photocopiers;

² e.g. The Management of Health and Safety at Work Regulations 1999 and the Health and Safety (Safety Signs and Signals) Regulations 1996.

- d. computer or similar display equipment, including personal digital assistants (PDAs);
- e. light emitting diode (LED) remote control devices;
- f. photographic flash lamps – when used singly;
- g. gas-fired overhead heaters;
- h. vehicle indicator, brake, reversing and fog lamps;
- i. any exempt or Risk Group 1 lamp or lamp system (including LEDs), as defined in British Standard BS EN 62471: 2008; and
- j. any Class 1 laser light product, as defined in British Standard BS EN 60825-1:2014+A11:2021, for example laser printers and bar code scanners.

8 There are also some sources of light that, if used inappropriately, e.g. placed extremely close to the eyes or skin or viewed through enhanced optics such as binoculars, have the potential to cause harm but which are perfectly safe under normal conditions of use. Examples include:

- a. ceiling-mounted fluorescent lighting without diffusers over bulbs or lamps;
- b. high-pressure mercury floodlighting;
- c. desktop projectors;
- d. vehicle headlights;
- e. non-laser medical applications such as: operating theatre and task lighting; diagnostic lighting such as foetal/neonatal transilluminators and X-ray light/viewing boxes;
- f. UV insect traps;
- g. art and entertainment applications such as illumination by spotlights, effect lights and flash lamps (provided that any ultraviolet emissions have been filtered out);
- h. multiple photographic flash lamps for example in a studio;
- i. any Risk Group 2 lamp or lamp system (including LEDs), as defined in British Standard BS EN 62471: 2008; and
- j. Class 1M, or 2M lasers, as defined in British Standard BS EN 60825-1: 2014+A11:2021.

9 The above list is not exhaustive. If these are your only sources, your workers are not at risk and no further action is required. However, when making this decision it is worth considering the following points to satisfy yourself that all personnel are protected:

- a. personnel whose health is at particular risk, (e.g. those with pre-existing medical conditions made worse by light);
- b. personnel who use any chemicals, (e.g. skin creams) or pharmaceuticals both prescription and “over the counter” that could react with light to make any health effects worse;
- c. personnel who are exposed to multiple sources of light at the same time; and
- d. if exposure to bright light could present unrelated risks, (e.g. temporary blindness could lead to mistakes being made in hazardous tasks).

10 The list is not exhaustive. If you have sources that are not listed but you know have not caused harm previously, and you have no reason to suspect they present a risk in the way they are used, you can assume no special control measures are needed.

11 Some sources of light can cause a risk of ill health, such as: burns or reddening (erythema) of the skin or surface of the eye (photokeratitis); burns to the retina of the eye; so-called blue-light damage to the eye (photoretinitis) and, damage to the lens of the eye that may bring about the early onset of cataracts.

12 Examples of hazardous sources of light that present a ‘reasonably foreseeable’ risk of harming the eyes and skin of workers and where control measures are needed include:

- a. metal working – welding (both arc and oxy-fuel) and plasma cutting;
- b. pharmaceutical and research – UV fluorescence and sterilisation systems;
- c. hot industries – furnaces;
- d. printing – UV curing of inks;
- e. motor vehicle repairs – UV curing of paints and welding;
- f. medical / dental and cosmetic treatments – laser surgery, blue light and UV therapies, Intense Pulsed Light sources (IPLs), annealing (blue light) equipment;
- g. industry, research and education, for example, all use of Class 3R, Class 3B and Class 4 lasers, as defined in British Standard BS EN 60825-1: 2014+A11:2021; and
- h. any Risk Group 3 lamp or lamp system (including LEDs), as defined in British Standard BS EN 62471: 2008, for example search lights, professional projections systems.

13 Less common hazardous sources are associated with specialist activities – for example lasers exposed during the manufacture or repair of equipment, which would otherwise not be accessible.

14 Certain drugs and chemicals can cause abnormal photosensitive responses. Additionally, some individuals have abnormal photosensitive responses due to genetic, metabolic or other abnormalities. Children and fair skinned people are also particularly sensitive to UVR.

15 It should be noted that a certain amount of exposure to UVR is necessary in the generation of Vitamin D. Vitamin D is necessary for healthy bone growth. Although periods of outdoor skin exposure are necessary for these effects to take place, excessive or intensive exposures will not confer additional benefits.

16 It should be noted that biological damage may be caused by exposure to UV radiation which is below the threshold of perception.

Exposure Limits

17 Limits on exposure have been adopted for exposure of the eyes and skin, at levels which nearly all individuals may be repeatedly exposed without adverse health effects.

18 These exposure limit values (ELVs) apply directly to workers and members of the public exposed to AOR. For laser radiation the BS EN standards should be applied. For non-coherent radiation the BS EN standards and the recommendations of the CIE and CEN should be followed.

19 Where exposure is due to artificially produced AOR in an occupational environment, engineering and administrative controls are the preferred measures for exposure control.

20 Measurement and calculation for comparison with quantitative ELVs is a relatively complex task.

Risk Assessment

21 A suitable and sufficient risk assessment as required by the CAOR 2010 is required for all work with potentially hazardous AOR sources. Potentially hazardous means that there is a potential exposure scenario (including accident scenarios) where ELVs can be exceeded or where workers have made it known to line management that they could be more susceptible to the effects of exposure to AOR due to the issues raised in Para 14.

Local Orders for Ultra Violet Sources

22 Where a risk assessment shows that working with a source of UV radiation requires special precautions to avoid an overexposure, these precautions should be included in local orders. Local orders should include (where relevant) details of the RSO/WPS, significant findings of the risk assessment, maintenance of engineering controls, requirements for PPE (including storage and checking procedures), requirements for monitoring, contingency plans and any training requirements for working safely with the source.