

Leaflet 37

Artificial Optical Radiation Safety

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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 Leaflet details the requirements for the keeping, using and disposal of equipment emitting AOR, or equipment containing components which emit AOR.

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.

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.

Statutory Requirements

2 The Control of Artificial Optical Radiation at Work Regulations 2010 (CAOR 10) applies directly. These regulations came into force on 27th April 2010. The regulations are based on the limit values incorporated in the guidelines issued by the International Commission on Non-ionizing 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 introduce new regulatory provisions limited to new specific requirements set by the Directive, where necessary.

3 These regulations (CAOR 10) having regard to existing protections, 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.

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

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

MOD Mandatory Guidance

5 There is no MOD mandatory guidance on exposure to artificial optical radiations except in this document and, in relation to lasers, the Ministry of Defence Military Laser Safety JSP 390 details the keeping, use and disposal of equipment involving lasers.

Duties

Commanding Officer and Head of Establishment (CO/HoE)

6 The CO/HoE has a duty to the Secretary of State, and a personal responsibility, to protect the environment and secure the health, safety and welfare of their staff at work. The CO/HoE is also required to protect persons not in MOD employment (e.g. members of the public) against risks to their health and safety arising from the MOD work activities. This includes radiation safety. The CO/HoE's authority (but not responsibility) for radiation safety management arrangements may be delegated to appropriate personnel, such as a Radiation Safety Officer (RSO) or a Laser Safety Officer (LSO).

Radiation Safety Officer (RSO)

7 The Radiation Safety Officer (RSO) is to ensure that:

- They are familiar with the specific radiation hazards at their unit or establishment and that an appropriate risk assessment has been carried out;
- Local orders include the requirements for keeping and using sources of UV radiation as detailed in this leaflet;
- Staff are appointed, instructed and trained in their duties relating to this leaflet;
- The requirements stemming from this leaflet are subject to audit.

Laser Safety Officer (LSO)

8 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. Duties of the LSO are given in JSP 390.

Employees

9 It is the responsibility of all employees to ensure that they are familiar with the relevant parts of local orders to ensure that these items are handled safely and correctly. Any incidents are to be reported to the appropriate supervisor or line manager.

Sources of Artificial Optical Radiation

10 For most people the main source of UVR exposure is the sun. However UVR is used in a wide range of applications in medical and industrial processes, and for cosmetic purposes. These include dentistry, dermatology, photo-curing of inks and plastics, solar simulation, fade testing photo-resist processes and cosmetic tanning. Many industrial processes employ arc sources for heat and light (e.g. arc welding) which produce UVR adventitiously. This list is not exhaustive.

Hazards

11 Because of the limited penetration of AOR into the body the main organs likely to be affected are the eye and the skin.

12 The majority of light sources are safe, such as the following:

List 1 - Safe Light Sources

- All forms of ceiling-mounted lighting used in offices etc that have diffusers over bulbs or lamps.
- All forms of task lighting including desk lamps and tungsten-halogen lamps fitted with appropriate glass filters to remove unwanted ultraviolet light.
- Photocopiers.
- Computer or similar display equipment, including personal digital assistants (PDAs).
- Light emitting diode (LED) remote control devices.
- Photographic flash lamps – when used singly.
- Gas-fired overhead heaters.
- Vehicle indicator, brake, reversing and fog lamps.
- Any exempt or Risk Group 1 lamp or lamp system (including LEDs), as defined in British Standard BS EN 62471: 2008.
- Any Class 1 laser light product, as defined in British Standard BS EN 60825-1:2007, for example laser printers and bar code scanners.

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

- Ceiling-mounted fluorescent lighting without diffusers over bulbs or lamps.
- High-pressure mercury floodlighting.
- Desktop projectors.
- Vehicle headlights.
- Non-laser medical applications such as: operating theatre and task lighting; diagnostic lighting such as foetal/neonatal transilluminators and X-ray light/viewing boxes.
- UV insect traps.
- Art and entertainment applications such as illumination by spotlights, effect lights and flash lamps (provided that any ultraviolet emissions have been filtered out).
- Multiple photographic flash lamps for example in a studio.
- Any Risk Group 2 lamp or lamp system (including LEDs), as defined in British Standard BS EN 62471: 2008.
- Class 1M, 2 or 2M lasers, as defined in British Standard BS EN 60825-1: 2007, for example low-power laser pointers.

14 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:

- Personnel whose health is at particular risk, (e.g. those with pre-existing medical conditions made worse by light).
- 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.
- Personnel who are exposed to multiple sources of light at the same time.

- If exposure to bright light could present unrelated risks, (e.g. temporary blindness could lead to mistakes being made in hazardous tasks).

15 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.

List 2 - Hazardous light sources

16 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.

17 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:

- Metal working – welding (both arc and oxy-fuel) and plasma cutting.
- Pharmaceutical and research – UV fluorescence and sterilisation systems.
- Hot industries – furnaces.
- Printing – UV curing of inks.
- Motor vehicle repairs – UV curing of paints and welding.
- Medical and cosmetic treatments – laser surgery, blue light and UV therapies, Intense Pulsed Light sources (IPLs).
- Industry, research and education, for example, all use of Class 3B and Class 4 lasers, as defined in British Standard BS EN 60825-1: 2007.
- 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.

18 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.

19 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.

20 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.

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

Exposure Limits

22 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.

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

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

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

Risk Assessment

26 A prior risk assessment as required by the Ionising Radiations Regulations 1999 is unlikely to be required. However, a suitable and sufficient risk assessment as required by the CAOR 2010 is required for all work with AOR sources.

Related Publications

27 Publications of relevance to this leaflet are shown in Table 2.

Table 2 Related publications

Publication
The Control of Artificial Optical Radiation at Work Regulations 2010
Guidance for Employers on the The Control of Artificial Optical Radiation at Work (AOR) Regulations 2010
EU Artificial Optical Radiation Non-Binding Guidance – HPA 2008

Legal and MoD Mandatory Requirements

28 The Ministry of Defence Military Laser Safety JSP 390 details the keeping, use and disposal of equipment involving lasers operating throughout the optical radiation spectrum. This guidance is consistent with CAOR 2010. Table 3 below summarises the legal requirements.

Table 3 Legal and MOD mandatory requirements

Requirement	Applicable	Comments	Related leaflet
HSE authorisation	✘		
HSE notification	✘		
EA notification	✘		
Risk assessment	✓	As required by CAOR 2010	-
Restriction of exposure	✓	Comply with local orders	4
PPE	✓	May be appropriate under certain circumstances	-
Maintenance of engineering controls	✓	See local orders	-
Contingency plans	✓	See local orders	-

Designation of areas	✘		
Monitoring	✓	On first installation then as local orders	-
Training for users	✓	Information and instruction only	-
Local orders	✓	Local orders are to specify the location and nature of UVR sources at the unit or establishment and the precautions to be taken in their normal use, and during maintenance.	-
RPS	✘		
Storage	✘		
Accounting	✘		
Leak testing	✘		
Personal dosimetry	✘		
Transport	✘		
Disposal	✓	Return to stores	-
MLSC	✓	Only if AOR is contained within, or emitted as, laser radiation.	34