Appendix 5. Laser control measures: normal operation

A5.1 General

A5.1.1 All lasers except for No Risk laser products (see definitions in Section 3) are to be labelled in accordance with Appendix 8.

A5.1.2 Laser equipment in use must be properly maintained and serviced.

A5.1.3 Lasers must be made safe prior to disposal and dealt with appropriately if they contain hazardous materials.

A5.2 Low Risk lasers

A5.2.1 Risk assessment

Low Risk category lasers (see definitions in Section 3) can be used anywhere on site provided that the person responsible for their use implements the default control measures set out below; otherwise a risk assessment must be undertaken before use.

A5.2.2 Engineering controls

Open beam paths for Class 1M, 2M and Class 3R lasers must take account of the following basic beam path design principles:

Basic beam path design principles
i. Locate horizontal beams above or below eye level
ii. No upwardly directed open beam paths
iii. Terminate the beam at the end of its useful range

A5.2.3 Administrative controls

Embedded lasers

A5.2.3.1 Embedded lasers must be operated according to the manufacturer's instructions.

A5.2.3.2 If access to the embedded laser is uncontrolled and a key switch is provided, this must be withdrawn and stored in a safe place when the product is not in use.

N.B. Additional measures apply for maintenance and service activities (see Appendix 6).

Class 1M and 2M lasers

A5.2.3.3 The use of binoculars and telescopes must be strictly controlled within the Extended Nominal Ocular Hazard Distance of Class 1M and 2M lasers.

Options include:

(i) banning the use of viewing aids in the area;

(ii) equipping viewing aids with filters that block at the laser wavelength; or

(iii) fitting an interlocked shutter or turning mirror arrangement that prevents the laser beam entering the viewing aid when the laser is on.

Class 1 and 2 lasers

A5.2.3.4 Where Class 1 and Class 2 lasers (and lasers that have been classified as 1M or 2M under EN 60825-1 Edition 2) emit a high divergence output; an assessment must be made of the increased beam hazard created by collimating optical components in the beam path. A similar assessment must be made of the output of Class 1M and 2M lasers that emit a large diameter collimated beam if optical components in the beam path reduce and then re-collimate the laser beam.

Green beam laser pointers

A5.2.3.5 CW Green beam laser pointers are notorious for being overpowered and incorrectly classified and, as an additional check, their maximum output (e.g. with new batteries) should be measured on site and their use be prohibited unless the output is below the AEL for Class 2 not exceeded the stated Class (i.e. ≤ 1 mW) for hand held general use and, exceptionally, below the AEL for Class 3R (i.e. ≤ 5 mW) for specialist use.

A5.3 High Risk lasers

A5.3.1 General

A5.3.1.1 High Risk lasers (see definitions in Section 3) must only be operated inside Designated Laser Areas (See Appendix 7).

A5.3.1.2 Before starting work involving High Risk lasers a number of basic risk reduction measures must be considered:

- Can a lower powered laser be used?
- Can the output power of the laser be restricted if full power is not needed?
- Can intra-beam viewing be prevented by engineering design?
- Can the laser be used in a screened off area - limiting potential for others to be affected?
- Can work be carried out in a total enclosure?

A5.3.1.3 All work involving High Risk lasers must be covered by risk assessments and Standing Orders.

A5.3.1.4 The risk assessment must address, in particular, any deviations from implementing the control measures set out below.

A5.3.1.5 Laser Nominated Persons must be suitably trained in the operating techniques required and inexperienced staff must be adequately supervised.

A5.3.2 Engineering controls

Control of access

A5.3.2.1 Lasers inside a Designated Laser Area (DLA) must be linked into the external interlock chain provided within the DLA, either using the remote interlock connector on the laser or an external safety shutter, such that:

- The laser emission is rapidly terminated when a break occurs in the external interlock chain. For pulsed systems, if termination is achieved by removal of the energy source, this must be accompanied by the dumping of any residual energy which could give rise to further laser pulses;
- Resetting the external interlock chain must not cause automatic emission of hazardous levels of laser radiation. A manual operation must be required for reinstatement of the laser emission.
- If an external safety shutter on the laser it must be:
  - located either within the protective housing or, if external, as close to the laser aperture as reasonably practicable and in fixed location to it;
  - of a robust, fail-safe design and construction;
  - fast acting;
  - provided with a clear visual indication of when it is in its closed position. This indication must be derived from the location of the interlocked beam stop and not from some control signal or interruption in the external interlock chain;
  - provided with an approved means of connection to the external interlock chain.

Design of beam paths

A5.3.2.2 High Risk laser beam paths must take account of the basic open beam path design principles in A5.2.2 plus the restricted open beam path design principles:

Restricted beam path design principles

i. Main and hazardous secondary beams are enclosed

ii. Lasers and optics that define the beam path are securely mounted

iii. Beam paths are as short as reasonably practicable with a minimum number of directional changes

iv. Open beam paths are clear of surfaces producing hazardous reflections

Design of enclosures

A5.3.2.3 Beam stops and enclosures for this purpose need to be robust and firmly located in position. Screening for Class 4 lasers must be of fire resistant material and beam stops must have a heat dissipating capacity sufficient for the output of the laser. (N.B. For high average power laser beams, such as are used for materials processing, the potential of the laser beam to penetrate an otherwise opaque screen by melting or vaporising the material of construction must be considered; design details for protective elements exposed to damaging levels of laser radiation can be found in EN 60825-4 'Safety of laser products: Part 4 - Laser Guards')

A5.3.2.4 Removable sections of enclosures should be fixed so that tools are required for their removal.

A5.3.2.5 The material of construction of enclosures should be opaque at the laser wavelength(s) and gaps in the enclosure should be sealed.

A5.3.2.6 The interlocking of removable sections of an enclosure is not a general requirement. If an interlock override is required then the use of the override must activate a visual or audible warning and the act of replacing the removable sections must reset the override.

A5.3.2.7 Enclosure and removable panels must be properly labelled. (See Appendix 8)

Permitted deviations from beam path principles

A5.3.2.8 Deviations from the basic and restricted beam path design principles are only permitted after a thorough risk assessment has been made.

A5.3.2.9 Calculations of worst case exposure to laser radiation must be referenced or appended to the risk assessment. The risk assessment should also include all measures taken and a note of why engineering controls are not feasible in this case.

A5.3.2.10 Where complete beam enclosure is impractical then a combination of local enclosure (in particular around sources of scattered radiation such as laser dye cells and sources of multiple beams such as prisms and filter stacks) and peripheral enclosure (skirts around optical tables) must be employed.

A5.3.2.11 In general, deviations should only be permitted if alterative engineering controls (e.g. a pressure pad or intruder-type beam interrupt in the case of beams crossing walk-ways) are implemented.

A5.3.2.12 Administrative controls (e.g. the use of retractable tape or chain or by floor markings in the case of beams crossing walk-ways, restrictions in the use of objects with flat shiny surfaces in the case of open beam paths) may only be considered to replace engineering controls if it can be demonstrated that the maximum reasonably foreseeable laser exposure is less that 5 times the MPE for accidental exposure.

Beam release

A5.3.2.13 If the master laser control panel of the laser cannot be located less than 2m away and in line of sight from where persons could receive a hazardous exposure from the beam, then a clear system of communication must be established between the laser operator and any person in the hazard zone, giving adequate warning of each activation of the laser hazard.

A5.3.2.14 The following considerations must be made in regard to the transfer of High Risk laser beams between rooms:

- Persons in the room receiving the laser beam must have sole and overriding control to prevent the emergence of the laser hazard. The means of preventing the emergence of the laser hazard must be clearly visible from within the room and an indication must be provided on the status of the laser with regard to emission of laser radiation.
- Persons in the room containing the laser must have a reliable means of terminating the beam path within the room.

A5.3.3 Administrative controls

Unauthorised use

A5.3.3.1 If access to the laser is uncontrolled then the key must be withdrawn from the switch when the laser is not in use and stored in a safe place.

Unintended reflections

A5.3.3.2 Watches, rings and other items of jewellery that might specularly reflect a laser beam must be removed or covered.

A5.3.3.3 Other items with shiny surfaces must be kept away from open beam paths. Optical benches must be kept free from clutter (N.B. Many surfaces which appear visually dull will be highly specularly reflecting for infrared radiation).

A5.3.3.4 The individual who adjusts or introduces an optical component into a beam path is responsible for identifying and terminating each and every stray beam coming from that component.

A5.3.3.5 The placement of additional optics should be planned to minimise the possibility of stray reflections.

A5.3.4 Personal Protective Equipment

A5.3.4.1 Laser safety eyewear must be provided and worn if, after applying all reasonably practicable control measures, adequate protection for the eyes has not been achieved. In general, this applies to all people working with High Risk lasers when the beam is not totally enclosed (See Appendix 9 for details of selection and use of laser safety eyewear).

A5.3.4.2 If the High Risk laser hazard is only present occasionally then controls should be introduced (e.g. deployment of engineering means to isolate the laser hazard; initiate a pre-warning to replace eyewear) to allow the removal of laser safety eyewear in the laser area when it is safe to do so.

A5.3.4.3 The risk of skin burns must be assessed when working with Class 4 lasers and appropriate measures taken. Where reasonably practicable exposed skin should be covered. This applies particularly where there is a risk of a serious burn, or exposure to UV laser radiation.

A5.4 Diode Lasers (General)

Laser diodes can easily be mistaken for other forms of light emitting diodes and simple testing techniques can cause them to produce a light output that is harmful to the eyes. The following additional control measures apply:

5.4.1 Laser diodes not incorporated in equipment must be kept in a container labelled with classification and registration particulars, and locked way;

5.4.2 Before laser diodes are incorporated into equipment, any energy storing components therein must first be discharged;

5.4.3 Before disposal of laser diodes, the LRO must ensure that they are made non-operational.