Public Health
England

Protecting and improving the nation's health

Ubiquitous Lasers

PHE publications gateway number: 2014792
Published: February 2016

Laser applications

Home use

Lasers are found in CD and DVD players, computer drives, laser printers and in many modern home appliances. Some toys contain lasers or light emitting diodes (LEDs). Laser pointers or pens have also found their way into the home. Some of these laser pointers have been found to be more powerful than is acceptable for unrestricted use.

Handheld devices for hair removal (or growth management) and skin rejuvenation may contain a laser. These types are intended for use at home as alternatives to visiting a professional cosmetic establishment for treatment. Misuse of such a device is a concern, either by overuse in one particular location or by use in an inappropriate place such as near the eyes; in many cases the laser safety of these devices is questionable.

Entertainment

Lasers have been used in entertainment since the mid-1960s. Their uses vary from supporting live and recorded music events, to conferences, trade exhibitions, in tandem with firework displays and Christmas illuminations, as well as in art installations.

Due to low divergence, a laser beam can be projected over long distances and scanned into images using a system of moving mirrors.

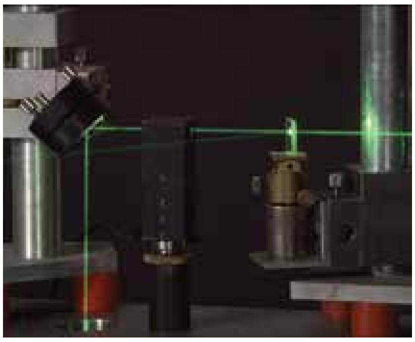
Diffractive optics employed to split a laser into many beams has become a very popular technique in recent years.

Safety at laser shows is critical as there is the potential to expose workers and the audience to laser beam levels that may lead to the risk of injury, particularly to the eye as the pattern passes across the face. The ideal situation is to refrain from exposing people; if that is not feasible, a beam should be directed above head height.

Materials processing

A high powered carbon dioxide (CO_2), Nd:YAG (neodymium-doped yttrium aluminium garnet) or fibre laser beam will produce enough heat to etch, weld or even cut metals. Ultraviolet laser beams are used to drill very precise holes in semiconductor manufacturing.

Research



Laser beams are valuable scientific tools in material, pharmaceutical and forensic research.

Lasers are widely used for non-destructive testing, spectroscopy and imaging, which may involve induced fluorescence.

Medicine and retinal pathology

Lasers play an important role in medicine.

Eye surgeons use lasers to treat ocular pathologies and to correct long or short sightedness. Lasers are used for the removal of diseased tissue. Dentists use laser beams to drill teeth.

Cosmetic procedures include removal of pigmented or vascular lesions, treatment of birthmarks, skin resurfacing, skin tightening, acne or acne scars, hair growth management and tattoo removal.

Lasers are used to accelerate wound healing and provide pain relief.

Laser beams are also used for diagnosing conditions of living tissues.

Construction

Laser use for indoor and outdoor construction is on the increase, replacing manual processes. Uses include measuring (elevation and distance), alignment, leveling, machine control, excavation work and landscaping. By linking the use of lasers with other technologies such as GPS, the accuracy and speed on construction has increased.

Military

Source: Pfuender at en.wikipedia
[public domain], from Wikimedia Commons

Laser weapon development began soon after the first laser was demonstrated. Today lasers are used for a wide variety of tasks in the military, not only as a destructive weapon but also for prevention and defence.

Incorporation of laser technology into existing weapons has enhanced the ability for effective detection, tracking and identification of targets before a weapon is fired. Other uses include measuring distances, marking out targets for weapons and mine detection.

Police and security

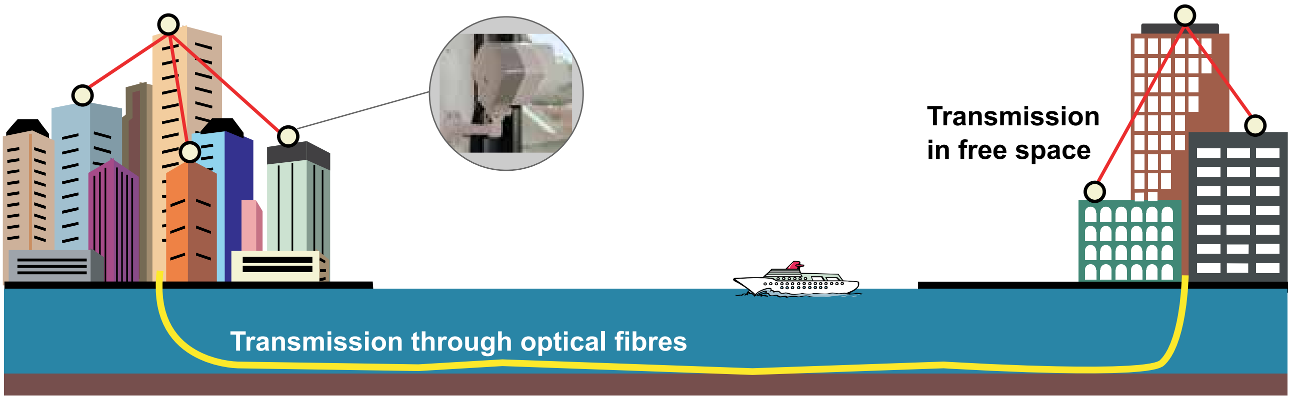
Lasers are used in aiding detection of vital evidence at a crime scene. Techniques such as induced fluorescence lead to the detection of evidence otherwise undetectable under white light. Three-dimensional laser scanners are used to map crime scenes for reconstruction and to collect evidence in cases.

Lasers are increasingly used for explosive and chemical detection at airports to prevent terrorism and to protect life.

Communications

Telecommunications are most commonly thought of when transmitted voice and digital information is passed through optical fibres; to transmit this information, GaAs and AlGaAs (gallium arsenide and aluminium gallium arsenide) diode lasers are used. With the demand for instant access to data, transmitting signals as fast possible is critical; this is achieved by the use of lasers and optical fibres.

Lasers are also used to communicate through free space, which usually requires the sender and receiver to be in the line of sight.



Inset photo © quantumBEAM Limited

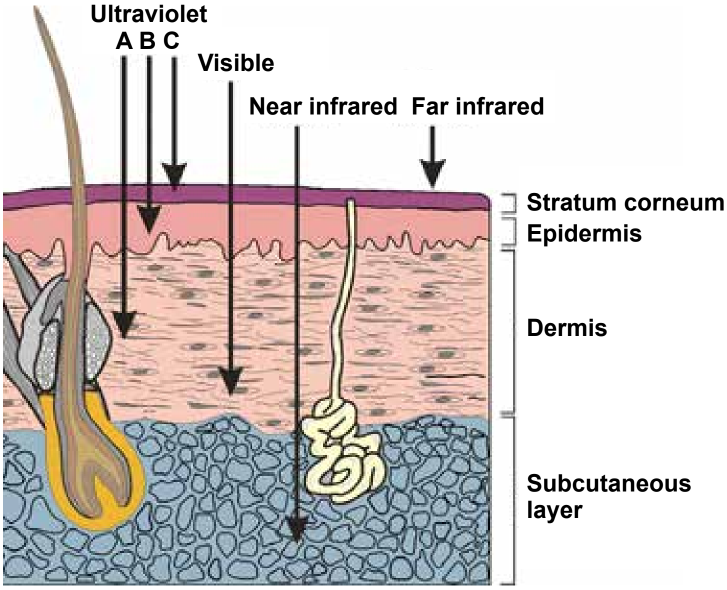
Laser beam interactions with the eye and skin

Optical radiation is absorbed in the outer layers of the body and, therefore, its biological effects are mostly confined to the skin and eyes. If a laser beam strikes a person, the laser radiation effects are characterised by very rapid absorption of energy. The damage caused depends on the organ or tissue exposed and is a particular hazard for the eyes, where the eye lens can focus the beam. The severity of the damage depends on the wavelength, power (measured in watts, W) if it is a continuous wave or energy (joules, J) from a pulsed laser, the area of the beam, the duration of exposure and the distance.

Skin damage

Different laser wavelengths penetrate to different parts of the skin. Exposure to short wavelength ultraviolet (UV) laser radiation may produce acute photochemical effects such as erythema (reddening of the skin) and thermal injuries. Thermal damage (burn) of the skin exposed to laser radiation in the region 380 nm to 1 mm can occur when the temperature exceeds 45°C.

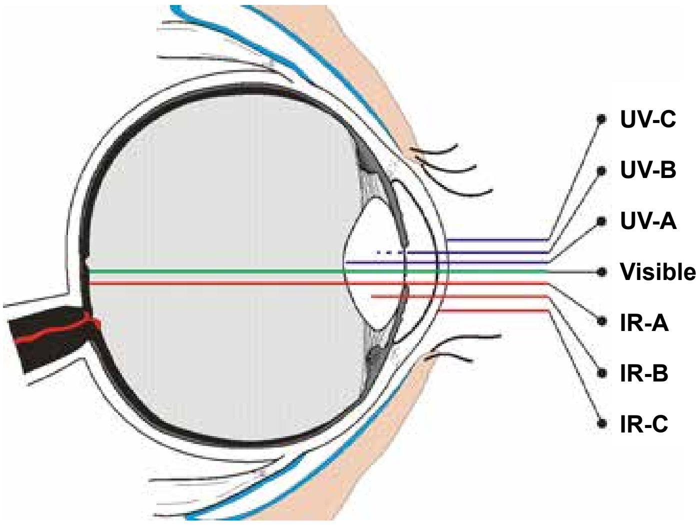
UV radiation may also cause photosensitisation of the skin; although photosensitisation of the skin from visible light can happen, it is extremely rare.



Eye damage

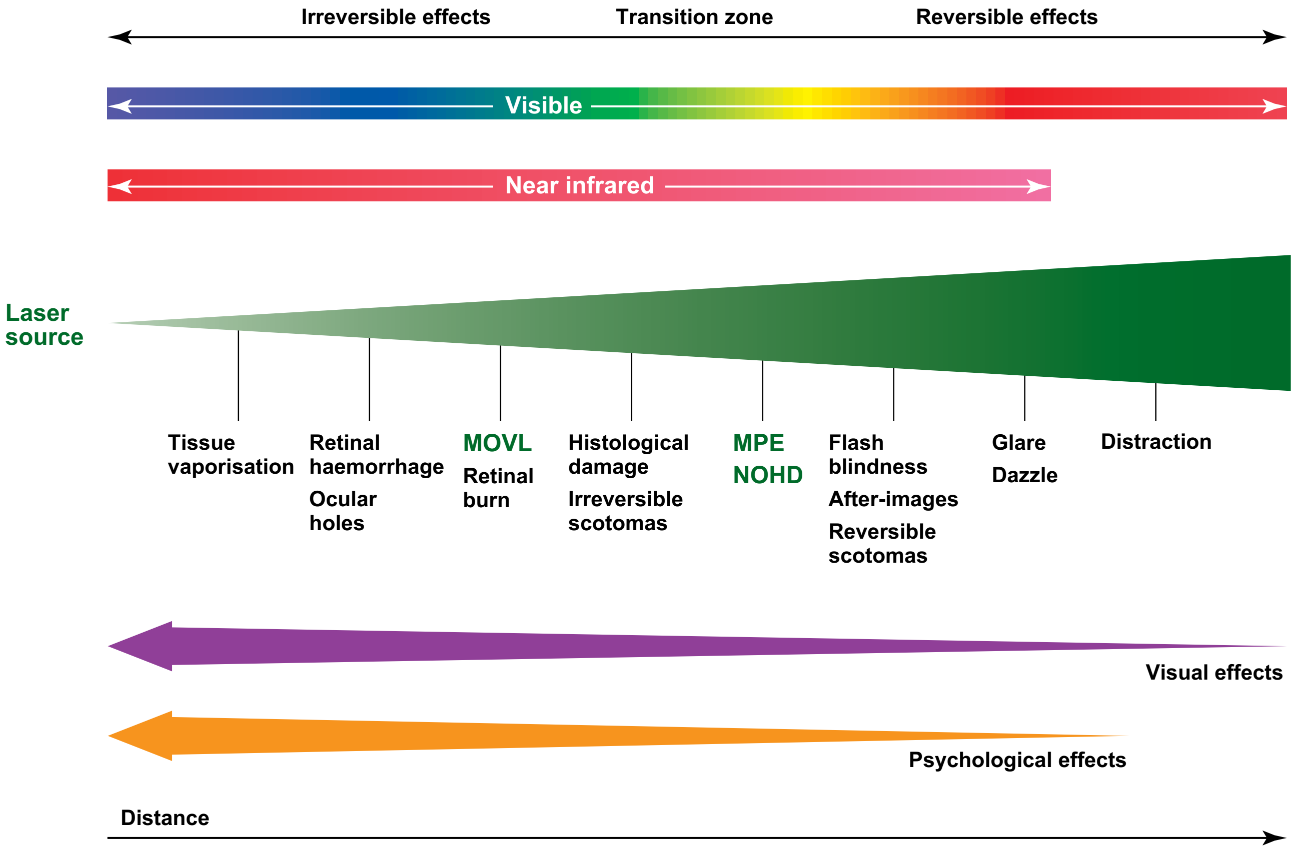
Different laser wavelengths penetrate to different parts of the eye. The cornea and the lens will focus visible and near infrared (IR-A) laser beams on to the retina at the back of the eye where damage may occur.

Infrared-B (IR-B), infrared-C (IR-C) and ultraviolet (UV) radiations (UV-A, UV-B and UV-C) do not penetrate to the retina but may cause damage to the cornea, the lens and other parts at the front of the eye.



The severity of the injury to the eye depends on the wavelength, irradiance (W/m²) with a continuous wave laser or radiant exposure (J/m²) from a pulsed laser, and the duration of exposure. Irreversible effects from exposure to the laser beam may occur, or there may only be slight improvement over time after severe damage.

Reversible effects such as glare, distraction and flash blindness may last only for a moment but can lead to life changing outcomes depending on the situation, eg landing a plane.



MOVL = minimum ophthalmoscopically visible lesion MPE = maximum permissible exposure NOHD = nominal ocular hazard distance

International Commission on Non-Ionizing Radiation Protection (ICNIRP) Guideline levels for protecting the eyes and skin

ICNIRP publishes guidelines which apply to human exposure to optical radiation emitted by lasers; they establish the levels below which no adverse biological effects are expected to the eyes and the skin.

The aim of the ICNIRP guidelines is to assist with the development of principles of protection against laser radiation (and non-laser optical radiation) hazards. The guidelines apply to exposures to laser radiation producing acute onset of observable biological responses. The exposure limits cover the wavelength ranges from 180 nm to 1 mm for exposure durations between 100 fs (f, femto = 10^{-15}) and 30 ks (about 8 hours). The guidelines for optical radiation in general do not differentiate between workers and the general public.

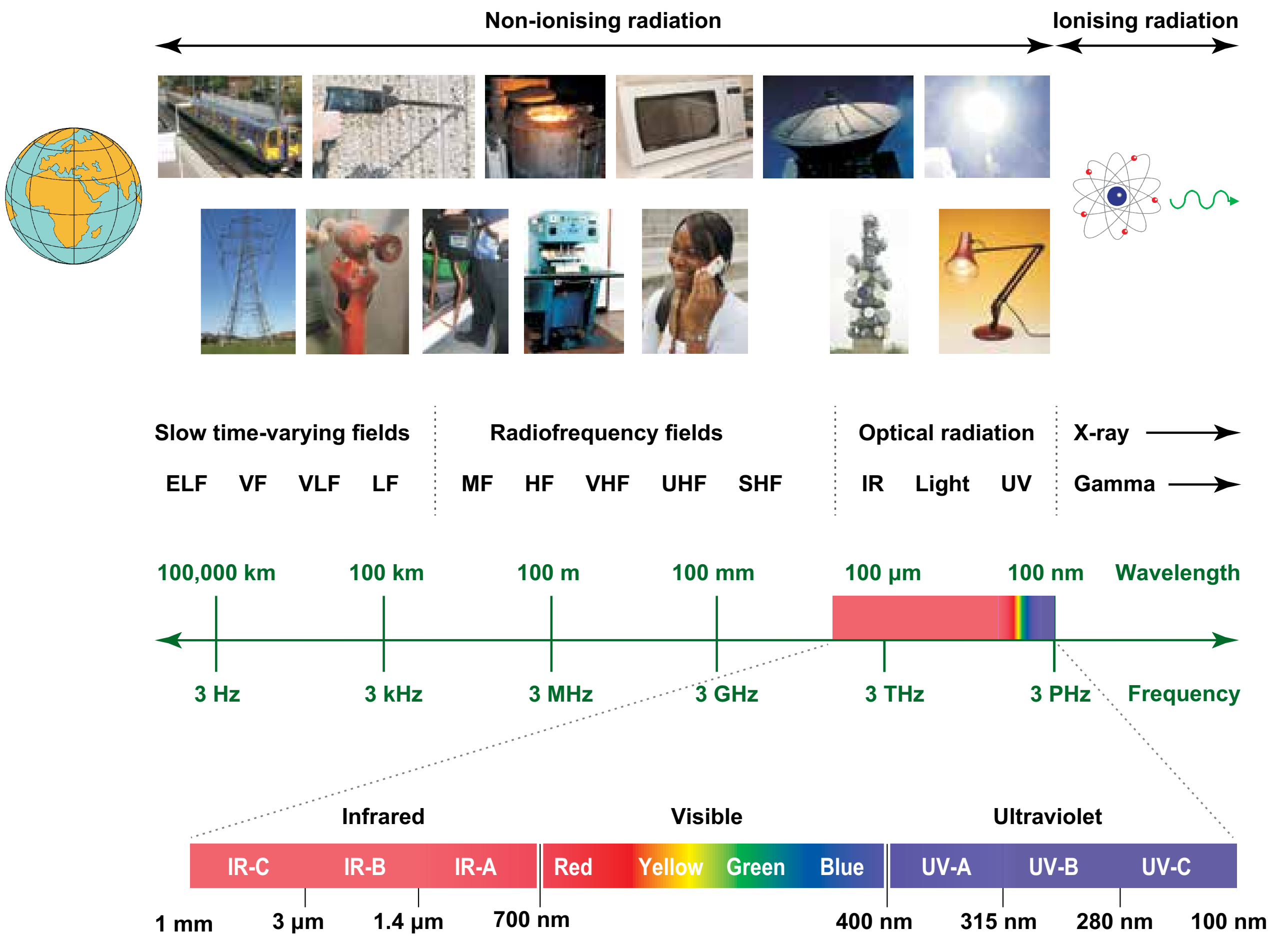
Non-ionising radiation – lasers

Optical radiation is the closest region of the non-ionising radiation spectrum to ionising radiation. The beam of a laser is normally a single, or small number, of discrete wavelengths from either the infrared, visible or ultraviolet regions of the spectrum.

Lasers beams usually have low divergence, maintaining the power or energy within a given area over considerable distances. Most laser beams are coherent and can usually be focused to a small spot.

However, these are all generalisations. There are lasers that produce laser beams over a wide wavelength spectrum, produce widely divergent beams and some laser beams are incoherent.

Laser beam emissions may be continuous, termed continuous wave (CW), or they may be pulsed.



Legislation

Laser-specific legislation

The European Directive 2006/25/EC – Artificial Optical Radiation came into force in 2006. It was implemented in the UK as the Control of Artificial Optical Radiation at Work Regulations 2010.

A number of additional acts and regulations may be relevant when considering product supply; many laser products require CE marking.

General health and safety law

- The Health and Safety at Work etc Act 1974
- The Management of Health and Safety at Work Regulations 1999
- Provision and Use of Work Equipment Regulations 1998

European directives

- Directive 2006/42/EC on Machinery
- The Low Voltage Directive (LVD) 2006/95/EC
- Directive 89/686/EEC on Personal Protective Equipment

Laser safety standards

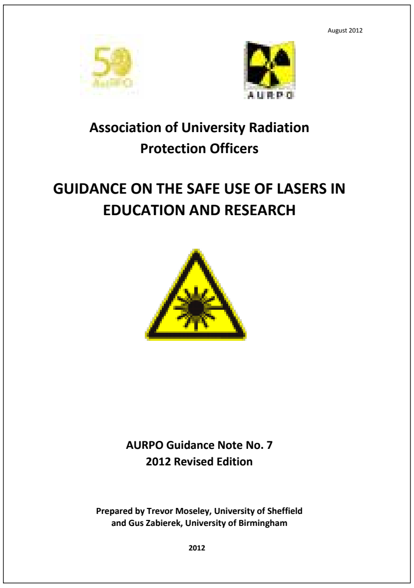
Laser safety standards are internationally agreed documents published by the International Electrotechnical Commission (IEC) – the international standards and conformity assessment body for all fields of electrotechnology. The standard is then usually adopted in Europe as a Euronorm and the UK edition is published by the British Standards Institution (BSI).

Applicable standard	Outline of document
BS EN 60825-1	General laser safety
BS EN 60825-2	Optical fibre communications
PD IEC/TR 60825-3	Laser displays
BS EN 60825-4	Laser guards
BS IEC 60825-5	Manufacturer's checklist
BS EN 60825-12	Free space optical communications
PD IEC/TR 60825-13	Measurements for classification
PD IEC/TR 60825-14	User's guide
BS EN 207 and 208	Eyewear
JSP 390 Part 1 and 2	Military laser safety

Guidance documents

A number of sectors have produced their own guidance documents relating specially to lasers; these include universities (AURPO), the medical sector (MHRA) and entertainment sector (PLASA), as well as the Health and Safety Executive (HSE), Civil Aviation Authority (CAA) and the police.

Examples of such guidance documents include guidance on the safe use of lasers in education and research by the AURPO and guidance for the operation of lasers, searchlights and fireworks in UK airspace by the CAA.


August 2012

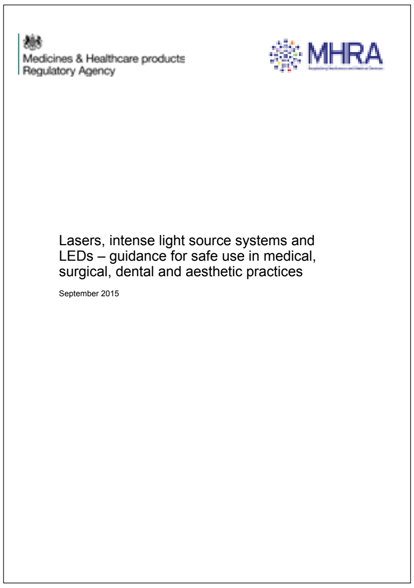
Association of University Radiation Protection Officers

GUIDANCE ON THE SAFE USE OF LASERS IN EDUCATION AND RESEARCH

AURPO Guidance Note No. 7
2012 Revised Edition

Prepared by Trevor Moseley, University of Sheffield and Gus Zabierek, University of Birmingham

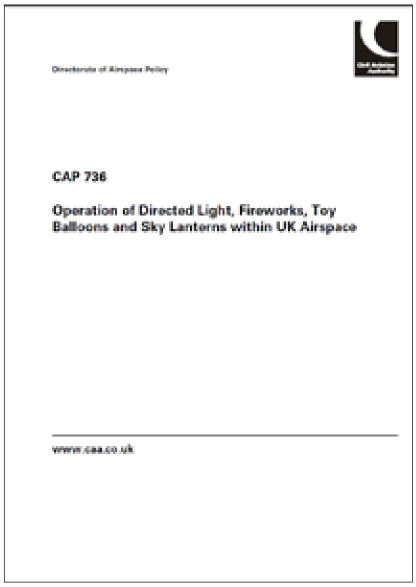
2012


Medicines & Healthcare products Regulatory Agency

MHRA

Lasers, intense light source systems and LEDs – guidance for safe use in medical, surgical, dental and aesthetic practices

September 2015

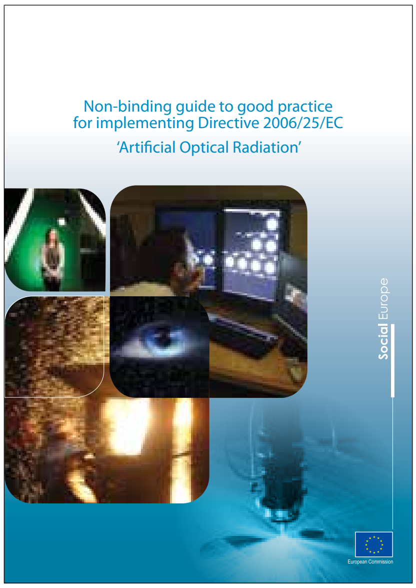

Directorate of Airspace Policy

CAP 736

Operation of Directed Light, Fireworks, Toy Balloons and Sky Lanterns within UK Airspace

www.caa.co.uk

A non-binding guide to good practice for implementing Directive 2006/25/EC – Artificial Optical Radiation produced by the Health Protection Agency (a predecessor organisation to PHE) provides guidance on the directive that has been implemented in Europe; there is an overview obtainable from the HSE that outlines the procedures within the guide that should be followed in the UK.



Definitions

Maximum permissible exposure (MPE)	Maximum level of laser radiation to which, under normal circumstances, people may be exposed without suffering adverse effects. Laser products should be engineered so that people are not exposed to levels above the MPE
Accessible emission limit (AEL)	Maximum accessible emission permitted within a particular laser class
Active medium	Active medium determines the wavelength of the laser radiation. It also gives the laser its name
Irradiance	Power density of a laser beam incident at 90° to a surface, measured in watts per square metre (W/m^2)
Radiant energy	Energy of a laser beam pulse, measured in joules (J)
Radiant exposure	Energy density of a laser beam incident at 90° to a surface, measured in joules per square metre (J/m^2)
Radiant power	Power emitted, transferred, or received in the form of radiation from a laser beam, measured in watts (W)
Wavelength	Length of a single cycle in a wave, generally measured in nanometres (nm) or micrometres (μm). Lasers emit beams which are made up of only one or a few wavelengths. For visible laser beams, the wavelength determines the colour
Limiting aperture	Circular area over which irradiance and radiant exposure are averaged
Exposure duration	Duration of a pulse, or if more than one pulse, the train of pulses or of continuous emission of laser radiation incident upon the human body, usually measured in seconds (s)
Nominal ocular hazard distance (NOHD)	Distance at which the beam irradiance or radiant exposure equals the appropriate corneal MPE, including the possibility of accidental misdirection of the laser beam

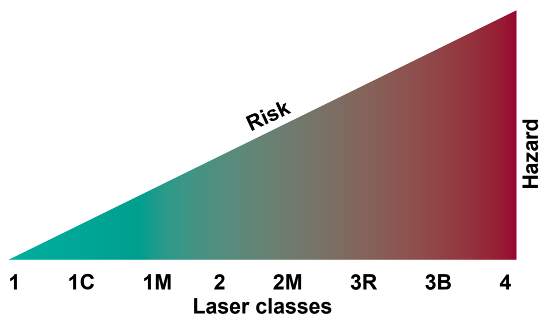
Radiant power (W)	Comparable to
0.001 (1 mW)	Laser pointer
5	To set fire to a small piece of wood
60	Common laser power used at laser shows
15,000	Enough to set fire to a small boat
100,000	Power goal for ‘militarily significant’ tactical ranges and tactical targets (solid state lasers have just become this powerful)
1,000,000	Requirement for strategic targets (such as ballistic missiles)

Laser classification

The classification schemes for lasers indicates the potential risk of adverse health effects. Depending upon the conditions of use, exposure time or environment, these risks may or may not actually lead to adverse health effects. With the help of classification, users may select appropriate control measures to minimise these risks.

The classification of lasers is based on the concept of accessible emission limit (AEL); an AEL is defined for each laser class, except Class 4. The AEL takes into account not only the output of the laser product but also human access to the laser emission. Lasers are grouped into eight classes: the higher the class, the greater the potential to cause harm. The risk could be greatly reduced by additional user protective measures, including engineering controls such as enclosures.

Useful to remember
'**M**' in Class 1M and Class 2M is derived from Magnifying optical viewing instruments
'**R**' in Class 3R is derived from Reduced or Relaxed requirements
'**B**' in Class 3B has historical origins



Class 1

Safe under reasonably foreseeable conditions of operation, including long-term direct intra-beam viewing, even when using optical viewing instruments (eg eye loupes or binoculars). Users of Class 1 laser products are generally exempt from optical radiation hazard controls during normal operation.

Class 1M

As Class 1: safe for the naked eye under reasonably foreseeable conditions of operation, but may be hazardous if the user employs magnifying optics (eg eye loupes or binoculars) within the beam.

Class 1C

A laser product which is designed explicitly for contact application to the skin or non-ocular tissue. The irradiance or radiant exposure levels may exceed the skin MPE as necessary for the intended treatment procedure. During operation, ocular hazard is prevented by engineering means, ie the accessible emission is stopped or reduced to below the AEL of Class 1 when removed from contact with the skin or non-ocular tissue.

Class 2 (visible laser beams only)

Laser products that emit visible radiation and are safe for momentary exposures, even when using optical viewing instruments, but can be hazardous for deliberate staring into the beam. Class 2 laser products are not inherently safe for the eyes, but protection is assumed to be adequate by natural aversion responses, including head movement and the blink reflex.

Class 2M (visible laser beams only)

As Class 2, laser products that emit visible laser beams and are safe for short-term exposure only for the naked eye, but possible eye injury for exposures when using loupes or telescopes. Eye protection is normally provided by aversion responses, including the blink reflex.

Class 3R

Direct intra-beam viewing is potentially hazardous, but in practice the risk of injury in most cases is relatively low for short and unintentional exposure. However, it may be dangerous for improper use by untrained personnel. The risk is limited because of natural aversion behaviour for exposure to bright light for the case of visible radiation and by the response to heating of the cornea for far-infrared radiation. Class 3R lasers should only be used where direct intra-beam viewing is unlikely.

Class 3B

Hazardous for the eyes if exposed to the direct beam at distances shorter than the nominal ocular hazard distance (NOHD). Viewing diffuse reflections is normally safe, provided the eye is no closer than 13 cm from the diffusing surface and the exposure duration is less than 10 s. Class 3B lasers which approach the upper limit for the class may produce minor skin injuries or even pose a risk of igniting flammable materials. Examples are lasers for physiotherapy treatments and research laboratory equipment.

Class 4

Laser products for which direct viewing and skin exposure are hazardous within the NOHD and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.

Practical laser safety

Control measures

The hierarchy of control measures is based on the principle that if any hazard is identified, then this hazard must be controlled. The selection of appropriate measures in any specific situation should be guided by the outcome of the risk assessment. Control measures applied at the design and installation stage can offer significant advantages in safety and operation. The later addition of such control measures may be expensive.

If the higher priority controls (elimination or substitution) are not possible, preference should be given to engineering means of reduction of exposure. Only when this is not possible, should alternative protection measures be introduced. There are very few circumstances where it is necessary to rely upon personal protective equipment (PPE) and administrative procedures. Administrative controls may be used in combination with higher control measures. If reduction of personal exposure is not feasible, impracticable or incomplete, PPE should be considered as a last resort.

Engineering controls

The safest laser products rely upon designed safety features. Identifying all the hazards of a laser product is critical, with the aim to control them safely at source. Engineering controls include:

- access prevention
- protection by limiting operation
- emergency stops
- interlocks
- filters and viewing windows
- alignment aids

Access prevention

This can be undertaken either with fixed guards or movable guards with interlocks. Fixed guards are usually applied to parts of the equipment which do not require regular access and are permanently attached. If access is needed, then a movable/opening guard interlocked to the process can be used.

Important – guards
should be adequate and robust
should not generate any additional risks and should cause minimal obstruction
if a fixed enclosing guard, should not be easy to be bypassed or defeated
if a fixed distance guard, should be located at an adequate distance from the danger zone

Protection by limiting operation

When frequent access is required through the physical guards, then these can often be considered too restrictive, especially if the operator is required to carry out loading/unloading or adjustment operations. In this instance, it is usual to employ sensors to detect the presence or absence of an operator and generate an appropriate stop command. They can be classed as trip devices: they do not restrict access but sense it. The time taken for the machine to reach a safe condition determines the location or proximity of any sensor.

Emergency stops

When personnel can access a hazardous environment, it is essential to provide emergency stops should anyone get into trouble while in the hazard zone. The emergency stop must have a fast response and stop all services in the hazard zone. Most people will be familiar with the red mushroom-headed emergency stop buttons; they should be suitably located around the facility in sufficient quantity to ensure there will always be one in reach. An alternative is a grab wire linked to an emergency stop button, this is often a more convenient means of providing protection in a hazard area. Other forms of trip switch can be located around any moving parts which sense unexpected proximity, such as a toggle switch, safety bar or rod.

Interlocks

There are many variations of interlock switches and each design comes with its own features. It is important that the right device be chosen for the application.

Important – interlocks
should be well constructed and reliable under the foreseeable extreme conditions
should fail-to-safety and be tamper proof
should have their status clearly indicated, eg by large flags on the defeat keys and warning status indicators on operators panels
should limit the operation while the guard door is not fully closed

Filters and viewing windows

Many industrial processes can be fully or partially enclosed. It is then possible to monitor the process remotely, through a suitable viewing window, optics or television camera. Safety can be ensured by using appropriate filter materials to block the transmission of hazardous levels of optical radiation. This removes any need for reliance upon safety goggles and improves operator safety and working conditions.

Examples can range from large-scale control rooms to a viewing window fitted within a small local enclosure around the interaction region.

Transmission of optical radiation through windows and other optically translucent panels should be evaluated as a potential risk. Although the optical beam may not present a direct retinal hazard, temporary flash issues may cause secondary safety concerns with other procedures in the vicinity.

Important – filter material
should be durable and appropriate
should be impact resistant
should not compromise safety of operation

Alignment aids

When routine maintenance requires the alignment of beam path components, some safe means of achieving this should be provided.

Important – alignment aid
human eye or skin should never be used as an alignment aid

If a Class 4 laser is embedded within a product, and engineering controls prevent access to any direct or scattered beams, then the product itself may be classified as Class 1.

The laser beams may be accessible if the engineering controls are defeated, eg during servicing.

The photograph shows an example of a Class 4 laser within a Class 1 product

Administrative controls

Administrative controls are the second stage in the hierarchy of control; they support engineering controls. They tend to need people to act on information and, therefore, are only as effective as the actions of those people. However, they do have a role and may be the principal control measure under some circumstances, such as during commissioning and servicing.

The appropriate administrative controls depend on the risk and include the appointment of people as part of the safety management structure, restricting access, signs and labels, and procedures.

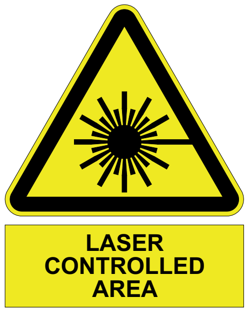
It is good practice to provide formal arrangements for an integrated approach to the management of laser safety. These arrangements should be documented to record what measures have been adopted and why.

Local rules

Where the risk assessment identified a potential for exposure to hazardous levels of optical radiation, it is appropriate to put in place a system of written safety instructions (or local rules) to regulate how work with optical radiation is carried out. These should include a description of the area, contact details for the laser safety officer (LSO), details of who is authorised to use the equipment, details of any pre-use tests required, operating instructions, an outline of the hazards, and details of contingency arrangements. Local rules should normally be available in the areas to which they relate and should be issued to all those affected by them.

Safety signs and notices

These form an important part of any system of administrative controls. Safety signs are only effective if they are clear and unambiguous.



Warning signs may include information about the type of equipment in use. If there is a requirement for personnel to use personal protective equipment, then this should also be indicated.

Warning signs are more effective if they are displayed only when appropriate, eg when the equipment is in use – otherwise they may be ignored after a while. All safety signs should be placed at eye level to maximise their visibility.

Controlled area

A controlled area may need to be designated where access to laser radiation in excess of the MPE is likely. A controlled area should be one to which access is restricted, except to authorised people. Preferably, this should be by physical means, eg using the walls and doors of the entire room. The area may be restricted by locks, number pads or barriers.

Arrangements should be put in place for the formal authorisation of users by management. There should be a formal process for evaluating the suitability of personnel prior to authorisation and this should include an assessment of their training, competence and knowledge of the local rules. The results of this assessment should be recorded and the names of all authorised users should be recorded in a formal register.

Appointments

Laser safety should be managed through the same health and safety management structure as other potentially hazardous activities. The detail of the organisational arrangements may vary according to the size and structure of the organisation.

Training and consultation

It is suggested that the level of training should be balanced with the risk from exposure to laser radiation. Where all of the sources are Class 2 or below then it should be adequate to inform workers and/or their representatives of this.

Where accessible laser radiation that is likely to exceed the MPE is in the workplace then consideration should be given to formal training, and perhaps the appointment of workers to specific roles. When determining the level of training required, the employer should consider the following:

- expertise of staff and current awareness of the risks from laser radiation and other hazards
- existing risk assessments and their conclusions
- whether the workers are required to assist with risk assessments or their review
- whether the workplace is static and the risks have been formally assessed as acceptable or whether the environment changes frequently
- whether the employer has access to external expertise to assist with the management of risks
- workers new to the workplace or to work with laser radiation

It is important that the risks are put into perspective. For example, requiring formal training courses for the use of a Class 2 laser pointer is not justified, whereas training for workers using Class 3B and Class 4 lasers will almost always be required.

It is not possible to define a specific length of a training programme or indeed how this is to be delivered. This is why the risk assessment is important.

Ideally, the requirement for training, and how this should be delivered, should be identified before the laser is brought into use.

Personal protective equipment (PPE)

Reduction of unintended exposure to optical radiation should be included in the design specifications of the equipment. Exposure to optical radiation should be reduced, as far as reasonably practicable, by means of physical safeguards, such as engineering controls. Personal protective equipment (PPE) should only be used when engineering and administrative controls are impracticable or incomplete.

The purpose of PPE is to reduce optical radiation to the level which does not cause adverse health effects in the exposed individual. The optical radiation injuries may not be apparent at the time of the exposure. It should be noted that MPEs are dependent on wavelength, and the degree of protection offered by PPE may also be wavelength dependent.

Although an acute skin injury resulting from exposure to optical radiation is less likely to affect the individual's quality of life, it should be recognised that the probability of skin injury may be high, especially for the hands and face. Exposure of the skin to optical radiation below 400 nm, which may increase the risk of skin cancer, is of particular concern.

Protection against other hazards

The following non-optical hazards should also be considered when selecting appropriate PPE to protect against exposure to optical radiation.

Impact	**Heat/cold**	**Penetration**	**Harmful dust**
Compression	**Biological**	**Chemical**	**Electrical**

Eye protection

The eye is at risk of injury from optical radiation if exposures are in excess of the MPE. If the other measures are inadequate to control the risk of eye exposure in excess of any applicable MPEs, eye protection recommended by the equipment manufacturer or optical radiation safety adviser and specifically designed for the wavelengths and output should be worn. The level of attenuation of optical radiation provided by protective eyewear should be at least sufficient to decrease the exposure level below applicable MPEs.

Luminous transmittance and the colour of the environment as seen through the protective filters are important characteristics of eyewear which may affect the operator's ability to perform the required tasks without compromising non-optical radiation safety. Protective eyewear should be clearly marked with the wavelength range and corresponding protection level. It should be correctly stored, regularly cleaned and subject to a defined inspection regime.

Skin protection

For occupational exposure to optical radiation, the areas of the skin most usually at risk are the hands, the face, the head and the neck, as other areas are generally covered by working clothes. The hands can be protected by wearing gloves with low transmission to hazardous optical radiation. The face can be protected by an absorbing face shield or visor, which may also offer eye protection. Suitable headwear will protect the head and neck.

Personal protective equipment (PPE)	Function
Protective eyewear: safety spectacles, goggles, face shields and visors	Eyewear should allow the worker to see everything in the work area but restrict the optical radiation to acceptable levels Selection of appropriate eyewear depends upon many factors, including wavelength, power/energy, scale number (including optical density), need for prescription lenses and comfort
Protective clothing and gloves	Sources of optical radiation may present a fire hazard and protective clothing may be necessary Equipment that produces UV radiation may present a skin hazard and skin should be covered using suitable protective clothing and gloves. Gloves should be worn when working with chemical or biological agents. Protective clothing or gloves may be required as a result of the risk assessment
Respiratory equipment	Toxic and harmful fumes or dusts may be produced during material processing. Respiratory equipment may be necessary for emergency use
Ear defenders	Noise can be a hazard from some industrial applications

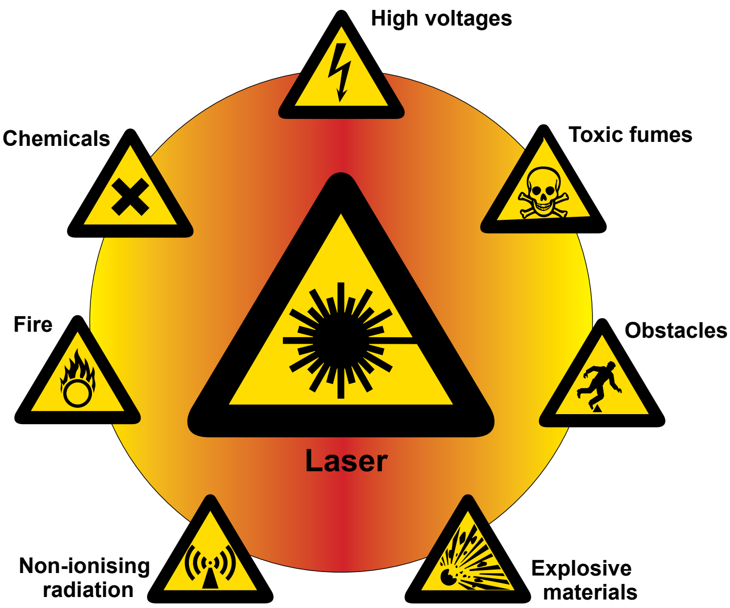
Associated hazards

Many people regard laser radiation to be the main hazard of lasers. This is often not the case as the non-radiation hazards associated with either the laser or the laser process can present bigger hazards.

The radiation hazards from a laser beam are not to be underestimated, they can inflict serious wounds and damage.

However, laser radiation is unlikely to be a direct cause of death and it is the associated hazards that should not be overlooked.

The associated hazards can easily be grouped into categories. Those most commonly encountered in laser applications are shown here.



Why should I come to PHE for laser safety training?

As the government agency responsible for advising on safe exposures, and as the authors of the European Commission guide to the Artificial Optical Radiation Directive, PHE is uniquely placed to deliver courses on laser and optical radiation safety. Our experts help develop the worldwide standards through their research, development and advisory roles, and PHE experts have been integral in establishing world leading laser and optical radiation safety approaches and training for over 25 years.

What to do next

If you want to find out more about lasers, specifically laser safety, attending a PHE-run laser safety course is the next step. To find out more about our courses, or to check that there are places available, please contact us using the details below. If you would like to go ahead and book a place, you can do so by visiting our website using the link below.

Please note: our scheduled course fees include accommodation and an evening meal for the night before the course starts. If there are any additional requirements such as staying the evening after the course, please contact us directly after you have placed your booking on the website. Please email us if you are interested in customised laser and optical radiation safety training: we can bring our courses to you.

Contact us directly

Training Centre
Public Health England
Chilton
Didcot
Oxfordshire
OX11 0RQ
United Kingdom

Website: https://www.phe-protectionservices.org.uk/nir/courses/
Email: laser@phe.gov.uk

Published: February 2016