Safe Use of Lasers Code of Practice

Reviews and Revisions

Date	Reason	Reviewer	Next review date	Approved by
22/03/2017	Updated to new template and inclusion of roles and responsibilities	Lee Rounds	22/03/2018	UHSMG
18/12/2018	Major revision and new template	Adam Swinburne	22/03/2020	Emrys Pritchard
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1 Introduction

The use of certain classes of laser can pose a significant risk of severe injury to the eyes and skin burns. It is a requirement of the Health and Safety at Work Act 1974 and The Artificial Optical Radiation Regulations 2010 that the University provides a safe place of work and that the risks from laser systems are assessed and control measures are put in place to reduce the risk to as low as reasonably practicable.

This Code of Practice (COP) applies to all work with lasers within Northumbria University.

There is a separate guidance document on the safe use of laser pointers.

2 Roles and Responsibilities

General Roles and Responsibilities are included within the University Health and Safety Policy. Additional Roles and Responsibilities are included here.

2.1 The Assistant Director for Health and Safety

The Assistant Director for Health and Safety is responsible for the appointment of a University Laser Safety Officer.

2.2 The University Laser Safety Officer

The University Laser Safety Officer must ensure that arrangements are in place for:

1. the training of new staff/students in laser safety;
2. the identification and maintenance of a central inventory of lasers and users of equipment;
3. the provision of a measuring service (where appropriate);
4. inspection of all new laser facilities;
5. routine inspection of laser facilities.

2.3 The Faculty Laser Safety Officer

The Faculty Laser Safety Officer must ensure that:

1. all lasers, except low power Class 1 devices and Class 2 laser pointers are identified and entered on the laser inventory and the University Laser Safety Officer notified;
2. any Class 1 product with an embedded Class 3B or Class 4 laser, apart from consumer products, are identified on the laser inventory;
3. all lasers and laser areas are labelled/signed in accordance with this code of practice;
4. risk assessment, control measures and schemes of work (Laser Local Rules) are drawn up in cooperation with the Research Supervisor, where necessary for the safe operation of lasers, including a robust justification of why it is not reasonably practicable to enclose any open beams. These will normally be required for Class 3B and 4 lasers, especially when not fully enclosed;

5. personnel intending to work with Class 3R, Class 3B and Class 4 lasers, and others who may be working with modified Class 1M or Class 2M devices, will need to be identified and receive training in the safe use of lasers;
6. ensure arrangements are in place for laser safety eyewear to be provided and worn (when appropriate and instructed) by all people working with Class 3B and 4 lasers when the beam is not totally enclosed and that training is given in their use, inspection and maintenance;
7. undergraduates working with lasers should use the minimum power laser practicable and follow a written scheme of work;
8. all lasers in the Faculty are used in accordance with the University's code of practice;
9. routine surveys are undertaken to ensure compliance with the risk assessment and control measures determined;
10. annually, the Faculty Laser Safety Officer will assess each laser against the requirements of the Laser Survey Form. Any laser failing to comply will be taken out of use until appropriate remedial action has been taken to secure compliance;
11. the Faculty Laser Safety Officer will notify the University Laser Safety Officer of any concerns regarding laser safety.

2.4 The Faculty Business Manager

The Faculty Business Manager has overall responsibility for health and safety arrangements within that Faculty and for ensuring that:

1. where Class 3B and Class 4 lasers are used, the Faculty Business Manager, in consultation with the University Laser Safety Officer, should appoint a suitably qualified member of staff as Faculty Laser Safety Officer;
2. arrangements are in place for all work involving hazardous lasers to be covered by risk assessments and where appropriate by engineering controls, written schemes of work and protocols.

2.5 Research Supervisor/Principle Investigator

The Research Supervisor must ensure that:

1. the Faculty Laser Safety Officer is informed of the intention to buy a laser system or bring one on site prior to its purchase or loan and arrival;
2. all work involving hazardous lasers must be covered by a risk assessment and where appropriate, by written schemes of work and protocols in cooperation with the Faculty Laser Safety Officer;
3. laser are made safe and hazardous materials identified prior to disposal and coordinated with the Faculty Laser Safety Officer;
4. their laser workers are effectively training in the operating techniques required;
5. inexperienced staff are adequately supervised.

2.6 Laser Users

Laser users have responsibilities:

1. to observe this Code of Practice, guidance and Schemes of Work (Laser Local Rules) applicable to the lasers that will be used and to follow the guidance of supervisors and the Faculty Laser Safety Officer;
2. to not leave a laser experiment running unattended unless a risk assessment has established that it is safe to do so;
3. for their own safety and that of others who may be affected by their acts or omissions;
4. that when working with Class 3B or Class 4 lasers, where there is the possibility of stray laser beams that could damage eyesight; where required the appropriate laser eyewear **MUST BE WORN**.

3 Purchase of Lasers

All new lasers or equipment containing lasers, that are purchased or brought onto the University premises on loan or by other arrangement, must be assessed for compliance to European safety standards, i.e. the system must be CE marked and the declaration of conformity examined, in particular, for compliance to BS EN 60825-1 for classification and labelling of the laser, as well as other product directives. The Faculty LSO must be consulted prior to the purchase/loan of a Class 3R, 3B and 4 laser and the University LSO informed.

Lasers that do not meet the standard will require detailed further assessment and the Central Health and Safety Team should be consulted for guidance.

4 Risk Assessment and the Hierarchy of Controls

4.1 Primary Hazard

All work with lasers is conditional on a suitable risk assessment being undertaken with adequate control measures put in place. The risk assessment must consider the following:

- level, wavelength and duration of exposure;
- the exposure limit values;
- the effects on exposure on employees or groups of employees whose health is at particular risk from exposure;
- any possible effects on the health and safety of employees resulting from interactions between artificial optical radiation and photosensitizing chemicals;
- any indirect effects of exposure such as temporary blindness, explosion or fire;
- the availability of alternative equipment designed to reduce levels of exposure;
- appropriate information obtained from health surveillance, including where possible, published information;
- multiple sources of exposure;
- any class 3B or 4 laser or any other optical source that is capable if presenting the same level of hazard;

- information provided by manufacturers in accordance with product directives.

Where appropriate, the assessments should consider Exposure Limit Values (ELVs), the Maximum Permissible Exposure (MPE), Accessible Emission Limits (AELs) and Nominal Ocular hazard Distances (NOHDs).

Elimination or reduction of the hazards must be considered as the primary control, for example ensuring the minimum laser power required for the experiment is used. Engineering controls should then be considered with enclosure of the laser beam being the preferred control method.

There must be a robust justification for working with open beam systems included in the risk assessment for Class 3B or 4 lasers. Fibre optics may be used as a means of enclosing the beam however fibre disconnection or breakage will result in an open beam.

If full enclosure of the beam is not practicable, consideration should be given to:

- partial guarding;
- interlocks (equipment and door);
- remote viewing aids;
- viewing windows;
- administrative controls;
- PPE;
- access restrictions.

Laser guards should conform to BS EN 60825-4, interlock systems should conform to BS EN ISO 14119 and screens should conform to BS EN 12254.

Further guidance on control methods can be obtained from the Faculty or University Laser Safety Officer.

Operating procedures and PPE should only be relied on when further engineering controls are not practicable.

Special consideration in the risk assessment should be given to the addition of new optical elements, alignment and servicing/maintenance where it is not reasonably practicable for guarding to remain in place and interlock systems may be overridden.

4.2 Secondary Hazards

Laser systems not only present a primary hazards from non-ionising radiation but may also present additional secondary hazards, such as hazardous chemical exposure (dye lasers, fume or dust formation), fire or explosion hazards from laser induced heating, the use of cryogenic liquids, electrical hazards and secondary ionising and non-ionising radiation emission.

It should also be noted that laser systems fall under the scope of other regulations e.g. the Provision and Use of Workplace Equipment Regulations 1998 (PUWER). In particular, laser systems that are designed, constructed or modified require further consideration and the Central Health and Safety team should be consulted.

4.3 Laboratory Design and Experimental Set-up

A laser laboratory in which open beam experiments with Class 3B and 4 lasers are undertaken should be designed so that, where reasonably practicable:

- lighting levels are high;
- there are no windows within the room or windows are covered;
- reflecting surfaces are minimized e.g. by use of matt paint or removal of glass cupboard fronts etc.;
- suitable ventilation is in place for secondary hazards such as cryogen or chemical use;
- suitable firefighting equipment is in place;
- there are a suitable number of power outlets, positioned to reduced trip hazards;
- the laboratory ergonomics allow the user to operate the system from a safe place, with access to laser shutter controls and any emergency stop button;
- beam paths are kept below eye height for the user in all operating positions;
- beam paths are as short as possible, optical reflections minimized and the beam terminated with a beam stop;
- optical components are securely fixed in position;
- all users remove personal items that have reflective surfaces such as jewellery;
- laser are operated on the minimum power required for the task, particularly during alignment.

4.4 Administrative Controls

Any area in which lasers are in use must display laser warning signage. The signage must include the laser hazard warning sign and the highest class of laser used in the area.

4.4.1 Designation of Laser Controlled Areas

Laser controlled areas are required for work with Class 3B or 4 lasers where beam enclosure is not practicable. Access must be restricted to authorised laser users and an interlock system (or other appropriate means of access control) must be installed. Any override mechanism must be considered as part of the risk assessment.

The laser controlled areas must be marked with the laser hazard warning sign, the words ‘Laser Controlled Area’, details of the lasers in use in the area, their class and emission wavelengths, the responsible person and authorised users.

Where reasonably practicable, the entryway to the area should display the status of the laser.

4.4.2 Labelling of Lasers

Class 1 laser that are safe under reasonably foreseeable conditions do not require any laser safety labelling. All other lasers requires laser safety labels that comply with BS EN 60825-1 and provide a warning of laser radiation, the laser class, basic precautions and the laser characteristics.

It is good practice for a Class 1 laser system containing a higher class laser but classified as Class 1 due to engineering controls, be labelled with an informative label and an explanatory note.

4.4.4 PPE

PPE should be considered where beam enclosure and other engineering controls are not reasonably practicable and a risk of exposure above an ELV remains. The use of PPE should be the last defense against laser exposure.

Laser eye protection must be selected to protect against specific laser hazards and conform to BS EN 207 Personal eye-protection – Filters and eye-protectors against laser radiation (laser eye protectors) and/or BS EN208 Personal eye-protection – Eye protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors) as appropriate. These standards require the use of maximum spectral density and resistance to laser radiation rather than optical density in the selection of appropriate eyewear.

Situations likely to require eye protection are the use of 3R laser outside 400 – 700 nm wavelength range and Class 3B or 4 lasers where the risk of exposure above the ELV after engineering and administrative controls are in place.

Protective clothing should be considered where a laser is capable of an exposure above the skin ELV.

4.4.5 Creation of a Laser Inventory

A central inventory of lasers within the University must be held and reviewed at least annually. In addition:

- each Faculty must hold its own laser inventory, which must be reviewed at least annually;
- the inventory must be updated when a laser is purchased, moved, transferred from or disposed of from a faculty and the information forwarded to the University Laser Safety Officer;
- lasers of Class 1M, 1C, 2, 2M, 3R, 3B, and 4 must be included in the inventory;
- Class 1 laser, including those in DVD players etc. and Class 2 laser pointers do not need to be recorded;
- Class 1 laser equipment that contains Class 3B or 4 lasers but are Class 1 due to engineering controls must be recorded.

4.4.6 Record of Users of Lasers

A record of all users for Class 3R, 3B and 4 lasers made by the Faculty Laser Safety Officer and forwarded to the University Laser Safety Officer.

5 Training

Laser safety training is compulsory for all users of Class 3R, 3B and 4 lasers. This training must cover as a minimum:

- the general nature of laser radiation;
- the health hazards, the tissues of the body at risk, and the severity of harm which can result;
- the different laser classes and the meaning of the warning labels appropriate to the classes;
- the proper use of hazard control procedures and where appropriate the need for personal protective equipment;
- the need for any necessary additional precautions when undertaking non-routine activities; and
- the University COP governing laser use, including emergency action and accident reporting procedures;
- specified laser risk assessments and laser local rules/procedures/safe systems of work;
- instruction on the use of the equipment.

Appointed Laser Safety Officers must have attended and passed a Laser Safety Officer training course.

Valid training records must be retained for inspection and refresher training under taken at least every 5 years.

6 Emergency Eye Examinations and Accidental Exposure

A health surveillance programme such as routine eye examinations is not required for work with lasers. However, an actual or suspected exposure to the eye will require an emergency eye examination. This must be carried out as soon as possible after exposure and within 24 hours. Follow-up health surveillance may be required.

Emergency procedures must be put in place for each Class 3B/4 laser identifying the most appropriate Accident and Emergency Department for eye injuries. An information card/sheet must be available to take to the hospital with the casualty detailing important information about the laser.

Any accidental exposure should be reported on the University's incident reporting forms.

7 Undergraduate Work

Where practicable, undergraduate work with lasers should be restricted to Class 1/1M, Class 2/2M or visible beam Class 3R lasers. All undergraduate work should be accompanied by laser local rules giving clear instructions on the practical.

Undergraduates involved in project work with Class 3B and 4 laser should be regarded as laser workers and subject to the registration, training and supervision requirements detailed in this COP.

8 Related Documents

BS EN 60825-1:2014, *Safety of laser products – Part 1: Equipment classification and requirements*. London: British Standards Institute.

BS EN 60825-4:2006+A2:2011*, Safety of laser products – Part 4: Laser guards*. London: British Standards Institute.

BS EN ISO 14119:2013, *Safety of machinery – Interlocking devices associated with guards – Principles for design and selection.* London: British Standards Institute.

BS EN 207:2017, *Personal eye-protection equipment – Filters and eye-protectors against laser radiation (laser eye protectors).* London: British Standards Institute.

BS EN208:2009, *Personal eye-protection – Eye protectors for adjustment work on lasers and laser systems (laser adjustment eye-protectors)*. London: British Standards Institute.

Association of University Radiation Protection Officers (2018) *Guidance on the Safe Use of Lasers in Education and Research*, AURPO Guidance Note No. 7. 2018 Revised Edition. [This document is available at http://www.aurpo.org.]

The following documents are available on the Health and Safety SharePoint site under Hazardous Substances – Radiation and Laser Safety

Laser Risk Assessment (Class 1M, 2, 2M and 3R Lasers)

Laser and Risk Assessment (Class 3B and 4 Lasers)

Emergency Procedure for Exposure to Class 3B or Class 4 Laser

The Safe Use of Laser Pointers

Laser safety training videos