University Health & Safety Arrangements : Chapter 27

Laser safety

Note

"Senior Managers" are responsible for health and safety within their organisational unit, specified areas or as a consequence of their activities, and for any additional activities as agreed and delegated to them (e.g. where they accept responsibility for day-to-day safety arrangements for staff who have other line managers, for reasons of geographical or other convenience). They may be Deans, Heads of School, Directors of Institutes, Directors and Heads of Service in non-academic areas, the University Librarian, the Directors of the Manchester Museum and the Whitworth Art Gallery, and their equivalents.

Introduction

1. This document describes how laser safety must be managed within the University. It includes limited guidance for the purposes of giving clarity, and should be used together with;

   - PD IEC TR 60825-14:2022 'Safety of laser products - A user's guide';
   - the Association of University Radiation Protection Officers (AURPO) Guidance Note No. 7 2018 'Guidance on The Safe Use of Lasers in Education and Research';
   - Non-binding guide to good practice for implementing Directive 2006/25/EC "Artificial Optical Radiation".

Laser Safety Management and Responsibilities

University Laser Safety Officer (ULSO) responsibilities

2. The University Laser Safety Officer (ULSO) has overall responsibility for the administration and auditing of administrative controls for the management of laser safety. The ULSO will work with local Laser Safety Advisers (LSAs), managers and Technical Specialists, who are responsible for or have oversight of laser safety, to ensure that arrangements are in place for;

   - the training of staff and students;
   - the identification of lasers, and users of lasers;
   - ensuring suitable and sufficient, up to date, risk assessments are in place
   - the inspection of laser facilities, and ensuring controls have been implemented;
   - the routine auditing of laser facilities to a schedule;
   - ensuring adherence to national and international standards;
   - provision and updating of the University Laser Safety Arrangements and Guidance;
   - reporting to the University Health, Safety and Well-being Committee (via the Radiation Safety Advisory Group; RSAG) on a regular basis;
   - coordinating the meetings and activities of the Non-Ionising Radiation Safety Working Group (NIRSWG), to whom the ULSO is the Secretary.

3. The ULSO will work closely with the Head of Radiological Protection to whom they report in an operational capacity.

4. The ULSO is responsible for maintaining their knowledge and competence and must attend such professional training and refresher events as are relevant.

Head of School / Department / Institute responsibilities

5. The Heads of Schools / Departments / Institutes have primary responsibility for ensuring that their school/department/institute works in accordance with the University Laser Safety Arrangements and Guidance.

6. Where laser equipment of Class 3B or 4 is present (including Class 1 products containing these lasers if emission may be accessible under certain conditions, e.g. servicing) they must appoint, in consultation with the ULSO, a local Laser Safety Adviser (LLSA). The LLSA must be officially appointed by letter by the Head of School / Department / Institute that gives their responsibilities; a copy of the letter of appointment must be sent to the ULSO.

7. The Head of School / Department / Institute must ensure the LLSA has sufficient time and resources to discharge their responsibilities in an effective manner.

Local (Department / School / Institute) Laser Safety Adviser (LLSA) responsibilities

8. The Local (Department / School / Institute) Laser Safety Advisers (LLSA) have the following responsibilities;

- act as a source of technical and operational advice on laser safety for staff and students whose work involves use of laser equipment;
- identify all lasers, except for Class 1 lasers and Class 2 laser pointers (whose classification has been verified by measurement rather than by label). This includes any Class 1 product with an embedded Class 3B or 4 lasers, apart from "consumer type" Class 1 products (e.g. laser printers);
- ensure that suitable and sufficient risk assessments have been prepared (by the line managers / supervisors whose responsibility this is), and standard operating procedures/schemes of work are in place for safe operation of lasers. These must include robust justification for instances where it is not reasonably practicable to enclose any Class 3B or 4 open beams;
- LLSAs must review and approve these risk assessments, along with systems of work;
- identify personnel intending to work with Class 3R, 3B, and 4 lasers, and others who may be working with modified Class 1M or 2M devices, and assist them to receive adequate training in the safe use of lasers;
- regularly inspect all laser activities to ensure that all lasers in the school/department/institute are used in accordance with the University Laser Safety Arrangements and Guidance. Reporting the findings of inspections to the local health and safety committee and the ULSO;

- restrict or stop any laser activity that is known not to comply with the University Laser Safety Arrangements and Guidance and inform the manager of the area and Head of School / Department / Institute of their action;
- ensure that undergraduates working with lasers follow a written scheme of work;
- attend and contribute to the School / Department / Institute health and safety committee.

Principal Investigator, Research Supervisor and Technical Specialist responsibilities

9. Principal Investigators, Research Supervisors and Technical Specialists have duties delegated to them by Heads of Schools/Departments/Institutes, to provide "such supervision as is necessary" to ensure the safety of all the individuals for whom they are responsible. This includes all postgraduate and undergraduate students working with lasers. They have the following responsibilities;

- day-to-day health and safety management and the provision of immediate supervision and training for the use of lasers in the laboratory;
- consult with the LLSA when any new activity or significant change in activity involving lasers is planned (submit a LS1 form);
- inform the LLSA of the intention to buy a laser system or bring one on site prior to its purchase or loan and arrival (submit a LS2 form);
- inform the LLSA of the intention to dispose of a laser system prior to disposal (submit a LS2 form);
- ensure that lasers are made safe prior to disposal and dealt with appropriately if they contain hazardous materials;
- ensure that all users are competent to work with lasers safely. This must occur before they start working with lasers in the University, and will normally consist of ensuring the users have attended appropriate training and been taken through the safety checklist (submit a LS3 form);
- implement, and enforce, the University Laser Safety Arrangements and Guidance. Ensuring that risk assessments, and standard operating procedures/schemes of work are in place and up to date, reviewing at least every three years, or when there is any new or significantly different activity involving lasers;
- attend an appropriate Laser Safety Training Session (at least once every 5 years), or, when released to replace the existing training provision, undertake the training module 'Managing Laser Safety' provided on Canvas and pass the associated knowledge tests and prepare / assess risk assessments;
- notify Safety Services and the LLSA immediately of any accident involving lasers (using standard University form).

10. The terms Principal Investigators, Research Supervisors and Technical Specialists may have local meanings that vary between Schools, Departments and Centres, therefore, to avoid ambiguity, local arrangements must specify definitions and duties of role holders.

Laser User responsibilities

11. Laser user refers to a person who during their normal work could be exposed to radiation greater than the accessible emission limit of a class 2/2M laser for visible light (400 nm to 700 nm) and class 1/1M for invisible light. Laser users have the following responsibilities;

- work in accordance with the University Laser Safety Arrangements and Guidance and follow safety procedures detailed in risk assessments, and standard operating procedures/schemes of work;
- follow the guidance of Principal Investigators, Research Supervisors, and the LLSA;
- keep the Principal Investigator / Research Supervisor fully informed of any proposal to depart from established safety procedures and be responsible for their own safety and that of others who may be affected by their acts or omissions;
- where required, wear the appropriate laser eyewear as instructed;
- know how to inspect, and report any faulty safety equipment, interlocks, safety systems and eyewear;
- attend an appropriate Laser Safety Training Session (at least once every 5 years).

Organisational Structure

12. The organisation in place to implement the University's health & safety policy is described in detail in the following document. The University Arrangements Chapter 1 also gives details of the University Health, Safety and Well-being Committee.

Radiation Safety Advisory Group (RSAG)

13. The Radiation Safety Advisory Group reports to, and is responsible for advising the University Health, Safety and Well-being Committee on measures to ensure the legal and safe use of all sources of radiation, and the protection of persons liable to be exposed to radiation hazards. The chair of the Non-ionising Radiation Working Group is a member of the RSAG. The University Arrangements Chapter 4 gives further details of its remit and membership.

Non-Ionising Radiation Safety Working Group

14. The Non-Ionising Radiation Safety Working Group reports to the Radiation Safety Advisory Group on laser radiation and is responsible for drafting arrangements to comply with legislation and national / international standards, ensuring consistency in compliance with laser safety requirements, and encourages the dissemination of good practice in this field. Membership includes the University Laser Safety Officer, all (or) the School / Department / Institute Local Laser Safety Advisers and the Head of Radiological Protection, and Trade Union representatives.

Training Requirements

15. Laser users, Principal Investigators / Research Supervisors, the LLSAs and the ULSO must all attend such laser safety training courses as are appropriate for the class of laser being used, and the activities being performed. For Laser Users and Principal Investigators / Research Supervisors this may be provided by the ULSO, the school/department/institute, or by an external organisation if approved by the ULSO. All laser users / Principal Investigators / Research Supervisors and Laser Technical Specialists must repeat this training every five years. A record of attendance will be kept by the ULSO.

16. The users must use the induction and training checklist (form LS3) to form the basis of their local instruction on the systems they will use. The local instruction will occur in the School / Department / Institute and will be delivered by the principal investigator, research supervisor and / or the LLSA. This must occur before they start working with lasers. Copies of the completed checklist should be kept by the Laser User and an electronic copy sent to the LLSA.

Documentation

Management Forms

17. Laser Safety Management Form LS1 must be completed by the Principal Investigator, Research Supervisor or a Technical Specialist to notify their LLSA of any new laser activity or significant change in laser activity.

18. Laser Safety Management Form LS2 must be completed by the Principal Investigator or Research Supervisor to notify their LLSA of any newly acquired laser or any laser for disposal.

19. Laser Safety Management Form LS3 must be completed by the Laser User and signed off by the Principal Investigator or Research Supervisor before the user is permitted to use any laser or laser system.

20. Copies of the forms must be sent to the LLSA in order that a record of lasers in their area can be maintained, users are identified and user training recorded.

Risk Assessment

21. A suitable and sufficient risk assessment must be carried out for all laser work undertaken at the University or by University employees. These assessments must include;

- a description of the system being assessed;
- an assessment of the beam hazards along with suitable control measures to mitigate these hazards (not withstanding that where reasonably practicable, control measures for class 3B/4 beams must include enclosing and preventing access to the laser radiation, interlocking access panels, and operation in a suitable laser-controlled area with restricted access);
- a robust justification for any open beam work with Class 3B and 4 lasers;
- and Class 3B and 4 users must have must have completed advanced laser safety course / managing laser safety course within the previous 5 years.

22. Completed risk assessments must be signed by the assessor, all users and the Principal Investigator / Research Supervisor. Risk assessments for Class 3B and 4 lasers must be reviewed by the LLSA.

23. Standard Operating Procedures / Schemes of Work should be provided that are based on the findings of the risk assessment, and which detail the safe operating procedures for working with a particular laser or laser system.

Open beam work

24. Open beam work with lasers must be eliminated wherever possible and only undertaken when all methods of enclosure have been deemed inappropriate. The responsibility for elimination lies with the Principal Investigator.

25. Where open beam work with class 3B and 4 lasers is essential, it must be robustly justified in a risk assessment and must be signed off by the Head of School / Department / Institute. The risk assessment must identify control measures to be put in place to properly protect users and others from beam hazards. All risk assessments for open beam work with class 3B and 4 lasers must be reviewed by the LLSA.

26. Work must never be carried out until all the approvals have been given and the LLSA is satisfied that work can be undertaken safely.

Use of Personal Protective Equipment (PPE)

27. Suitable PPE must be available and used when required. The calculations to show the PPE is appropriate must be included in the risk assessment. Training should be given in the use and maintenance of any available eyewear.

28. The PPE must comply with BS EN 207:2017 or BS EN 208:2009 and have a UKCA or CE mark.

29. The condition of PPE must be inspected on a regular basis and before each use to ensure that, in particular, it is the correct PPE, is free from damage (such as scratches), is hygienic and properly fits. A record of inspections and checks must be made before each period of use.

Use of lasers by undergraduates

30. Undergraduates working with lasers should use the minimum power laser practicable and follow a written Scheme of Work / Standard Operation Procedure (SOP).

31. Schools / Departments / Institutes must make every attempt to use lasers of as low power and class as possible for undergraduate experimental work (i.e. Class 1/1M, 2/2M or visible CW 3R lasers). If a School / Department / Institute wishes to use class 3B or 4 lasers for undergraduate teaching, the LLSA must be consulted and suitable arrangements made and recorded to ensure that the students (or inexperienced staff) receive appropriate training, instruction, information, and supervision.

32. Students involved in project work and working with Class 3B or 4 lasers should be treated as laser users and be subject to the normal training process. The risk assessment should consider the inexperience of the users and additional close supervision is likely to be necessary.

Laser Installation and Service Engineer Visits

33. If an outside agency (e.g. the laser equipment supplier) is engaged to install or service any equipment, then a permit-to-work procedure must be issued, and then be followed (the person issuing the permit-to work must do this) for handing the equipment over to the service engineer and accepting it back, fully restored to normal operation, when the work is completed.

34. The PI, Local LSA, Technical Specialist or a suitable trained University employee must liaise with the external agency to ensure a suitable and sufficient risk assessment is in place for activities undertaken by the outside agency. A suitable and sufficient risk assessment must be in place for activities undertaken by the outside agency. The assessment should include evaluation of the laser hazard posed to University personnel and assess PPE requirements for University personnel to be present during open beam work.

Use of lasers outdoors and off campus

35. The use of lasers of any class outdoors or off campus should be subject to careful planning and thorough risk assessment, which must include a consideration of any risks to the public, and of public relations or reaction to the work. Any laser works outdoors or off campus must be discussed with the University Insurance Office, and the must discuss the proposal with the Head of Radiological Protection.

36. If the beam is to be directed upwards and the risk assessment indicates a hazard (including distraction) to aviators, it may be necessary to consult the Civil Aviation Authority. Users should review CAA document CAP736 during the planning for any such work. If 'lookout arrangements' are made for short term outdoor laser operations, these should consider the possibility of aircraft including low or no noise aircraft such as gliders.

Accidents and accident reporting

37. Accidents and incidents must be promptly reported as described on the health and safety web pages; www.healthandsafety.manchester.ac.uk/toolkits/accidents/reporting.

38. If Laser Users suspect they have been struck in the eye by a laser beam or have any immediate concerns over their eyesight they should go to A&E as a matter of urgency. In emergencies the LLSA, or a member of staff, must assist and ensure that a copy of all relevant documentation is taken that may help in diagnosis and treatment.

Support and Guidance

39. The Radiation Safety Unit is a source of further support and guidance and can be contacted through www.staffnet.manchester.ac.uk/rsu/.

Acronym / term	Meaning / definition
AURPO	Association of University Radiation Protection Officers.
CAA	Civil Aviation Authority.
Canvas	The University digital teaching platform introduced in 2025.
CE (mark)	The CE mark is a mandatory European symbol indicating a product meets EU health, safety, and environmental standards, allowing free movement in the European Economic Area (EEA). Affixing it signifies the manufacturer's declaration of compliance with relevant directives (like for toys, electronics, medical devices) for products sold in the EU and EEA, including items imported from other countries. It's not a quality mark, but a declaration of conformity to essential requirements.
Class 1	Class 1 laser products are safe during normal use, including long-term direct intrabeam viewing. Class 1 also includes high power lasers that are fully enclosed so that no potentially hazardous radiation is accessible during use. Intrabeam viewing of Class 1 laser products which emit visible radiant energy may still produce dazzling visual effects, particularly in low ambient light. The term "eye-safe" may only be used for Class 1 laser products.

Class 1M	Class 1M laser products that are safe, including long-term direct intrabeam viewing for the naked eye (unaided eye). However, these laser products can be harmful to the eye if the beam is viewed using magnifying optical instruments. Intrabeam viewing of Class 1M laser products which emit visible radiant energy may still produce dazzling visual effects, particularly in low ambient light.
Class 1C	Class 1C laser products that are intended for direct application of laser radiation to the skin or internal body tissues for medical, diagnostic, therapeutic or cosmetic procedures such as hair removal, skin wrinkle reduction, acne reduction. Although the emitted laser radiation may be at Class 3R, 3B or 4 level, eye exposures are prevented by engineering means.
Class 2	Class 2 laser products that emit visible radiation in the wavelength range from 400 nm to 700 nm that are safe for short exposures (due our natural aversion behaviour for exposure to bright light) but can be hazardous for deliberate staring into the beam and presumption is that there is very low risk of injury for short exposures that are somewhat longer. Dazzle, flash-blindness and afterimages may be caused by a beam from a Class 2 laser product, particularly under low ambient light conditions. This may have indirect general safety implications resulting from temporary disturbance of vision or from startle reactions. Such visual disturbances could be of particular concern if experienced while performing safety-critical operations such as working with machines, at height, with high voltages or whilst driving.
Class 2M	Class 2M laser products are products which produce a large diameter beam that emit visible radiation in the wavelength range 400 to 700 nm and are safe for short time exposure only for the naked (unaided) eye. These laser products can be harmful to the eye if the beam is viewed using magnifying instruments. Dazzle, flash-blindness and afterimages may be caused by a beam from a Class 2M laser product, the same as for a Class 2 laser product.

Class 3R	Class 3R laser products that emit radiation may have a maximum output power of 5 mW that can potentially cause eye injuries with direct intrabeam viewing, but the risk of injury in most cases is relatively low but does increase with exposure duration. Class 3R laser products are not considered intrinsically safe; the risk is limited because 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. Dazzle, flash-blindness and afterimages may be caused by a beam from a Class 3R laser product in the visible wavelength range, the same as for a Class 2 laser product.
Class 3B	Class 3B laser products may have an output power of up to 500 mW that are normally hazardous when intrabeam ocular exposure occurs including accidental short time exposure. Viewing diffuse reflections is normally safe. Class 3B lasers which approach the upper limit for the Class 3B may produce minor skin injuries or even pose a risk of igniting flammable materials. However, this is only likely if the beam has a small diameter or is focussed.
Class 4	Class 4 laser products have an output power greater than 500 mW for which intrabeam viewing and skin exposure is hazardous and for which the viewing of diffuse reflections may be hazardous. These lasers also often represent a fire hazard.
Consumer Class 1 laser	Consumer Class 1 lasers are the safest category, considered harmless under normal use because any hazardous radiation is fully enclosed or too weak to damage eyes/skin. Examples include laser printers, CD/DVD players, and enclosed laser engravers
Consumer Class 1M	Safe for unaided viewing but dangerous if viewed with optical instruments (like magnifying glasses), common in fibre optics.
Consumer Class 2	Low-power visible lasers (e.g., <1mW) where the blink reflex protects the eye, like laser pointers.
Consumer Class 3R	A subgroup of Class 3R (up to 5mW) may be used in some consumer products, deemed low risk if used as intended.
CW	Continuous wave laser emits a constant, steady beam of light without pulsing.
LASER	Light Amplification by Simulated Emission of Radiation.
LS1, LS2, LS3	Laser Safety Management forms.
LSA (or LLSA)	Laser Safety Adviser (Local LSA), the LSA is an advisory role who provide advice on laser technologies, compliance and safety to the Heads of Schools and Departments, and also to employees, visitors and students.
NIRSWG	Non-ionising Radiation Safety Working Group.

PPE	Personal protective equipment.
RSU	Radiation Safety Unit.
UKCA (mark)	The UKCA (UK Conformity Assessed) mark is a British product marking indicating compliance with UK regulations for goods sold in Great Britain (England, Scotland, Wales) after Brexit, replacing the CE mark for many products, covering safety, health, and environmental standards for items like toys, machinery, and electronics. While mandatory for new goods in GB from January 2021, the CE mark remains valid for an extended period, creating a transitional phase where both might be accepted, but the UKCA mark signifies adherence to UK-specific rules.
ULSO	University Laser Safety Officer.
SOP	An SOP (Standard Operating Procedure) is a set of step-by-step instructions detailing how to perform routine tasks to ensure efficiency, quality, consistency, and compliance with regulations, acting as a guide for employees on the 'what, when, and how' of specific operations, reducing errors, and aiding training.

Document control box	
Title	Arrangements Chapter 27
Approving body	University Health, Safety and Wellbeing Committee
Implementation date	25 February 2026
Issued by:	Radiation Safety Unit
Implementation date:	25 February 2026
Version, date and reason for change:	v3.0 February 2026 – significant editing, use of Laser Technical Specialists, acronyms explained v2.1 Nov 2020 – Radiation Safety Co-ordinating Committee updated to Radiation Safety Advisory Group following Will Spinks' Governance review v2.0 August 2019 – revised introduction of AURPO Guidance Note No. 7 v1.0 – Implemented 1st February 2018
Next review date:	Dec 2029 or Upon significant change
Owner of this document:	Non-ionising Radiation Technical Advisory Group Chair: Dr Andrew Thomas Secretary: Katharine Sullivan
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