

Laser Risk Assessment & Scheme of Work for use of Class 3R, 3B and 4 lasers

1. **Overview & Sign-off**

|  |
| --- |
| Project title: |
| Assessment number: |
| Location & Room: |

|  |
| --- |
| Assessor: |
| Role: |
| Signature: |
| Section: |
| Date: |

|  |
| --- |
| Approved (DNIRPA): |
| Signature: |
| Date: |

1. **Brief Description of Activity / Project:**

This should be more detailed if the set-up is using open beams, as you will need to justify why it cannot be enclosed.

|  |
| --- |
|  |

1. **Scheme of Work (Class 3R, 3B and 4 Lasers only)**

|  |
| --- |
| Responsible Person: |
| Authorised Laser Users: |

1. **General Precautions**

Precautions should be based on the risk assessment and background information in this document. The hierarchy of control must be used in selecting control measures, i.e. prioritising elimination/substitution of hazard; engineering controls such as interlocking and shutters; procedural controls such as signage and training; and personal protective equipment as a last resort:

|  |
| --- |
|  |

|  |
| --- |
|  |

1. **Specific Considerations Relating to this Experiment**
2. **Risk Assessment**

**Insert diagram of Experiment / Project Setup:** Provide a diagram and/or photograph of the experiment or project, showing approximately how the laser interacts or connects to other components.

|  |
| --- |
|  |

1. **Who Could Be Harmed?**

**Authorised Laser Users**

List the users who are authorised to operate this experiment/equipment*.*

|  |
| --- |
|  |

**Project Supervisors**

List the responsible person(s) supervising the above-named individuals. This will generally be the academic member of staff in charge of the experiment/equipment.

|  |
| --- |
|  |

**Others [a*pprox. # of others*]**

List any other people who could be at risk as part of their work or study, and others who could be harmed who are not directly involved with the work, e.g., cleaners, Estates staff, contractors, visitors etc.

|  |
| --- |
|  |

1. **Background Information (refer to Appendix 1 for further guidance)**

**Laser Product(s)**

Describe the lasers, from the laser aperture back to the wall sockets (e.g. the laser is contained in a die cast aluminium box, with FC/PC bulkhead adaptor providing optical interface. Current and temperature controllers are connected via D-type sockets).

|  |
| --- |
|  |

**Beam Delivery**

**Note: All open beam work must have an appropriate protocol / operating procedure**

Describe the beam delivery, from the laser aperture to the place where the laser beam carries out its function (e.g. the laser beam is delivered via an optical patch lead, which uses FC/PC connectors at both ends).

|  |
| --- |
|  |

 **Laser Process**

Describe the laser process (e.g., what the laser beam does, such as cutting, communication).

|  |
| --- |
|  |

 **Environment**

Describe the environment where the laser application is contained (e.g., open access, restricted or controlled area, teaching room, office; suitable signage present if required; access shared with non-laser users? Access control methods, enclosures etc).

|  |
| --- |
|  |

1. **Laser Identification and Specification/Hazard Calculation**

List all lasers, including low power alignment lasers. Enter as much information as possible. If more lasers used, duplicate the table as required. Rows must not be removed from this table.

|  |  |  |  |
| --- | --- | --- | --- |
| Specification | Laser 1 | Laser 2 | Laser 3 |
| Description |  |  |  |
| Laser Type |  |  |  |
| Manufacturer |  |  |  |
| Model |  |  |  |
| Serial |  |  |  |
| Laser Class |  |  |  |
| Output Type (CW / Pulsed) |  |  |  |
| Wavelength Range (nm) |  |  |  |
| Wavelength Used (nm) |  |  |  |
| Max Power or Energy (W/dBm/J) |  |  |  |
| Measured Power or Energy (W/dBm/J) |  |  |  |
| Initial Beam Diameter (m) |  |  |  |
| Beam Shape |  |  |  |
| Beam Divergence $θ$ (mrad) |  |  |  |
| Pulse Length (s) |  |  |  |
| Pulse Repetition Rate (s/Hz) |  |  |  |
| ELV / MPEOCULAR (Wm-2) |  |  |  |
| NOHD@MAX (m) |  |  |  |
| NOHD@MEASURED (m) |  |  |  |
| ELV / MPESKIN (Wm-2) |  |  |  |
| NSHD@MAX (m) |  |  |  |
| NSHD@MEASURED (m) |  |  |  |

1. **Beam Hazards**

Detail any relevant ocular and skin hazards, along with consequences that may result. Are open or partially enclosed beams used?

|  |
| --- |
|  |

1. **Identification of hazards additional to the laser hazard(s)**

The following are some typical hazards that could lead to reasonably foreseeable accidents and need to be covered in this assessment. Answer yes or no to indicate if the hazard is applicable to this project. Provide details on the following pages.

|  |  |
| --- | --- |
| Hazards Identified | Yes / No |
| Laser / Non-Ionising Radiation *Can alternative lower power devices / equipment be used instead? If not reasonably practical to fully enclose hazardous beams, then this needs to be justified, along with detailing the alternative suitable controls being implemented. Burns to skin should be considered, along with the possibility of diffuse and specular reflections.* |  |
| PPE - Personal Protective Equipment (refer to section 13)*Is PPE appropriately rated, free from damage, and fitting correctly?* |  |
| Viewing Devices*Intrabeam viewing or magnifying optics (e.g. microscope, eye loupes, etc) - may result in 1M/2M classes becoming hazardous.* |  |
| Damage *Are components, such as optical fibres positioned where they will not be damaged, leading to beam escape?* |  |
| Electrical *Some lasers contain high-voltage power supplies, and often large capacitors / capacitor banks that store lethal amounts of electrical energy; poorly maintained equipment; exposed electrical parts (development, servicing or repair, etc).* |  |
| Cryogens *Cryogenic liquids and gases can deplete the oxygen in an environment to unsafe levels (as a minimum the oxygen concentration in the workplace should be maintained above 19.5%).* |  |
| Chemicals, Compressed and Toxic Gases *Laser dyes are often toxic and / or carcinogenic, dissolved in flammable solvents. Excimer lasers may use fluorine and hydrogen chloride. Other sources of hazardous chemicals, such as cleaning fluids. Compressed gases (e.g. helium) may explode if heated. Consider interaction of lasers with photosensitising chemical substances.* |  |
| Fumes / Vapours / Laser Generated Air Contaminants from Beam / Target interaction *When laser beams are sufficiently energised to heat up a target, the target may vaporise, creating hazardous fumes or vapours that may need to be captured or exhausted.* |  |
| Explosion Hazards *High‐pressure arc lamps, filament lamps, and capacitors may explode if they fail during operation. Laser targets and some optical components also may shatter if heat cannot be dissipated quickly enough.* |  |
| Fire *High power Laser beams may ignite combustible materials. This should particularly be a consideration when designing enclosures to contain beams.* |  |
| Artificial Optical Radiation (non-lasing)*UV and visible radiation may be generated by laser discharge tubes, pump lamps, or plasmas. The levels produced may be a hazard to the eyes and skin. Bright visible wavelengths may result in flash / temporary blindness, leading to other tasks becoming more hazardous.* |  |
| Ionising Radiation (X‐rays)*X‐rays can be produced from two main sources, high voltage vacuum tubes of laser power supplies such as rectifiers, thyratrons, and electric discharge lasers. Any power supplies that require more than 15 kV may produce x‐rays.* |  |
| Liquids *Water may be used to cool certain apparatus, so consideration should be given to the location of pipe work in case of leaks or service requirements. Legionella bacteria may also cultivate in stagnate sources / dead-legs.* |  |
| Persons at Increased Risk of Exposure *Wheelchair users may be at eye level of bench mounted lasers (could also apply to normal users if seated). Individuals with active body-worn or implanted medical devices (EMF).*  |  |
| Interaction between artificial optical radiation and photosensitising chemical substances *Skin creams and some other chemicals can react with light to make symptoms worse.* |  |
| Poor Controls *Can control measures such as enclosures, beam stops, interlocks, be easily defeated? Enclosures require ‘a tool’ to remove covers (i.e. removing a wingnut by fingers is not allowed), and interlocks should be encoded to prevent them being bypassed.* |  |
| Multiple Sources of Exposure *Exposure to multiple sources of bright AOR at the same time may exceed exposure limit values. If this is the case, a more detailed assessment will be required.* |  |
| Manual Handling *Transportation of gas cylinders & cryogen dewars will require separate assessment and appropriate handling equipment / PPE. Other equipment (large lasers, control gear) may also need to be considered.* |  |
| Lone Working *Anyone working by themselves without close or direct supervision or regular contact with other employees may be at increased risk. This includes individuals working outside normal working hours.*  |  |
| Environment *Certain classes of lasers must be operated in restricted or controlled locations, and access must not be given to unauthorised users / untrained users respectively. Suitable signage present? Access control (electronic, key etc), Interlocks? Is there suitable access to equipment, with workspaces free from trip / slip hazards?* |  |
| Other*Please state any other applicable non-beam hazards.* |  |

1. **Control Measures**

Provide further details on the hazard if ‘yes’ to any of the above and state the control measures to be used for the laser(s) and other identified hazards.

|  |
| --- |
|  |

1. **Personal Protective Equipment**

PPE is typically used as a last resort, or where other control measures are not practical.

|  |  |
| --- | --- |
| Identification of possible PPE required | Tick if required ü |
| Skin Protection? *(particularly for UV)* |  |
| Face Mask / Respirators? |  |
| Gloves? *(for cryogenics / chemicals)* |  |
| Laser Safety Eyewear? |  |
| Other Eyewear? *(for impact protection)* |  |

**Details**

*Provide further details if ‘yes’ to any of the above (e.g. Laser Protection Eyewear ‘L’ rating calculation).*

|  |
| --- |
|  |

1. **Other Hazards / Comments**

|  |
| --- |
|  |

1. **Training and instruction**

|  |
| --- |
|  |

1. **Monitoring**

|  |
| --- |
|  |

1. **Review & Audit**

|  |  |  |
| --- | --- | --- |
| Reviewed/Audited by | Date | Comments / Action |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Emergency Procedure for Laser Exposure (Class 3R / 3B / 4)[[1]](#footnote-1)**

If you suspect an eye injury from a Laser strike you must report to Colchester Hospital A&E as soon as possible, **and within 24 hours of the incident**. **DO NOT DRIVE YOURSELF**.

Contact the Information Centre on 01206 87 **2222** *(located off Square 3)* and tell them that you have a suspected Laser eye injury. You must take this document along with you *(or at least this page)*. They will arrange a taxi for you to go to Colchester Hospital Accident and Emergency department. Please ensure you have sufficient means to pay for a taxi whilst operating Lasers[[2]](#footnote-2).

**EMERGENCY OPHTHALMIC EXAMINATION:**

**LASER Exposures:**

|  |
| --- |
| Report to: Colchester Hospital A&E Department  |
| Tel: 01206 747474 (Main Reception) |
| Address: Turner Road, Colchester, CO4 5JL |

**Laser Details:**

|  |
| --- |
| Type: |
| Wavelength: |
| Power: |
| Laser Class: |

**Exposure Details:**

|  |
| --- |
| Institution Name: University of Essex, Wivenhoe, Essex. CO4 3SQ |
| Location of Incident: |
| Circumstances of Injury: |
| Time / Date of Injury: |
| Eye(s) Affected: Left / Right / Both |
| Protective Googles Used? Yes / No |

You must report the incident to Workplace Health, Safety and Wellbeing (WHSW) as soon as possible on 01206 87 2944 or [safety@essex.ac.uk](file:///C%3A%5CBox%5CSafety%20Audit%20Shared%20Drive%5C5%20Performance%20and%20Monitoring%5CAudits%5C2019_laser%20audit%20PHE%5C2019-03%20laser%20safety%20audit%20report%20and%20action%20plans%5CAction%20update%20files%5CDocumentation%20updates%5Csafety%40essex.ac.uk).

All incidents, whether involving an emergency examination or not, must be reported promptly to WHSW using the [incident report form](https://www.essex.ac.uk/-/media/documents/directories/health-and-safety/hsincidentrecordweb.doc). This must be sent to [safety@essex.ac.uk](file:///C%3A%5CBox%5CSafety%20Audit%20Shared%20Drive%5C5%20Performance%20and%20Monitoring%5CAudits%5C2019_laser%20audit%20PHE%5C2019-03%20laser%20safety%20audit%20report%20and%20action%20plans%5CAction%20update%20files%5CDocumentation%20updates%5Csafety%40essex.ac.uk).

**Appendix 1: Guidance on providing information for the risk assessment**

The risk assessment should inform the selection of reasonably practicable controls that will be implemented. Where controls have been considered, but discounted as not reasonably practicable, then this should also be recorded including the reasons.

Background information should include a description of hazards and risks at different points in the beam path, including details of powers or energies in the beam at any accessible point; and any beam manipulations that may alter the magnitude of the hazard. This analysis should include comparison of irradiance or radiant exposure in the beam with relevant exposure limit values and, where they are more restrictive, the maximum permissible exposures. As an indication of the level of detail required, it should be sufficient to lead to the selection of appropriate control measures.

It is recommended that the rationale behind the design of enclosures should be documented. This would include both the need for the enclosure and its purpose: either containing the beam or preventing access to the beam. The general design features should also be documented, including any requirements for access and how these are satisfied, along with any interlocking or fastenings.

**Appendix 2: Guidance notes for laser eyewear**

Where laser protective eyewear is required, the specification should be assessed by someone who is competent to do this. This should be recorded and should be available in the laboratory where the eyewear is used. Where existing eyewear does not meet the required specification, it should be replaced.

Records to show eyewear examinations should be kept. Each pair of laser safety eyewear requires a unique ID number, in order to be referenced by the laser safety eyewear inspection record. Suitable eyewear that meets the ‘L’ rating calculated above should be listed.

An important consideration that should not be overlooked in selecting laser protective eyewear is the visible light transmission. Often more than one filter may meet the required specification, therefore consideration should be given to selecting eyewear that gives good visible light transmission.

# **Appendix 3: Supplementary Information: Laser Class vs University Requirements**

 **User** **DNIRPA / Responsible Person**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Laser Class | Basic Training | Additional Training | Laser Videos | Scheme of Work | Risk Assessment | Local Rules | User Register | Laser Inventory | Laser Controlled Area (LCA) |
| 1 | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  |
| 1M | Green tick signifying required | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Green tick signifying required | Red x signifying not required  | Green tick signifying required | Red x signifying not required  | Green tick signifying required\*1 |
| 2 | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  |
| 2M | Green tick signifying required | Red x signifying not required  | Red x signifying not required  | Red x signifying not required  | Green tick signifying required | Red x signifying not required  | Green tick signifying required | Red x signifying not required  | Green tick signifying required\*1 |
| 3R | Green tick signifying required | Green tick signifying required | Red x signifying not required  | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required\*1 |
| 3B | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required |
| 4 | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required | Green tick signifying required |

*Note: \*1 - Open beam work for Classes 1M, 2M and 3R must also be carried out in a LCA.* A more detailed quick guide can be found on the Universities H&S “Lasers and Laser Pointers Safety” page: <https://www.essex.ac.uk/staff/working-with-physical-agents/lasers-and-laser-pointers-safety>

1. If there are any other foreseeable incidents identified in these local rules, such as burns, fire or dazzle, the contingency arrangements must also be detailed in this section, or the relevant departmental emergency procedure cross-referenced in this document. [↑](#footnote-ref-1)
2. The DNIRPA can authorise a claim for the taxi fare back through the School upon presentation of a receipt. [↑](#footnote-ref-2)