

1) Description of Laser Hazards

Limited hazard circumstances:[] Laser hazard exists only during alignment [] Laser Hazard exists only during service

Describe type of lasers used or nature of laser hazard

2) Mitigation of Laser Hazards

<Laser radiation from Class 3B & Class 4 laser sources present a real potential eye and skin hazard. Within an instant a life changing accident can occur. The purpose of this laser schedule is to outline general and specific controls that will allow the user to work with laser in a safe manner. **It is critical that users complete the user specific sections of this schedule.** The general guidance give that accepted practice for safe work, but it is the specific controls and user compliance for this AHD that will make all the difference.>

a) LBNL General Laser Safety Policy

All laser operations shall be conducted in accordance with Pub 3000 chapter 16, Lasers.

All operating personnel with possible exposure to laser radiation shall have had laser safety training (EHS 302), laser lessons learned (EHS 303) laser eye exam (EHS 288) and On the Job training (OJT).

Laser areas shall be kept as clean as possible. Reflective objects such as tools, optics, screws, etc. shall be kept away from laser beams.

An authorized LBNL laser operator shall be in the lab whenever a laser is operated with non-LBNL personnel present. Visitors accompanied by an authorized individual who shall assure that all are wearing required laser protective eyewear and protective clothing.

The LBNL LSO shall be notified if any lasers are added or any experimental changes are made to an approved laser set up that impact safety

The laser use area must be posted with an approved warning sign(s) that indicates the nature of the hazard. Wording on the sign will be specified by the LSO.

Communicate your intentions to others present at all times (e.g. before opening/closing shutters, removing beam blocks, or actions that might put others unintentionally at risk).

Modifications determined to have a minor impact on safety per the PI/Work Team Lead and LSO will be uploaded to the AHD Upload Tab and will be placed in the body of the AHD at the time of annual renewal.

All Class 3B and Class 4 laser authorized under this AHD must be listed in the Laser inventory, this includes homemade units.

b) Guidance to Users for Laser Lab Visitors

A visitor is defined as an individual who is not listed on the AHD, this included LBNL Facilities staff. All visitors must be escorted while in the lab unless previous arrangements have been made (i.e. they fall under a SJHS). Visitor need to receive a safety orientation to the hazards and restriction in the lab space. See Visitors & Spectators in Personnel section for additional guidance.

2) Beam Path Controls

The beam path is considered to be the space between the laser source and intended termination of the beam. This may include beams transported through other lasers. Within the beam path wavelengths may change and output may increase or decrease or both. The beam could be open or enclosed or a combination of both. Whenever possible (within experimental considerations), appropriate enclosures, barriers, beam blocks, or beam tubes shall be applied to contain laser radiation below the threshold that could cause eye or skin damage. No lasers beams direct or scatter are allowed to unintentionally exit the laser use area. Total beam path enclosure provides the greatest level of laser safety.

<Describe how beam containment to the optical table is achieved (include the use of beam blocks and perimeter guards, curtains etc). In some cases you may wish to describe how any beams are blocked from exiting the laser use area:>

a) Beam Alignment

The majority of laser accidents in research activities occur while aligning the laser. All possible steps will be taken to prevent any such accidents. Alignment for the particular systems in this AHD shall be covered in required OJT of fully authorized users.

- The laser beam is never to be viewed directly.
- As a precaution, reflective jewelry, ID badges, etc will be taken off by those handling the laser.
- Only laser operators authorized by the PI may perform laser alignment activities.
- Whoever manipulates or moves optics shall be responsible to check for stray reflections. When found, those reflections shall be contained to the optical or experimental table(s), even if they are below an eye hazard level.
- Alignment should be conducted optic-to-optic and constant checking for stray reflections.
- Alignment procedures are performed at the lowest possible laser output.
- A Notice Alignment in Progress sign will be used during alignment activities.

<Describe any specific laser alignment procedures :>

b) Beam interaction Not Applicable []

Once the laser beam reaches its goal a consequence is realized. It might be raising an energy level or cutting a material. Laser radiation interaction with a variety of target or sample materials can generate beam target interaction hazards. The purpose of this section is to cause the user to think about what these interactions might be including reflections from a reaction chamber. Beam interactions could include: ultra violet exposure, ionizing radiation, reflective material and fumes.

<Describe any safety precautions that will to be taken to mitigate beam interaction:>

3) Environment

This section responds to the laser use area, which could be an isolated room or a multi-user facility (i.e. ALS).

a) Lighting conditions

Room illumination can have a dramatic effect on eyewear selection and general safety within a laser use area. Keep in mind that the need for laser eye protection must be balanced by the need for adequate visible light transmission. Indicate level of illumination:

Normal room light [] Low light illumination [] Complete darkness []

b) Open Walkways Not applicable []

Any beam paths between tables or between laser tables and targets where an open walkway exists shall have a control in place to warn or block those in the room from crossing the pathway (e.g. hinged tubes, beam tubes, retractable tapes, posting or chains).

<Describe control measures for open walkways:>

c) Access Control

In accordance with the ANSI Z136.1, standard access control for class 3B or class 4 lasers use areas can be an engineering control (i.e. interlock) or administrative/procedural control (posting or locking of doors). After consultation with the PI/Work team leader the LSO shall determine room access controls. Access control can also be achieved through: key card control, locking of doors or posting. Technical areas using a keypad as part of the interlock system should use a unique code combination (other than default code) and consider changing every 2 years.

Non-interlocked Access Yes [] No []

<Describe access control for this laser use area: >

d) Workstations

A common error is to have a workstation in a laser use area where the users are in line with the laser beam path. User protection such as a partition between the user and optical table maybe required.

<If this condition is present describe user protection:>

e) Unattended Laser Work:

In the event of unattended operation of non-enclosed lasers and non interlocked room the following controls shall be in place:

A sign shall be posted outside the laboratory which states that an unattended laser operation is underway (the sign can be obtained from the LSO).

The Lab entrance must contain emergency contacts information.

The LSO can review and allow exemptions (e.g. for access restricted areas)

4) Personnel

a) On the Job Training

One of the best way to reduce the chance of a laser injury is through well thought out OJT. OJT is a mixture of instruction, observation and supervised activities. The trainee needs to feel they have an ample opportunity to ask questions and have received satisfactory explanations to their questions. The PI or designee shall train/orientate staff on the hazards of the specific experimental work to be performed. This will include location and mitigation of potential hazardous beams /reflections, hazards associated with the work and the use of all required personal protective equipment (PPE). OJT needs to include an emphasis on the following core laser safety principals:

1. Selection of proper eyewear
2. Check condition of eyewear
3. Check for stray reflections, thoroughly & often
4. Block stray reflections
5. Demonstrate beam detection methods
6. Understand controls for different intensity levels
7. Read & Familiar with controls per AHD
8. Familiar with equipment
9. Communicates with others in the area

This OJT will be documented, including a signature by the trainer and trainee.

b) Visitors & Spectators

When visitors or guests are allowed in a Class 3B or Class 4 area covered by this AHD it is the responsibility of the escort to make the visitor aware of the level of hazard and appropriate protective measures they need to be taking. It is the responsibility of the guest to follow instructions and limitations on their activities. Guest or visitors without a background in the science of the laboratory may require additional safety briefings or training prior to being allowed in the space covered by the AHD.

5) Eyewear

Laser operators shall use the appropriate laser protective eyewear (have the appropriate optical density and/or reflective properties based on the wavelengths of the beams encountered, and the expected exposure conditions.

- This eyewear shall be stored in such a manner as to protect its physical integrity.
- There shall be sufficient laser protective eyewear on hand for users and expected visitors.

- Laser eye protection shall be inspected prior to each use to ensure that it is in good condition.
- The eyewear must be labeled with readable optical density & wavelength (user can label or use other means to ID eyewear).
- The eyewear will be reviewed by the LSO or other safety professional during periodic audits.

Any listed manufacturer and model of safety eyewear is representative only. Alternative laser eyewear may be used as long as they provide equivalent protective filtration (optical density) and wavelength coverage that match the specific laser output specifications. Verify with the Laser Safety Officer if you have any questions. Eyewear obtained for this AHD

Pair #1	Wavelength	OD
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Alignment Eyewear: In use Yes [] No []

Alignment eyewear is for laser adjustment work where hazardous laser radiation occurs in the visible portion of the spectrum (400-700 nm). This eyewear reduces but does not completely block the visible spectrum. It does allow the user to see the beam and therefore perform laser alignment (adjustment) activities. The alignment filters should attenuate the radiation level to a class 2-3A level. **The use of alignment eyewear can only be authorized by the LSO. That authorization is only valid for a year and for a set of specific circumstances, demonstrated to and evaluated by the LSO.**

< The specific alignment eyewear and the alignment controls. Examples: reduce output, use of ND filters, use of Iris, use of beam enclosures, remote viewing, will be found on the alignment authorization form, in the upload tab..>

6) Maintenance/Service/User Preventative Maintenance

Maintenance

Service vendors are responsible for providing technicians who are properly trained and qualified to work with their laser systems. LBNL staff is responsible for the safety of service personnel. Any service vendor performing work that requires open laser beams must:

- Receive a laser safety orientation from the LSO or designee (for each individual service person)
- Receive a site orientation from the user, including additional room hazards
- Follow safety guidance from the AHD and the laser chapter of Pub 3000
- Wear the proper laser protective eyewear for the level of laser output
- Be responsible to make anyone who enters the room is aware of the enhanced laser hazard status of the room
- It is the responsibility of the service person to re-install all safety system at the completion of the work (i.e. protective housings, interlocks)
- Their firm must have on file with LBNL a non-construction safety checklist
- In case of an injury or suspected injury notify his or her LBNL contact ASAP
- Electrical work and LOTO permit and Division permit maybe an additional requirement prior to allowing maintenance to proceed

User Preventative Maintenance or Repair

It is common and acceptable practice for laser users to perform PM on their laser systems (i.e. cleaning optics, optimizing output). A laser lab may have multiple energy sources that must be secured prior to maintenance or servicing activities. Steps described in the LBNL Lockout/Tagout Program shall be followed whenever this equipment is locked/tagged out. When access to electrical sources over 50 V is required (guarded or unguarded) the user must evaluate the need to applicability of LBNL Lock out tag out and electrical safety rules. This could include obtaining an electrical work permit. An activity where this applies is Flash lamp change out, work on diode drivers and power supplies. *Rationale: Flash Lamp change out: A lamp can be electrically secured by unplugging the power source from the wall outlet. Residual high voltage may persist for a significant period (minutes) in capacitors in the power supply even after it has been de-energized. Note the lamp is under vacuum and care should be taken to avoid damaging the bulb.*

Interlock Maintenance (operational checks)

Room access interlocks must receive a functional operational check every 6 months. This check needs to be documented, and should follow a written procedure. A Jan & June schedule is recommended. Suggested interlock test procedure

- Prior to arming interlock see if laser will start, reset interlock after each step/drop
- With door (s) closed arm (switch) interlock on
- Check illuminated sign(s) on outside turns on (if applicable)
- Hold open door to see that system shuts off after time delay (generally 15 seconds)
- Test emergency crash button (both outside and inside as appropriate)
- Each door of the lab shall be tested
- If the laser is blocked by shutter(s), see that they drop each time
- Check each by pass to see that it works

Document test and in particular any problems, also document corrective action on log.

7) Emergency Response

Authorized laser users will be familiar with the Building Emergency Plan, location of emergency equipment, and emergency procedures for fires, earthquakes, and evacuations. Emergency shut-off for lasers is done at the electrical panel circuit breakers or by electrical shut off switches.

Suspected Laser Injury

Accidental laser beam exposure is a serious event. In the case of suspected laser injury operations will be ceased and the laser setup will remain unchanged to allow for analysis of the cause of the accident. Exposed employees will be transported to Health Services (Bldg.26) for evaluation. Call 7-911. Notify any staff in the area, laser use supervisor and

LBNL LSO. Key item is to keep the individual calm.

