

Chapter 10: [Laser Safety](#)

Laser Operation Requirements for Class 1/2/3R Lasers with an Embedded Class 3B/4 Laser

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URL: <https://www-esh.slac.stanford.edu/eshmanual/references/laserReqClass1and2and3RembeddedClass3Band4.pdf>

1 Purpose

The purpose of these requirements is to protect workers from harmful exposure to *embedded lasers*. (Lasers are classified based on their output during normal operation. The beams from embedded lasers may be accessible during maintenance or service or if a control fails during normal operation.)

These requirements cover identifying hazards, developing and implementing controls, and authorizing operations for Class 1, Class 2 and Class 3R (Class 1/2/3R) lasers with an embedded Class 3B or Class 4 (Class 3B/4) laser in a location which is not a Class 3B/4 laser facility.

The following consumer laser products are exempted:

- Class 1 optical disc products, such as CD or DVD players or recorders
- Class 1 products intended for home or office use, such as conventional laser printers

Note Laser engravers and 3-D laser printers are NOT exempt.

They apply to workers using lasers of this classification, *system laser safety officers (SLSOs)*, *laser equipment custodians*, directorate laser leads, *laser facility program managers*, line management, ESH coordinators, the Laser Safety Committee (LSC), and the *laser safety officer (LSO)*.

2 Requirements

Class 1/2/3R lasers with an embedded Class 3B/4 laser have significant potential to cause injury and require specific control measures, described below for operation in a location that is not part of a Class 3B/4 laser facility.

Note For operation of Class 1/2/3R lasers with an embedded Class 3B/4 laser in a location that is part of a Class 3B/4 laser facility, the requirements are described in the safety documents for that facility and in [Laser Safety: Class 3B and Class 4 Laser Operation Requirements](#).

2.1 Hazard Evaluation

2.1.1 Manufacturer-provided Class 1/2/3R Lasers with an Embedded Class 3B/4 Laser

All manufacturer-provided laser products require a hazard evaluation by the LSO. The hazard evaluation includes utilizing the hazard control hierarchy and using a graded approach for hazard controls requirements.

- If there is no accessible laser radiation in excess of the Class 3R limit during any maintenance or service tasks, the LSO may determine that no further controls are needed beyond the requirements specified for Class 1, 2, and 3R lasers in [Laser Safety: Laser Hazards, Classification, and General Requirements](#) and [Laser Safety: Class 2 and Class 3R Laser Operation Requirements](#).

The LSO may also determine that one or more of the requirements in Section 2.2 must be completed before operating the laser; in this case, SOP document approval would be required. The LSO will also determine if any of the controls described in Section 2.3 need to be implemented.

- If there may be accessible laser radiation in excess of the Class 3R limit during a maintenance or service task, then the LSO will specify which requirements in Section 2.2 must be completed and which controls in Section 2.3 must be implemented before operating the laser. The requirements will include approval of an SOP document.

2.1.2 Class 1/2/3R Lasers with an Embedded Class 3B/4 Laser, Provided by SLAC or a SLAC User

All Class 1/2/3R lasers with an embedded Class 3B/4 laser that are built or modified by SLAC or a SLAC user must have an LSO hazard evaluation and all the requirements (except Laser Safety Committee review may not be needed, for example, for a laser system whose hazards are well understood and easily mitigated) specified in Section 2.2 must be completed. The LSO will determine how the controls described in Section 2.3 should be implemented.

2.2 SLAC-specific Requirements

The LSO hazard evaluation (see Section 2.1) determines which of the following requirements must be completed:

- A [System Laser Safety Officer Approval Form](#) for the SLSO, who will have line management and supervision responsibilities for safe laser operations of the laser
- [Laser Safety Committee](#) (LSC) review to provide expertise and advise on hazards and controls for the laser system and its operation. This helps ensure the laser hazards are adequately analyzed and controlled, in conformance with ESH policy and requirements.
- Standard operating procedure (SOP) document approval. The SOP describes the equipment utilizing the laser and its operation procedures. It includes a description of the laser hazards and controls to mitigate them. Approvers include the SLSO (or the equipment or laser supervisor), the LSO, and the ESH coordinator.
- Laser safety certification checks performed by the SLSO (or the equipment or laser supervisor) who provides a certification document for the LSO to approve

- LSO inspection of the laser configuration and controls to mitigate the laser hazard. The LSO will write an inspection report that will describe any action items that need to be completed before operation approval.
- [Laser Safety SharePoint](#) site document library for the laser system. This library can host or provide links to documents associated with the laser system, including the SOP, certification documents, inspections reports, and the operation approval.
- [Laser Operation Approval](#) for the laser, utilizing the [Laser Safety Tool](#) (LST). The approval request is submitted by the SLSO, who must first affirm that the required laser safety certification checks and any necessary SOP updates are complete. The request must be approved by the laser's program manager, the ESH coordinator, and the LSO. LSO approval requires that 1) the SOP, with any needed revisions, is approved, and 2) a facility inspection and all pre-approval action items are completed. The LSO approval includes an approval expiration date, which is nominally one year from the approval date but can be as long as 18 months.

2.3 Controls for Lasers with SLAC-specific Requirements

The controls in this section are applicable when an LSO hazard evaluation determines that one or more of the SLAC-specific requirements in Section 2.2 must be completed.

Note *Engineering controls* are given priority over *administrative controls* and *personal protective equipment (PPE)*.

2.3.1 Controls for the Embedded Class 3B/4 Laser

LSO hazard evaluation will consider which of the controls described in [Laser Safety: Class 3B and Class 4 Laser Operation Requirements](#) are needed for the laser operation. The requirements will be described in the SOP. Particular attention will be given to controls for

- Removable covers
- Removable connectors for fiber transport cables
- Equipment labels
- Configuration control
- Maintenance and service tasks, including those which may require establishing a temporary *laser controlled area (LCA)*
- Supervision requirements
- Training
- Non-beam hazards, including electrical and fire

2.3.2 Training

Training requirements for the laser operators and laser users should be described in the SOP document. For simple laser systems, the following training may be adequate:

- SOP document review
- [Chapter 10, "Laser Safety"](#) review

- Equipment training provided by the equipment supervisor or SLSO/laser system supervisor

More complex laser systems may require appointment of an SLSO with line management responsibility for providing and documenting *on-the-job training (OJT)* to the laser operators and laser users. The SLSO should then provide annual or periodic refresher training. If any of the laser operators are QLOs or LCA workers, their training can be documented using the [Laser Safety Tool](#) site for the laser.

2.3.3 Maintenance and Service Tasks

If there may be accessible Class 3B or 4 laser radiation, then a temporary LCA must be established and laser eyewear will be required. (See [Laser Safety: Laser Controlled Area Requirements](#) and [Laser Safety: Class 3B and Class 4 Laser Eyewear Protection Requirements](#).)

2.3.4 Periodic Inspections by the LSO

Periodic inspections, if required, should be conducted at least every 18 months and include the following:

- Verification that the current SOP document(s) accurately reflects current laser operations
- Verification that laser system safety checks have been completed
- Review of the list of authorized laser operators, and verification that their training is current
- Checking that barriers and beam containment are adequate
- Review of status of open action items from last inspection

The LSO will write an inspection report that will identify and describe action items that need to be addressed. Non-laser hazard action items should be discussed with the ESH coordinator.

3 Forms

The following forms and systems are referenced by these requirements:

- [Laser Safety Tool](#). System used for maintaining information on laser personnel and facilities, including approvals of facilities and qualified laser operators and laser controlled area workers (used for maintaining information on Class 3B/4 laser facilities and some Class 1/2/3R lasers with an embedded Class 3B/4 laser)
- [Laser Facility Operations Approval](#). Documents operation approvals for Class 3B/4 laser facilities (and for some Class 1/2/3R lasers with an embedded Class 3B/4 laser) (in the [Laser Safety Tool](#))
- [Laser Safety: System Laser Safety Officer Approval Form](#) (SLAC-I-730-0A05J-001). Documents approvals for SLSOs
- [Laser Safety Program Site](#) (SharePoint). Contains additional information and documents for implementing laser safety requirements

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- Any documents required per Section 2.2 must be posted or linked on a [Laser Safety SharePoint](#) site document library for the laser system.

5 References

[SLAC Environment, Safety, and Health Manual](#) (SLAC-I-720-0A29Z-001)

- [Chapter 10, “Laser Safety”](#)
 - [Laser Safety: Laser Hazards, Classification, and General Requirements](#) (SLAC-I-730-0A05S-008)
 - [Laser Safety: Class 2 and Class 3R Laser Operation Requirements](#) (SLAC-I-730-0A05S-003)
 - [Laser Safety: Class 3B and Class 4 Laser Operation Requirements](#) (SLAC-I-730-0A05S-004)
 - [Laser Safety: Laser Controlled Area Requirements](#) (SLAC-I-730-0A05S-009)
 - [Laser Safety: Class 3B and Class 4 Laser Eyewear Protection Requirements](#) (SLAC-I-730-0A05S-007)
 - [Laser Safety Committee](#) (SharePoint)

Other SLAC Documents

- [On-The-Job \(OJT\) Training Requirements \(200-2P-1\)](#)