Chapter 10: Laser Safety

Class 3B and Class 4 UV Laser Operation Requirements

Product ID: 662 | Revision ID: 2216 | Date published: 16 November 2020 | Date effective: 16 November 2020
URL: https://www-group.slac.stanford.edu/esh/eshmanual/references/laserReqClass3Band4UV.pdf

1 Purpose

The purpose of these requirements is to minimize skin exposure to ultraviolet (UV) radiation. They cover setup and use of facilities where Class 3B or Class 4 UV lasers may operate. They apply to workers in these facilities, visitors to them, and *system laser safety officers (SLSOs)*, *laser facility program managers*, and the *laser safety officer (LSO)*.

2 Requirements

2.1 Hazard Overview

Eye and skin *maximum permissible exposures (MPEs)* are the same in the UV and in the infrared IR outside of the retinal hazard region. In the retinal hazard region between 400–1400 nm, eye MPEs are less than skin MPEs; for example, for a 1000s exposure eye MPEs are ~×100–1000 less than skin MPEs.

- MPEs in the UV are the same for coherent (laser) and incoherent sources.
- MPEs in the UV depend on the cumulative exposure. For example the MPE is 3mJ/cm^2 between 180–300 nm for exposures from 10^{-9}s to 1000s. The potential hazard from long exposures to *diffuse reflections* must be considered.
- Skin injuries are less serious than eye injuries:
  - Vision impairment has much higher consequences
  - Skin injuries are usually self-repairing
- Skin injuries are much more probable than eye injuries:
  - Large surface area
  - Hands close to laser beams

2.2 Controls

2.2.1 Engineering Controls (Enclosures and Barriers)

Skin protection can best be achieved with engineering controls: enclose UV laser beam paths as much as practical. When there are open beams, primary protection to accessible diffuse reflections is provided by *personal protective equipment (PPE)* for eye and skin protection.

- Enclose UV laser beam paths to the extent practical. If the beam paths cannot be enclosed, then implement adequate barriers to minimize potential skin exposure from chronic exposure to beam losses and other sources of diffuse reflections.
- Beam dumps. Design barriers or enclosures for beam dumps to minimize potential exposure to diffuse UV reflections from them.

2.2.2 Administrative Procedures

- Attenuate laser beams to the minimum power required when there are open UV laser beams, in particular when alignment is done.
- Use remote steering controls and diagnostics as much as practical for aligning UV laser beams.
- Plan work to minimize time with potential skin exposure to hazardous UV laser beams.
- Keep exposed skin as far as practical from open beams.

2.2.3 PPE for Skin

- Wear long-sleeved shirts.
- Use gloves when working with hands near accessible laser beams (direct beam exposure hazard for primary or stray beams).
- Use gloves when diffuse reflection *nominal hazard zone (NHZ)* > 20 cm if hands may be within this distance of an open beam path when diffuse reflections may not be well shielded, for example, for beam powers above 10 mW at wavelengths less than 300 nm.
- Use a face shield when diffuse reflection NHZ > 1m if working within this distance of an open beam path when diffuse reflections may not be well shielded: for example, for beam powers above 250 mW at wavelengths less than 300 nm.

2.2.4 Medical Exams

- Skin exams for laser personnel can be performed by the Occupational Health Center. Laser personnel should request a skin exam if they experience any symptoms from exposure to UV laser beams.
- Periodic skin exams are recommended for laser personnel who may have chronic exposures exceeding MPE values.

2.2.5 Site-specific Training and Procedures

- Lab-specific *on-the-job training (OJT)* and *standard operating procedures (SOPs)* must describe the potential for skin injury and the controls to use. These need to emphasize barriers and enclosures for UV beams and when to use skin PPE.

3 Forms

The following are forms required by these requirements:

- None

4 Recordkeeping

The following recordkeeping requirements apply for these requirements:

- None

5 References

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

- Chapter 10, "Laser Safety"
  - Laser Safety: Class 3B and Class 4 Laser Operation Requirements (SLAC-I-730-0A05S-004)
  - Laser Safety Program Site (SharePoint)
  - PPE – Eye-Skin Protection