



Safety instructions for working with embedded (closed) laser systems

Objective

To indicate the risks of working with a laser in an embedded/closed system (confocal microscope, FACS devices, etc.) and to prevent damage from exposure to a laser beam in an embedded laser system.

1. Definitions

- 1.1 Laser risk zone: An area in which laser radiation is produced and the expected exposure in routine activity, malfunction, or accident may exceed the Maximum Permissible Exposure.
- 1.2 Laser product: An apparatus, device, or machine that emits laser radiation, including non-finished products.
- 1.3 Embedded laser product: A laser product with engineering measures installed that limit the maximum accessible laser radiation emission level.
The laser is classified at a lower risk level than that which was assigned to it.
- 1.4 Hazardous laser product: A laser product classified at risk level 3R that emits laser radiation not in the visible light spectrum, or a laser product with risk level 3B or 4.
- 1.5 Protective goggles for laser products: Protective goggles according to Israeli Standard 4141, Section 10.
- 1.6 Laser radiation: Coherent, directional light radiation, concentrated in a narrow range of wavelengths, produced or amplified through a controlled process of forced radiation emissions.
- 1.7 Risk level: Categorization of a laser product's risk according to its Accessible Emission Limit.
- 1.8 Risk level 1 (Class 1): A laser product whose radiation level is not dangerous.
- 1.9 Risk level 3B (Class 3B): A laser product where radiation from a direct beam endangers the eye at any duration of exposure, but is generally not dangerous to the skin.
- 1.10 Risk level 4 (Class 4): A laser product whose risk to the eyes and skin is dangerous with both a direct beam and a scattered reflected beam. Such a product's beam can ignite flammable materials.

2. Background

The Weizmann Institute of Science works with various laser systems. Some laser systems are constructed so that the laser beam is embedded and



protected by a number of safety devices that prevent exposure to the laser beam.

Confocal microscope: Confocal microscopy uses filters which block out-of-focus light that interferes with the formation of a clear image in the microscope. This feature allows higher quality viewing than a standard microscope.

FACS (Fluorescence Activated Cell Sorting): Sorting by size characteristics, flow cytometry. This method takes the examined cell population and injects it into a thin stream of liquid. The cells pass in front of several light sources and lasers, and the dispersion of light/fluorescence is measured and recorded.

- 2.1 The light source is a laser typically categorized at a Class 3B, or Class 4, risk level.
- 2.2 A confocal microscope has shielding measures installed, such as a door and interlock, which prevent the laser beam from exiting the microscope, so that its risk level drops to Class 1 (an Embedded-1 type system). Therefore, when used normally according to the manufacturer's instructions, there is no danger from the laser, so employees do not need to take special protective measures.
- 2.3 During servicing (repair, adjustment, etc.), when bypassing the interlock and exposing the beam, the system's risk level is determined according to the risk level of the laser, i.e. level 3B or 4. When servicing, use all appropriate safety requirements for the laser risk level as detailed below.

3. Authority and responsibility

- 3.1 It is the responsibility of the head of the laboratory/facility to ensure that every user of a closed laser system and/or confocal microscope has done the following:
 - 3.1.1 Performed annual safety training (a new user will be trained upon starting work) about the risks of laser radiation and protection (confocal microscope – instructions for safe work).
 - 3.1.2 Read the safety instructions from the device's instruction manual.
 - 3.1.3 Signed a commitment form pledging to follow all safety instructions when working with a confocal microscope.



3.1.4 Examined, at least once every six months or after any maintenance or inspection by a technician, whether the laser source's interlock is intact (opening the door stops the laser). The details and date of the examination must be recorded in the microscope service log.

3.2 In the event of a malfunction or a need for a change in the system, the head of the laboratory/facility is responsible for the following:

3.2.1 Inviting a service representative or certified technician of the closed laser system provider and/or microscope to repair the malfunction or to make changes.

3.2.2 Ensuring that the maintenance of the closed laser system and/or confocal microscope was performed as necessary, and the safety devices were not impaired.

4. Method

The provider of the closed laser system and/or microscope must provide the following:

A sticker on the closed laser system and/or microscope that defines the laser's risk level according to the requirements of Israeli Standard 60825, section 1.

A fail-safe interlock above the laser compartment connected to the laser system that halts its operation as soon as the door or lid is opened.

5. Safety requirements for users of embedded laser systems

- Before starting the work or using the microscope, you must receive guidance from the laboratory or unit head on the structure of the microscope, how it is operated, the risks, including laser risks and safety requirements at work.
- Read (as a new user or for review once a year) the safety tutorials on laser radiation risks and protection from them, and safety instructions with a confocal microscope.



- Read (as a new user or for review once a year) the safety instructions in the device's instruction manual.
- Sign a commitment form to follow all safety instructions when working with a confocal microscope.
- It is forbidden to disassemble or open the microscope's lids.
- The direct supervisor/responsible technician must be informed about any malfunction or concerns about the system.
- The operator/user must not make any changes to the optical path components of the system.
- When servicing the system, no entrance to the room where the system is located is permitted for Weizmann Institute employees of any status.

6. Procedure for performing maintenance on embedded laser products (Class 1) that have a laser beam with a risk factor of 3B or 4

- 6.1 Maintenance and service work will be performed only by the manufacturer's representatives, who are authorized to do so and who are well acquainted with the laser system and all the associated risks.
- 6.2 The service provider must present a valid authorization to work with dangerous lasers.
- 6.3 The service provider must sign a declaration form (hereinafter: "Appendix A – statement of service provider for laser/laser-inclusive system") in which the provider undertakes to work in accordance with regulations and safety instructions for working with lasers.
- 6.4 The service provider will use personal protective equipment against laser beams according to Israeli Standard 4141, sections 10 and 11 (EN207, EN208).
- 6.5 The service provider will use only the service provider's own equipment and not equipment belonging to the Weizmann Institute of Science.
- 6.6 The fenced-off area must be signposted with the following signs: "Danger! Entrance for authorized personnel only" and a laser radiation warning sign with a caption indicating the laser risk level.



- 6.7 While the work is being carried out, no one will be allowed into the room/hall except for the abovementioned service person/personnel.
- 6.8 Before carrying out maintenance work, place protective screens between the system and the front doors of the room/hall, or place a laser beam-resistant curtain over the front door. All windows in the room must be draped with a fireproof curtain.
- 6.9 Ensure that all the room's doors are locked and the warning lights are on, and there is no possibility of entering the room.
- 6.10 If the laser system does not need to be operating during the maintenance work, it must be turned off. If the laser beam is necessary for work, then the operating time and beam intensity should be reduced to the minimum necessary.
- 6.11 Protective measures must be used, including protective goggles suitable for the laser type.
- 6.12 The ray will target only controlled areas within the system. Under no circumstances should the laser be operating when aimed at other areas such as the operator's body, the entrance door, or windows.
- 6.13 No flammable or explosive materials will be allowed into the work area.
- 6.14 Service and maintenance work and the employees who perform such work are subject to the approval of a Laser Safety Officer.
- 6.15 Only persons who have undergone appropriate safety training and are equipped with appropriate protective measures (protective goggles suitable for the laser type, clothing, etc.) may remain in the laser risk zone.
- 6.16 When the servicing is completed, the technician must return the system to normal working conditions, including all its safety devices.
- 6.17 At the end of the work, check to ensure that the interlock and other safety systems, if any, are working properly. This must be recorded in the microscope's service log.



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7. In an emergency

- 7.1 Follow emergency instructions and report to the Weizmann Service Center 08-934-2999.
- 7.2 Any laser-related accident or near-accident must be reported immediately to Weizmann Service Center 08-934-2999, the Laser Safety Officer Yehuda Moshayev (tel. 050-9001995, 08-9345155), and the direct supervisor.
- 7.3 In case of injury or suspected injury from a laser, the subject must be immediately evacuated to "Kaplan" Medical Center emergency room for a medical examination.