

Laboratory Safety Design Standards for Class 3b and 4 Laser Use Labs and Areas

The following items must be considered and included when designing new Class 3B and 4 lasers laboratories and use areas. Specific design considerations for these items may depend on whether the designated laser control (use) area is the entire room or an area within a larger room. These standards were compiled to meet the ANSI Laser Safety Standard (Z136.1 2022)

- ✓ **Illuminated laser warning signs (interfaced to laser operation)**
- ✓ **Entryway/Access controls**
 - **Interlocked entrance**
 - **Curtains and barriers**
- ✓ **Laser power circuit activation switch**
- ✓ **Emergency Power shutoff (outside laser control area)**
- ✓ **Personal Protective Equipment Station**
- ✓ **Laser hazard information signage**
- ✓ **Window covering/elimination**

Specific design considerations/requirements for these items are outlined in greater detail below and may depend on whether the designated laser control (use) area is the entire room or an area within a larger room. These requirements are compiled to meet the ANSI Laser Safety Standard (Z136.1 2022)

Laser Control Area – Entire Room

The following requirements apply for laser lab design if the entire room will be considered the laser control area (LCA). The preference is one laser per LCA; however more than one laser may be allowed within a single LCA if the laser protective eyewear needed for all lasers in the LCA is the same or the lasers will be prohibited from operating at the same time.

Room Access

- Access to the room will be limited to trained laser users only.
- Anyone entering the room when the laser on warning sign is illuminated must wear appropriate laser eyewear and PPE at all times.

Room Access Door

- Card swipe access at door to room if feasible.
- Self-closing device on door

Illuminated Laser Warning Sign

- Lighted Laser Warning sign mounted outside room (LCA) by entry door. If there are multiple entry doors, a lighted sign must be at each door.
- Sign must illuminate when any laser in the room is energized/operating.
- Lighted sign must include words indicating “Laser in Use”. A plain red light is not acceptable.
- Lighted sign should be hung close to normal eye level (~ 6’ above ground) if possible.
- Lighted sign must be interfaced to laser system following University’s standard electrical detail connection of illuminated laser warning signs.

Entryway Controls (Laser Curtains /Access Controls)

- One of the following options must be used to provide a means of entryway control for the laser control area (preference given in order listed where feasible)
 1. Non-defeatable Interlock(s):
 - A non-defeatable interlock installed on the room entry door(s) or laser curtain(s)
 - Interlock must shut off power to the laser when the door/curtain is opened.
 2. Defeatable interlock(s):
 - A defeatable interlock installed on the room entry door(s) or laser curtain(s) that can be temporarily defeated through a mechanism accessible only to authorized laser users. Defeated interlock must re-engage automatically after a short time period.
 - Interlock must shut off power to the laser when the door/curtain is opened.
 - There may not be any line of sight between room entrance (laser safe area) and laser. A second laser barrier (i.e. curtain) must be in place between the defeatable interlocked barrier and the laser to prevent access to the laser beam when the interlocked barrier is defeated and opened with the laser in operation.
 - Examples: Interlocked door plus curtained vestibule, Interlocked door plus curtain around laser table, Interlocked curtained vestibule plus barrier around laser table, etc.
 3. Non-interlocked barriers and procedural safety controls:
 - Where interlocks are not feasible, at least 2 laser entryway barriers are required. There may not be any line of sight between room entrance (laser safe area) and laser.
 - Room entry door(s) will be initial access control/barrier for LCA.
 - Secondary access control/barrier(s) must include either:
 - Laser curtain/barrier installed around laser, or laser table blocking the primary and reflective beam hazards at LCA entry point entry door.
 - Laser curtain/barrier creating a vestibule immediately inside LCA entry.
 - Beam blocks and barriers mounted around or on the optical bench should be considered as well to provide additional level of access control and user protection.

Standards for New Laser Labs November 2023

- **Curtain/barrier height:** Laser curtains/barriers should extend from ceiling to the floor of the room or the base of a laser table if enclosing a table. Where the curtain/ barrier does not extend completely to the ceiling or to the floor, the laser safety officer must conduct a hazard analysis to ensure safety is afforded to all workers outside the barrier-protected area.

Laser PPE Station

- A PPE station to store laser eyewear and PPE must be available:
 - Outside the entry to the room if no laser curtain or vestibule within the room
 - For curtained lasers: Immediately inside the room, outside the laser curtained area.
 - For curtained vestibules: Within the curtained vestibule area
- If multiple lasers are present in the room, there must be a mechanism to allow anyone entering the room to know which laser is operating and which laser protective eyewear to use. This can be accomplished in several ways based on the lasers and lab design.

Laser Power Circuit Activation (Starter) Switch

- A dedicated power circuit for the laser to receive its electrical power from.
- Power circuit must be equipped with a switch (Combi Starter) that engages power to the circuit when switched on.
- Power switch must also be connected to the laser on sign and illuminate the sign when the switch is turned on (circuit to powered) to allow for laser to operate.
- Power switch (combi starter) must be within the LCA.

Emergency Shutoff

- An emergency stop (“panic button”) capable of deactivating the laser remotely must be installed:
 - For curtained lasers: Outside the laser curtained area by LCA entry point or PPE station.
 - For curtained vestibules: Within the curtained vestibule area.

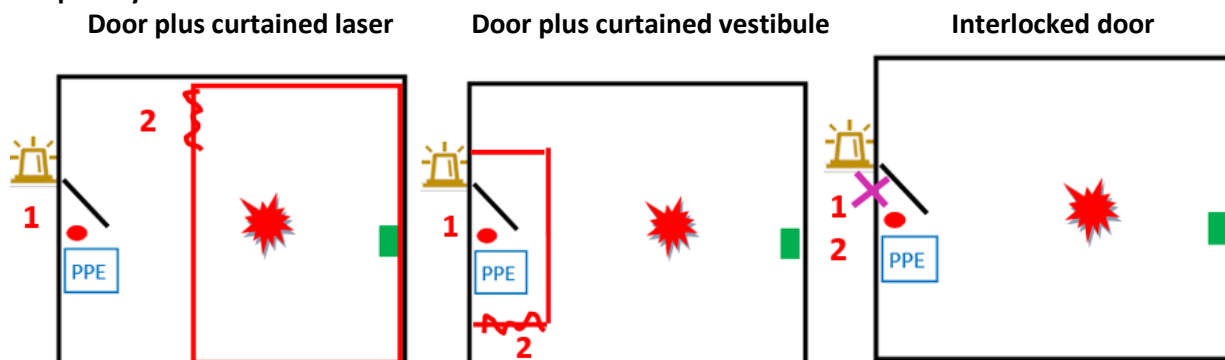
Windows:

- Avoid windows in the walls or doors of the lab. If windows cannot be avoided they must be blocked with laser filtering material or laser blocking material (usually the same material as for laser curtains).

Signage

- Two 8”x11” sign holders at the exterior of the room entry door to post lab door sign and laser hazard information sign.
- If multiple lasers in room – will need signage/ mechanism for lab to indicate which laser(s) are in operation at any time before entry into the laser use area.

Example Layouts:



Laser Control Area(s) – Area(s) within a larger room

The following requirements apply for laser lab designs where laser control area (LCA) is a curtained area within a room. The preference is one laser per LCA; however, more than one lasers may be allowed within a single LCA if the laser protective eyewear needed for all lasers in the LCA is the same or the lasers will be prohibited from operating at the same time.

Room Access

- Anyone with access to the room must complete laser awareness training.
- Access to the LCA will be limited to trained laser users only.
- Anyone entering the LCA when the laser on warning sign is illuminated must wear appropriate laser eyewear and PPE at all times.

Room Access Door

- Card swipe access at door to room if feasible.

Illuminated Laser Warning Sign

- Lighted Laser Warning sign mounted outside LCA entrance (i.e. curtain). If there are multiple entrances, a lighted sign must be visible at each entrance point.
- Sign must illuminate when any laser in the room is energized/operating.
- Lighted sign must include words indicating “Laser in Use”. A plain red light is not acceptable.
- Lighted sign should be hung close to normal eye level (~ 6’ above ground) if possible.
- Lighted sign must be interfaced to laser system following University’s standard electrical detail connection of illuminated laser warning signs.

Entryway Controls (Laser Curtains /Access Controls)

- One of the following options must be used to provide a means of entryway control for the laser control area (preference given in order listed where feasible)
 1. Non-defeatable Interlock(s):
 - A non-defeatable interlock installed on the laser curtain(s) designating the LCA. Interlock must be on each entry point into the curtained LCA.
 - Interlock must shut off power to the laser when the door/curtain is opened.
 2. Defeatable interlock(s):
 - A defeatable interlock installed on laser curtain(s) designating the LCA that can be temporarily defeated through a mechanism accessible only to authorized laser users. Defeated interlock must re-engage automatically after a short time period.
 - Interlock must shut off power to the laser when the door/curtain is opened.
 - Interlock must be on each entry point into the curtained LCA.
 - There may not be any line of sight between room entrance (laser safe area) and laser. A second laser barrier (i.e. curtain/barrier) must be in place between the defeatable interlocked barrier and the laser to prevent access to the laser beam when the interlocked barrier is defeated and opened with the laser in operation.
 - Examples: Interlocked curtain designating LCA plus: 1) curtained vestibule at the LCA entry point, 2) laser curtain/barrier around laser table, 3) alternative laser barrier inside LCA entry.
 3. Non-interlocked barriers and procedural safety controls:
 - Where interlocks are not feasible, at least 2 laser control area barriers are required. There may not be any line of sight between LCA entrance (laser safe area) and laser.
 - Laser curtain designating the LCS plus an additional laser protective barrier which may include:
 - Laser curtain/barrier installed around laser or laser table blocking the primary and reflective beam hazards at LCA entry point entry door.
 - Laser curtain/barrier creating a vestibule immediately inside/outside LCA curtain.

Standards for New Laser Labs November 2023

- Beam blocks and barriers mounted around or on the optical bench should be considered as well to provide additional level of access control and user protection.
- **Curtain/barrier height:** Laser curtains/barriers should extend from ceiling to the floor of the room or the base of a laser table if enclosing a table. Where the curtain/ barrier does not extend completely to the ceiling or to the floor, the laser safety officer must conduct a hazard analysis to ensure safety is afforded to all workers outside the barrier-protected area.

Laser PPE Station

- A PPE station to store laser eyewear and PPE must be available outside the LCA or within a LCA's curtained entry vestibule.
- If multiple lasers are present in the LCA, there must be a mechanism to allow anyone entering the room to know which laser is operating and which laser protective eyewear to use. This can be accomplished in several ways based on the lasers and lab design.

Laser Power Circuit Activation (Starter) Switch

- A dedicated power circuit for the laser to receive its electrical power from.
- Power circuit must be equipped with a switch (Combi Starter) that engages power to the circuit when switched on.
- Power switch must also be connected to the laser on sign and illuminate the sign when the switch is turned on (circuit to powered) to allow for laser to operate.
- Power switch (combi starter) must be within the LCA.

Emergency Shutoff

- An emergency stop ("panic button") capable of deactivating the laser remotely must be installed outside the LCA by room entry point, LCA entry or PPE station.

Windows:

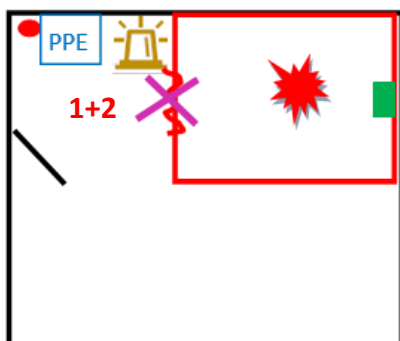
- Avoid windows either in the walls or doors of the lab. If windows cannot be avoided they must either be blocked with laser filtering material or laser blocking material (usually the same material used for laser curtains).

Signage

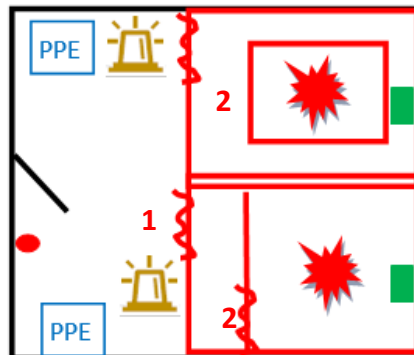
- One 8"x11" sign holders at entrance to the LCA for posting laser hazard information sign.
- If multiple lasers in a single LCA –One 8"x11" sign holder for each laser to post laser hazard information sign.
- A mechanism for lab to indicate which laser(s) are in operation at any time before entry into the laser use area.

Example Layouts:

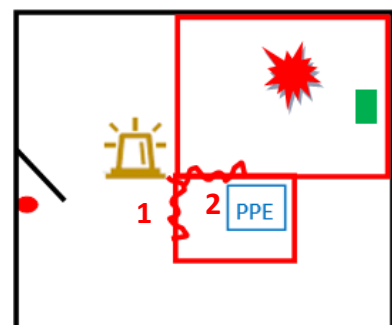
Interlocked curtain



Double curtains in both LCAs



Curtained vestibule



Electrical controls for LCA (start up, illuminated light, emergency off)

