

Laser Safety

Controlled Entrance Guidance For Open Beam Class 4 Lasers



Guidance for Laser Controlled Entrance, Containment Curtains, Interlocks, Control Circuit – for Class 4 Laser Systems¹ with additional Points on General Lab Safety

- The door to the laboratory shall be equipped with a self-closing device and be secured at all times.
- The door may be locked with a standard keyed lock, but a cipher lock with key override is preferred so that the code may be easily changed as necessary.
- Key override is provided for custodial services or emergency access.



Door Cipher Lock installed

¹ All photos and guidance tips courtesy of North Carolina State University

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Example of Two Piece Laser Curtains



Note Sign posted on Curtain

Laser Beam Containment Curtains

- Immediately inside the entrance to the lab, a two piece laser beam containment curtain shall be hung on a track with rollers which, when closed, fully protects the doorway from stray beams that might otherwise be reflected out the door. The curtain attaches to the walls by a Velcro strip.
- The curtain material shall be capable of stopping laser radiation from the ultraviolet to the infrared and comply with ANSI:Z136.1-2007 Section 4.6.4.
- An overlap of ~ 12 inches of the two vertical curtain pieces shall provide access for persons desiring to enter the laser usage area. The curtain is parted slightly and the user may enter the laser usage area via the curtain overlap without breaking the pull-apart interlock.
- When the curtain is parted wide enough, however, an interlock sewn into the curtain shall activate and the laser(s) will be de-energized.



Interlocks closed



Interlocks open

Example of a Control Circuit

- An electrical control circuit shall be installed in the laboratory for the

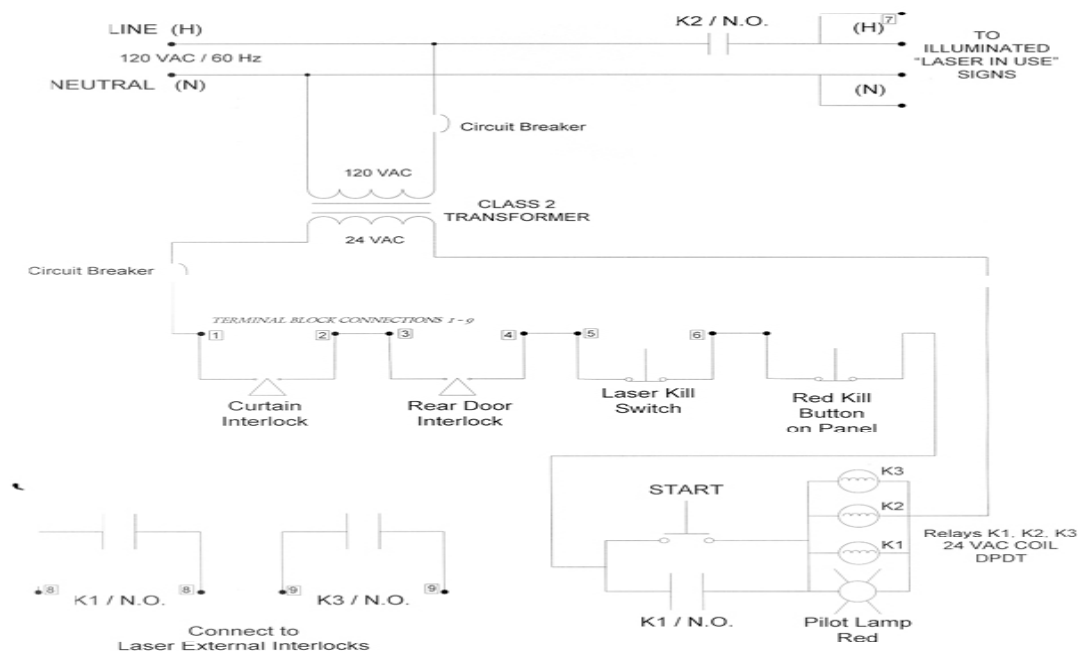
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primary purpose of shutting down laser operation in the event that one or more of the following occurs:

- Curtain is wide open, the interlock is opened
- The door interlock is opened
- An emergency laser off switch is activated
- The Laser "Stop" switch is activated
- The power is lost to the control circuit

Refer to Attached Schematic Below:

LASER INTERLOCK CONTROL PANEL FOR CLASS IV LASER LABORATORIES



Circuit is patented contact Will Rowland EHSC, NCSU

Permission to use this Schematic granted 1/25/ 2006 North Carolina State University

Description of Control Circuit

The control circuit is a typical low voltage (24 VAC) section which is fed from a standard class 2 control transformer. A start / stop sequence with seal-in contacts (M1,AUX 1) is used to energize the main contactors (M1 and M2) provided all of the interlock conditions are met. The contactors

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pass 208 VAC, 3 phase to the laser power supplies. Smaller lasers may require only 120 VAC. A set of auxiliary contacts (M1,AUX2) or an additional relay shall be used to energize the illuminated signs or a (flashing) "laser on" red light. A green pilot light indicates that the control loop and therefore the contactors are energized.



Class 2 Control Transformer

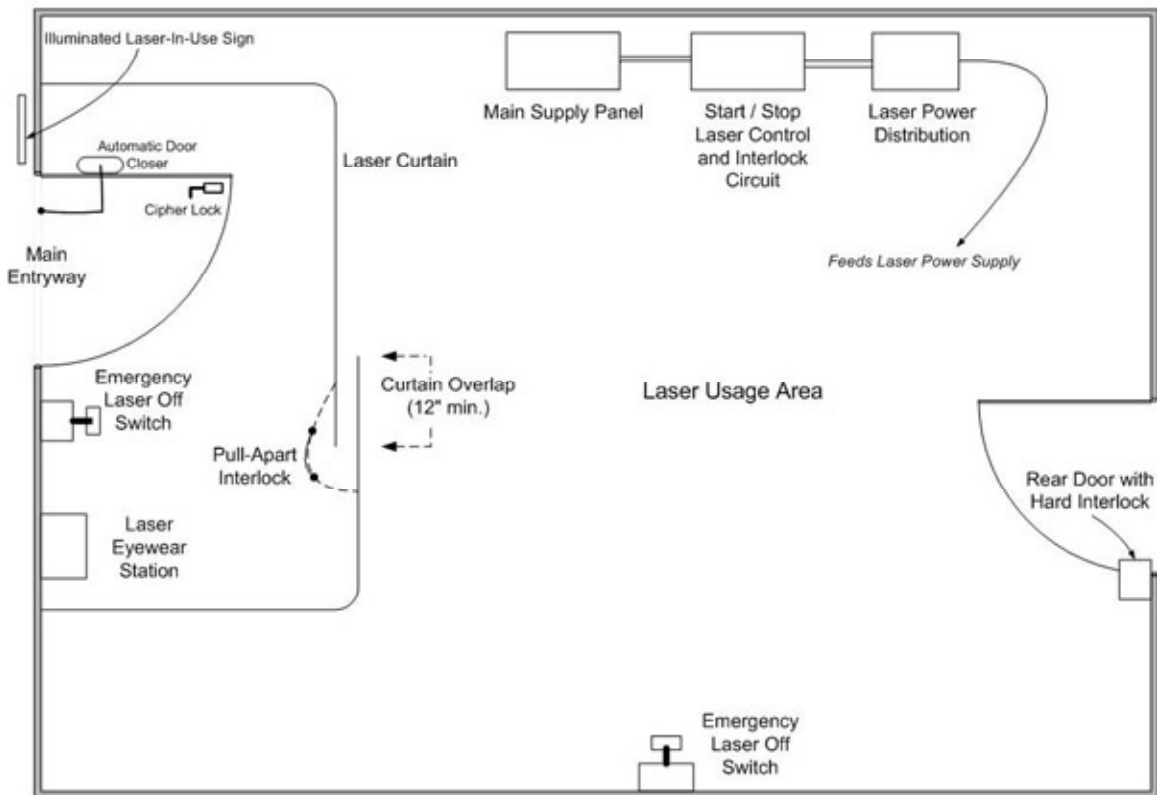
Circuit Action

When one of the elements in the control loop listed above causes a loss of continuity in the loop, contactors M1 and M2 lose power, and the normally closed (maintained) contacts across the "start" switch open. The shut down condition holds even if the interlock is once again satisfied . A manual reset is required to re-energize the laser power supplies.

Some labs will have a single emergency power off (EPO) switch which will drop power to the entire lab as well as the control circuit and thus serve as the emergency laser "off" button.

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Layout of Typical Class IV Laser Laboratory



Typical Class 4 Laser Lab Line Drawing

Laboratory Layout Line Drawing shows a typical class IV laser laboratory. Entry into the lab is gained via a coded cipher lock. The number is given to authorized personnel only.

Use of External Lab Laser Warning Lights

An illuminated (flashing) red light or a “Laser on” or “Laser in use” sign visible outside the main lab entry would be lit if a laser were “in use” inside the lab. “In use” means that the laser has power to its power supply and is capable of producing a beam.

A self-closing apparatus will close the door behind the user entering the lab.

Laser Goggles – Storage, Selection and Inspection

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Laser safety goggles are selected at this point from the eyewear station located inside the protected entryway prior to entry into the Nominal Hazard Zone (NHZ) .



Proper storage of Laser goggles

- Protect from dust
- Don't hang by the straps
- Inspect for lens cracks and frayed straps
- Adequate Optical Density for Wavelength in use

Emergency "On-Off" Switches and Their Locations



Wall mounted Emergency Laser On-Off Switch

The emergency on-off laser beam switch may be located just inside the door, as shown, and is available to emergency responders to cease laser beam operation before entry.

A second laser stop switch may be located in the laser usage area and be available to lab occupants.

A secondary exit may be equipped with a "hard interlock" as shown. This switch action will cease laser operation when the door is opened and can not be defeated.

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Within the lab are located the start / stop controls for the laser power supply which are wired similar to the supplied schematic. Refer to the circuit description in the previous section.

Don't Forget the Following Items:

Covering Windows and See-Thru Door Panels

Window panels in doors should be covered or replaced with an opaque material. In general, windows in the laboratory are covered both for light level control and to contain stray beams so that they are not reflected outside.

Smoke Detectors, Sprinklers and Fire ALARM Devices

All class IV laser labs should be equipped with smoke detectors, sprinkler heads, and fire alarm annunciators.

Use of Gases and Gas Cylinder Safety

Gases required for excimer lasers require gas cabinets with adequate exhaust and an exhaust monitoring device, additional sprinkler heads, and a gas detection system wired for fail-safe shutdown.

Protection from Toxic Plumes and Laser Generated Effluents

Laser generated plumes, gases and air particles or effluents shall be vented via a commercial collection system or directly to an appropriate chemical hood.

Liquids in the Lab

**Use of all liquids in the lab will require double containment
The floor shall be free of spilled or splashed liquids.**

Cable Runs

Cover cable runs with a suitable protective cover to preclude accidental snags and tripping falls.