

LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
-LIGO-
CALIFORNIA INSTITUTE OF TECHNOLOGY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Procedure	LIGO-M040014-00-W	01/30/04
Standard Operating Procedure Thermal Compensation Laser Operating in LAB BLDG. Optics Laboratory		
<u>SPONSOR</u> D. Cook		

LHO Laser Safety Officer

LIGO Hanford Observatory
Route 10, Mile marker 2
Richland, WA 99352
Phone (509) 372-8191
Fax (509) 372-8137
E-mail: info@ligo-wa.caltech.edu

California Institute of Technology
LIGO Project – MS 51-33
Pasadena CA 91125
Phone (626) 395-2129
Fax (626) 304-9834
E-mail: info@ligo.caltech.edu

LIGO Hanford Site Safety Officer

LIGO Livingston Observatory
19100 LIGO Lane
Livingston, LA 70754
Phone (225) 686-3100
Fax (225) 686-7189
E-mail: info@ligo-la.caltech.edu

Massachusetts Institute of Technology
LIGO Project – MS 20B-145
Cambridge, MA 01239
Phone (617) 253-4824
Fax (617) 253-7014
E-mail: info@ligo.mit.edu

WWW: <http://www.ligo¹.caltech.edu>

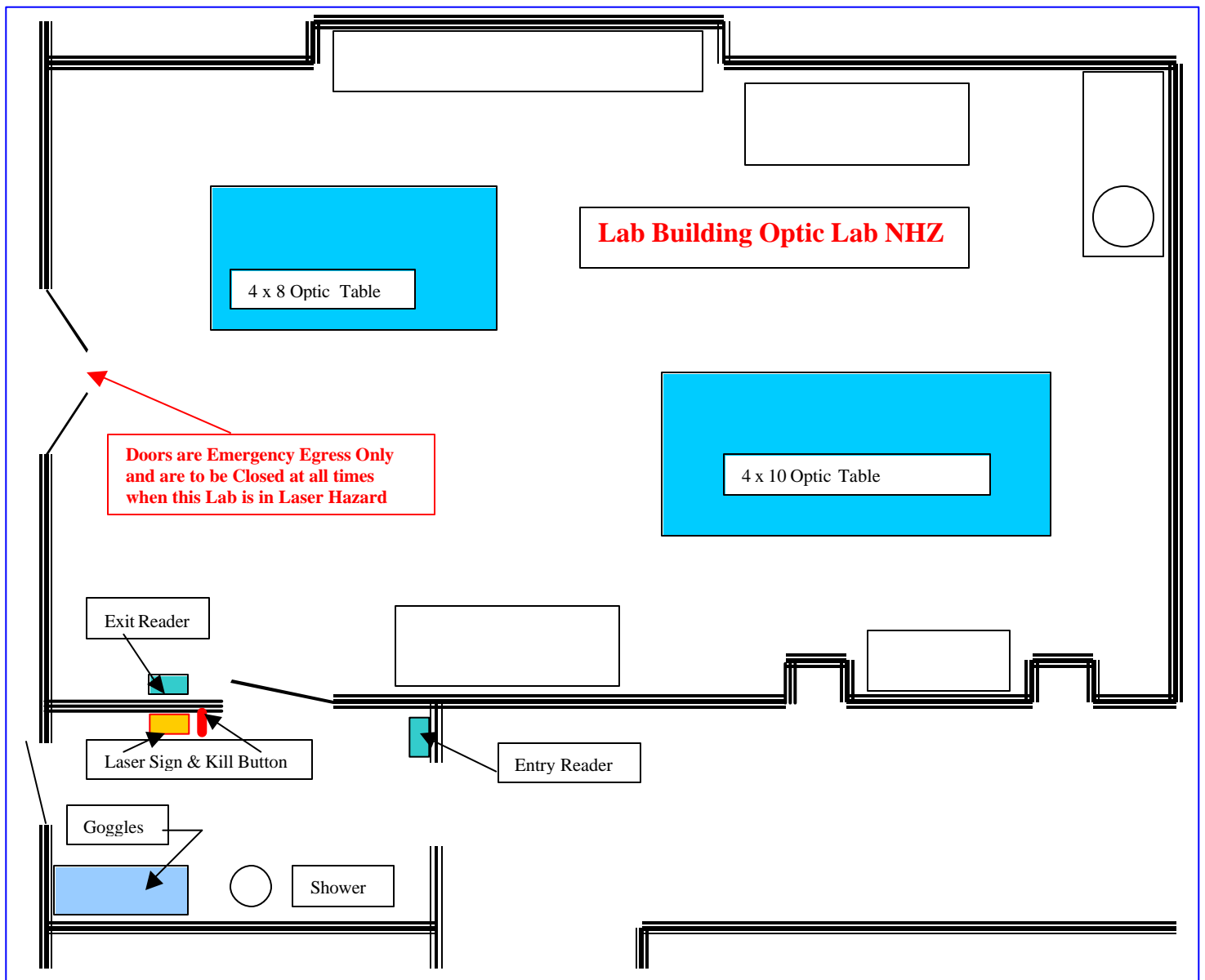
1 PURPOSE AND SCOPE

This Document is the Standard Operating Procedure (SOP) for the LIGO Thermal Compensation Lasers when it is operating in the Optics Laboratory (Lab). This SOP is designed to ensure the safety of all personnel and equipment in and around the area where the LIGO Thermal Compensation Lasers are operating. Its role within the overall laser safety plan is described in LIGO-M0300131-A-W, [LIGO Hanford Laser Safety Plan](#).

This SOP contains the essential procedures required for the safe operation of the LIGO Thermal Compensation Lasers when operating in the Optics Lab and is approved by both the LIGO Hanford Observatory (LHO) Laser Safety Officer and the LHO Site Safety Officer.

2 LABORATORY LAYOUT

The LIGO Thermal Compensation Lasers will be located in the Optics Lab Laser Control Area for testing and assembly and alignment. The designated Nominal Hazard Zone (NHZ) includes all of the area within the Optic Lab, shown below. The double doors are to have the dead bolt anchored into the floor at all times when the Optics Lab is in the Laser Hazard Condition. The double doors are for emergency egress only.



3 LASER DESCRIPTIONS and LOCATIONS

The primary LIGO Thermal Compensation Laser is a Class IV FIR laser. The output from this laser is in the far infrared region of the electromagnetic spectrum and is therefore not visible to the human eye.

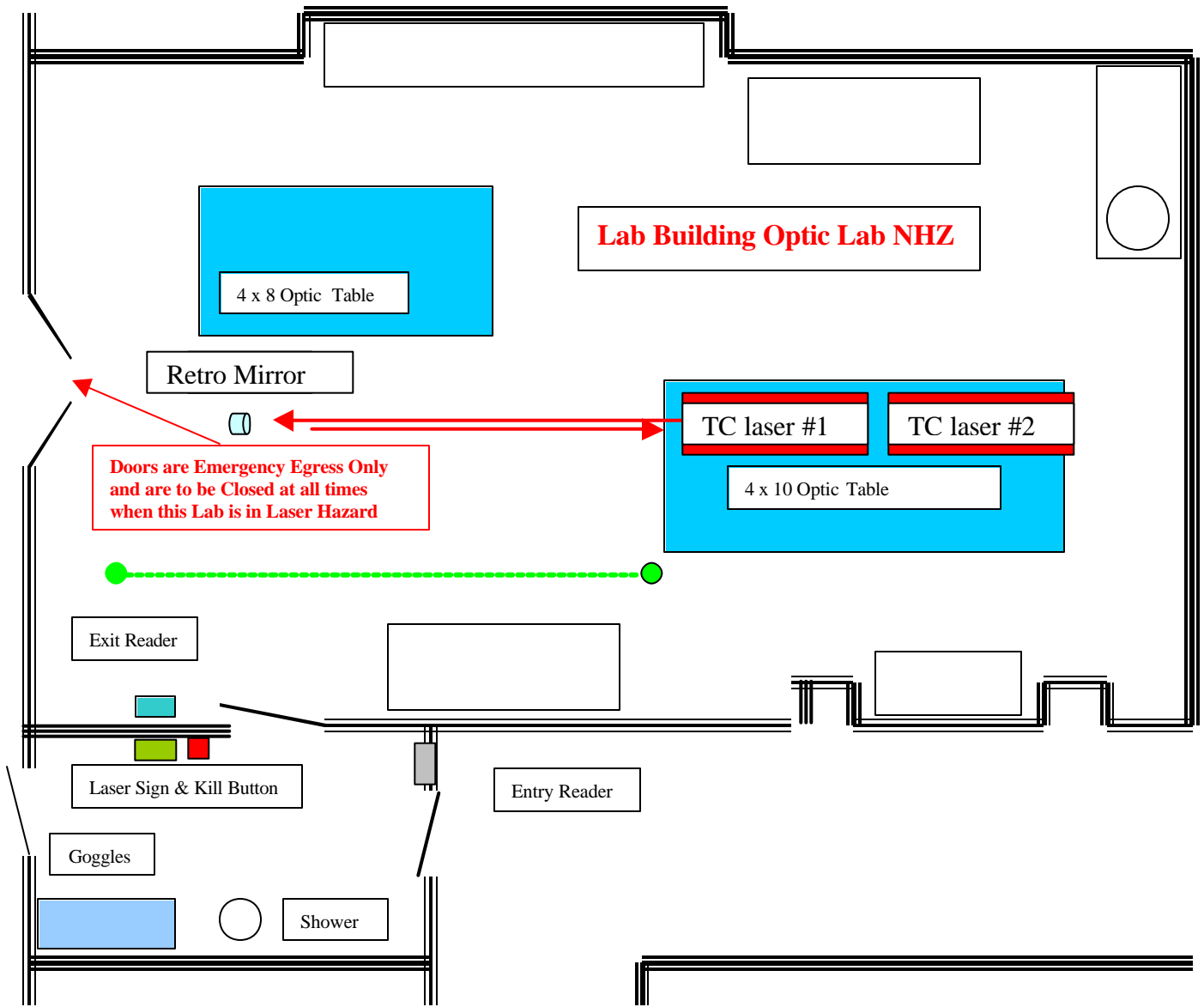
The relevant operating parameters for the LIGO Thermal Compensation Laser are:

- 10600 nm wavelength
- 8.0 W maximum power output
- Continuous wave output
- 4mm beam diameter.
- .2mrads divergence

The secondary LIGO Thermal Compensation Laser is a Class II Visible laser.

- 635nm wavelength
- 1mW
- Cross hair line generator.

The primary CO2 laser beam will be aligned coaxially with a visible (635nm) HeNe laser beam. This visible laser beam will project a cross hair onto a target. When the two lasers are coaxially aligned the visible beam will serve as a beam-pointing guide for the CO2 beam. To properly align the two beams it will be necessary to project both beams across the lab and fold them back toward the laser to gain the 30meter distance needed to assure proper alignment. The laser location in the lab layout is shown below. The laser and ancillary optical components are mounted on an optics breadboard, set upon Optics Table 1. When aligning the two lasers the CO2 laser power will be reduced to a minimal operating power. Whenever the beams are being projected off of the optics table, at least one person will be assigned to monitor in coming personnel traffic. Yellow stanchions and chain will be placed near the door on the inside of the lab to prevent people from walking through the beam path.



4 HAZARDS

A Class IV laser is a hazard to the eye from the direct beam, and maybe a hazard from a diffuse reflection. Far infrared lasers pose an additional hazard because the output radiation is not visible to the unaided human eye. This laser is capable of burning skin and/or may be a fire hazard if beams are not properly dumped.

5 CONTROLS

5.1 Access Controls

- The Optics Lab has an **Entry** and **Exit** proximity reader installed and is part of the Laser Safety Access System. The Entry reader unlatches the door to gain access to the NHZ. Access controls, alarms and all transactions for this area are recorded and monitored in the Control Room and reviewed by the LSO.
- Only those with an access card validated for this SOP will be allowed to enter the NHZ without an escort when the laser is capable of operating (Power supply energized).

- An illuminated Laser Safety Warning sign with the message “**DANGER VISIBLE AND/OR INVISIBLE LASER RADIATION – AVOID EYE OR SKIN EXPOSURE TO DIRECT OR SCATTERED RADIATION**” is mounted at the entrance to the Optics Lab Laser Control Area, outside the double entrance curtains.
- A schematic layout of the Optics Lab Laser Control Area showing the location of the LIGO Thermal Compensation Laser and notice identifying emergency contact people are posted near the laser safety warning sign.
- A signed copy of this SOP is also posted at the entrance to the Optics Lab Laser Control Area.
- If additional lasers are running simultaneously, Access Cards must be valid for these additional lasers as well.
- **Any authorized person escorting unauthorized personnel inside the NHZ shall assume responsibility for compliance with all governing laboratory laser safety procedures.**

5.2 Electrical Controls

- All control and monitoring functions for the LIGO Thermal Compensation Laser are accessed via the laser power supplies. The laser is connected to a dedicated power line that is only energized when the warning sign is activated (Key actuated switch). The “Emergency Kill” button mounted below the laser warning sign will ‘Kill’ the power to all Class IIIb and Class IV lasers in the Optics Lab. The ‘Kill’ button when pulled out (ON) illuminates the Laser Warning Sign and energizes the door lock and energizes the dedicated power lines.

5.3 Eye Protection

- Required protective eyewear for the LIGO Thermal Compensation CO₂ Laser must have an optical density (OD) of greater than 2.8 for 10600 nm wavelength radiation.
- The laser safety eyewear is *never* intended for intra-beam viewing. (OD is calculated for intra-beam viewing for 1 minute at the laser aperture diameter).
- The visible HeNe laser does not require eyewear protection.

6 GENERAL OPERATING PROCEDURES

1. When the LIGO Thermal Compensation Laser is operating within the Laser Control Area the laser warning sign must be energized and all persons entering the Laser Controlled Area are required to wear eye protection as described in Section 5.3 above, before entering and at all times while working within the Laser Control Area (NHZ).
2. Prior to powering up the laser, the Responsible Laser Operator (The person actively in charge of the laser) shall ensure that all persons in the NHZ are aware of his intent to power up the laser and that they are in compliance with all laser safety requirements, eye protection in particular.
3. Anytime one or more people will be working within the Laser Control Area *or* the laser will be running unattended, ONE person shall be designated the “**Responsible Laser Operator.**” The name of the **Responsible Laser Operator** shall be posted near the Laser Controlled Area laser warning sign.
4. The **Responsible Laser Operator** shall coordinate activities on or in the vicinity of the laser optical table. Multiple independent activities involving manipulation of the laser beams shall only occur simultaneously when the **Responsible Laser Operator** deems it safe to do so.

5. If multiple lasers are to be operated simultaneously, all “Responsible Laser Operators” (RLOs for each laser system), **must agree** that it is safe to have multiple systems running. All eyewear must be compatible for **all** laser systems running concurrently. When in doubt, consult the Laser Safety Officer. When multiple lasers are being used, **none** of the governing SOP’s shall have conflicting guidelines.
6. Any time the laser beams will be manipulated, e.g. by inserting, removing, or adjusting optical components, persons not directly participating in the beam manipulation activity will move to a safe location until the activity is completed.
7. Before and during insertion or removal of any optical component, the power of all affected laser beams shall be reduced to the lowest working power setting or be blocked up stream by an appropriate device, such as a ceramic wand.
8. All persons manipulating the laser beams, e.g. by placing objects such as mirrors, lenses, power meters, or beam dumps into or near the laser paths, must remove all jewelry such as wrist watches and rings.
9. Immediately after inserting, removing or making significant adjustments to any optical component, the vicinity of the optical table shall be scanned with a thermal imaging camera or other suitable beam-finding device to ensure that all stray beams are dumped.
10. Scattering of laser light shall be kept to a minimum **at all times** by maintaining proper alignment of optics, utilization of beam dumps, and ensuring that optics are securely fastened. At no time are beams allowed to leave the perimeter of the optics table except as noted in paragraph 3.
11. Each time the laser will be left running unattended, the vicinity of the optics table shall be scanned for stray beams immediately prior to vacating the Laser Control Area. The “unattended” status of the laser shall be clearly posted (yellow cones) or posted near the name of the Responsible Laser Operator at the entrance to the Laser Control Area.
12. **If a laser beam is found (reported by any observer), leaving the optics table, the laser will be shut down by the LSO and will remain “OFF”, until start up authorization is received from Gary Sanders (LIGO Project General Manager).**

It is the responsibility of each person working within the Optics Lab Laser Control Area (NHZ) to ensure that LIGO standards for safe laser operation are being followed at all times.
