

## Laser System Standard Operating Procedures



All Principal Investigators are **required** to write standard operating procedures (SOP) for all laser operations involving Class 3B and 4 lasers detailing alignment, operation, and maintenance procedures for each laser. The SOP should be available to all laser users in the laboratory and signed by each individual prior to the use of the laser.

This SOP shall address specific safety considerations and controls during beam alignment, normal operations, servicing and any non-beam hazards that might exist. The key to any SOP is to keep it as simple as possible so that it can be used on a routine basis. Refer to Chapman University's laser safety manual and the laser safety training as well as ANSI Z136.1, which is available by contacting EH&S at (714)532-6021. This SOP does not take the place of site- specific laser safety training or the online Laser Safety Training course in LearnUpon.

### INSTRUCTIONS

- Use this template to create a standard operating procedure (SOP) for each setup involving Class 3B and/or Class 4 lasers. Use it for activities outside of standard operation for fixed/permanent laser systems as well. **NOTE:** All laser users, including visitors, must be briefed on proper safety protocols and must wear appropriate laser protective eyewear located on the premises. Authorized personnel shall escort them at all times.
- Principal Investigators, or delegate(s), shall train all laser users on this laser standard operating procedure and ensure it is followed each time the laser is used. This SOP is an important component of any operational on-the-job training.
- Each laser user that has been trained on this procedure shall sign the "**Laser Use Acknowledgement,**" on page 10.
- Place SOP in a conspicuous location near the laser/laser system, and ensure it is readily available to the laser supervisor, laser user(s), and the laser safety officer.
- This SOP shall be available for review upon request by the Laser Safety Officer.
- In conjunction with training and an approved LUA, the SOP is required to be approved to work with any Class 3B and 4 lasers.

## Laser Standard Operating Procedures (SOPs)

Section A: Laser Holder and General Information			
<b>Principal Investigator (PI):</b>			
<b>Office Phone Number:</b>		<b>E-mail Address:</b>	
<b>Laser Operator(s): (Check all that apply)</b>	<input type="checkbox"/> Paid Staff/Faculty <input type="checkbox"/> Enrolled Students <input type="checkbox"/> Volunteer Employees <input type="checkbox"/> Visitors		
<b>Laser Manufacturer:</b>	<input type="checkbox"/> Chapman Fabricated Laser		
<b>Model Number:</b>		<b>Serial Number:</b>	
<b>Type of Laser Equipment:</b>			
<b>Type of Registration:</b>	<input type="checkbox"/> New laser/laser system acquisition or installation <input type="checkbox"/> Alteration/ transfer/status change of an existing laser system* Explain: _____ _____		
Section B: Location and Laser Details			
<b>Department:</b>		<b>Building:</b>	<b>Room Number:</b>
<b>Laser Classification (Check one):</b>	<input type="checkbox"/> <b>Class 3B</b> (5-500 mW) or ( $\leq 125$ mJ pulsed) <input type="checkbox"/> <b>Class 4</b> (>500 mW) or (>125 mJ pulsed)		
<b>Active Medium (i.e. Argon, Ruby, Nd:YAG, Diode):</b>			
<b>Tunable Laser? (Check one):</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No	<b>Details:</b>	
<b>Wavelength(s) (nanometers)</b>			
<b>Beam Divergence</b>		<b>mrاد</b>	
<b>Beam Diameter at laser output:</b>		<b>mm</b>	
<b>Purpose and Frequency of Use:</b>			
<input type="checkbox"/> Research <input type="checkbox"/> Classroom			
<input type="checkbox"/> Continuous Wave	<b>Average Power (W):</b>		<b>Maximum Power (W):</b>
<input type="checkbox"/> Repetitively Pulsed	<b>Energy per Pulse (J):</b>		<b>Pulse repetition frequency (Hz):</b>
<input type="checkbox"/> Single Pulse	<b>Pulse duration (nsec):</b>		<b>Pulse width (s):</b>
<input type="checkbox"/> Q-Switched	<b>Peak Pulse Power (W):</b>		<b>Peak Power Density (W/cm<sup>2</sup>):</b>

\*Alterations include any changes(s) that substantially increases or decreases the output or wavelengths produced. Relocation from one workspace to another or transfer to a new owner is also an "alteration."

Section C: Laser Preparation
<ol style="list-style-type: none"> <li>1. Always follow the guidelines outlined in Laser Safety Program.</li> <li>2. Lock the room to prevent unauthorized access during laser operations.</li> <li>3. Ensure the room is properly posted for laser activities (see below).</li> <li>4. Ensure the optical set-up is free of foreign objects and inspected for recent changes.</li> <li>5. Ensure required laser safety barriers or curtains are in place.</li> <li>6. Ensure windows and doors are properly covered to prevent laser beam transmission.</li> <li>7. Ensure the emergency egress from the Laser Control Area (LCA) is not obstructed.</li> </ol>

8. Ensure all laser operations are performed in accordance with the PI instructions and the Laser Safety Program Guide.

**Comments or Additional Information:**

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**Section D: Laser System Operating Procedures**

1. Always follow the guidelines outlined in Laser Safety Program.
2. If required, ensure all personnel present are wearing protective eyewear (appropriate Optical Density for wavelength/power).
3. Ensure all jewelry which may reflect beams is removed.
4. Issue a verbal warning prior to starting the laser operation.
5. Ensure all laser operations are performed in accordance with the PI instructions and the Laser Safety Program Guide.

- I. **Entering Laser Room** (Specify below the engineering and/or administrative controls you have in place to protect against unauthorized personnel entering the laser control area)

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- II. **Setup** (Explain in sufficient detail the process of setting up the laser operating system)

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**III. Start-up and Operation** (List the basic sequential events that describe the complete operation, including when to turn on the laser warning light, laser setting, etc. The procedures shall be written for the benefit of the laser user who must read and understand them to perform the operation safely)

**IV. Shutdown** (Describe normal and emergency shutdown procedures)

**Section E: Laser System Beam Alignment Procedures** (When performing beam alignment, follow all applicable safety measures listed below)

1. Exclude all unnecessary personnel from the LCA during alignment procedures.
2. If possible, use a low power alignment laser or use the lowest possible laser power setting.
3. Always wear the proper laser protective eyewear during alignment.
4. For aligning invisible (IR, UV) beams, use beam display devices (i.e., image converter viewers or phosphor cards to locate beams.
5. Use a shutter or beam block to block the high-power beams except when needed for alignment.
6. Use a laser rated beam block to terminate high power beams downstream of the optics.

7. Locate and block all specular reflections as close to the source as possible.
8. Ensure all beams and specular reflections are terminated before high power operation.
9. Only trained laser operators are permitted to perform laser alignments.
- 10. Include below the specific beam alignment instructions, including PPE to be worn and any applicable signs to be used.**
11. Ensure all laser operations are performed in accordance with the PI instructions and the Laser Safety Program Guide.

**Comments or Additional Information:**

**Section F: Laser Protective Eyewear**

For enclosed beams, all personnel utilizing a Class 3B and/or Class 4 laser or laser system MUST wear laser protective eyewear. Inspect all eyewear periodically and ensure it is in good condition. Ensure eyewear with the correct Optical Density (OD) and wavelength is provided to all laser operators and individuals in the Laser Control Area during open beam operation. Appropriate wavelengths and optical density can be confirmed on the LIA website: <https://www.lia.org/evaluator/od.php>

Eyewear Manufacturer	Eyewear Model	Rated Wavelength (nm)	Optical Density (OD)

**Comments or Additional Information:**

Section G: Beam Hazards		
Check if Present	Beam Path Characteristics	Comments
<input type="checkbox"/>	Beam Path is Clearly Identified	
<input type="checkbox"/>	Beam is Enclosed as Much as Possible	
<input type="checkbox"/>	Beam is Not Directed Towards Hallways, Doors, Desk Areas, Traffic Areas, Laser Control Area Entry Points, or Windows	
<input type="checkbox"/>	Beam is Terminated at the End of its Useful Path	
<input type="checkbox"/>	Beam is Not Located at Sitting or Standing Eye Levels	
<input type="checkbox"/>	Surfaces Scatter Radiation and Minimize Specular Reflections	
<input type="checkbox"/>	Beam is Viewed Remotely	
Section H: Non-Beam Hazards		
Check if Present	Non-Beam Hazards	Comments
<input type="checkbox"/>	Electrical Hazards	
<input type="checkbox"/>	Collateral Radiation Hazards	
<input type="checkbox"/>	Plasma Radiation Hazards	
<input type="checkbox"/>	Noise Hazards	
<input type="checkbox"/>	Glass or Nanoparticle Hazards	
<input type="checkbox"/>	Laser Generated Air Contaminant Hazards	
<input type="checkbox"/>	Laser Dye and Solvent Hazards	
<input type="checkbox"/>	Cryogenic Liquid Hazards	
<input type="checkbox"/>	Biological Agent Hazards	
<input type="checkbox"/>	Trip Hazards	

<input type="checkbox"/>	Fire Hazards	
<input type="checkbox"/>	Other (Specify)	
<b>Section I: Laser System Control Measures</b> (For each hazard present, check the hazard. Under 'Implemented Control Measures' indicate the attachment number which outlines the appropriate control measures)		
<b>Check if Present</b>	<b>Non-Beam Hazards</b>	<b>Comments</b>
<input type="checkbox"/>	Safety Interlocks are Present/Functioning Properly	
<input type="checkbox"/>	The Protective Housing Interlock is Not Bypassed or Overridden During Laser Operation	
<input type="checkbox"/>	An Emergency Stop Button, Key, or Coded Access Pad, is Available Which Will Terminate the Laser Beam Immediately (Class 3B & Class 4)	
<input type="checkbox"/>	An Activation Warning System, a Remote Interlock Connector, and a Beam Stop or Attenuator are in Place and Functioning Properly (Class 4)	
<input type="checkbox"/>	Laser is Securely Mounted on a Stable Platform	
<input type="checkbox"/>	Laser System is Grounded	
<input type="checkbox"/>	Nominal Hazard Zone (NHZ) Clearly Marked	
<input type="checkbox"/>	Protective Barriers, Curtains	
<input type="checkbox"/>	Windows Covered Where Applicable	
<input type="checkbox"/>	No Reflective Surfaces Near Beam	
<input type="checkbox"/>	Laser Warning Signage	
<input type="checkbox"/>	Audible Warning System	
<input type="checkbox"/>	Fire Extinguisher Available	
<input type="checkbox"/>	Emergency Contact Information Located on Door Signage	
<input type="checkbox"/>	Extra Safety Eye Wear Available	
<input type="checkbox"/>	Lit Sign Interlocked with Laser Power Supply	
<input type="checkbox"/>	Lit sign controlled by switch	

<input type="checkbox"/>	Mounted Reversible Sign: <b>Green "Laser OFF," Safe To Enter;</b> <b>Red "Laser ON," Do Not Enter</b>	
<input type="checkbox"/>	Other (Specify)	

**Section J: Laser System Maintenance-** Appropriate signage is required for maintenance activities. EHS will provide 'Laser Service in Progress' door placards upon request.

**Comments or Additional Information:**

**Section K: In Case of Emergency**

<b>Laser Safety Officer:</b>	Jennie Evangelista	<b>Phone:</b>	(714)532-6023
<b>Email:</b>	evangelista@chapman.edu		
<b>Medical Emergencies and Fire:</b>	Public Safety	<b>Phone:</b>	(714) 997-6763

- 1) Shut the laser off immediately and remove the interlock key. If not possible, alert everyone to exit the laboratory.
- 2) If there is a fire or medical emergency, call the University Police Department (911) as necessary.
  - a. Laser induced medical emergencies include severe injuries from beam exposure such as suspected eye exposure, vision loss, bleeding from the eye, and burns to areas around the eyes and/or on the face.
- 3) Do not alter the laser setup. It is important to analyze the setup as it existed at the time of injury so we can help find the cause of accident and develop corrective actions to prevent a recurrence.
- 4) Call the Principal Investigator and the Laser Safety Officer.

**Comments or Additional Information:**



**Section L: Laser User Acknowledgement**

I certify that I have read and understood this Standard Operating Procedure and its contents. I agree to comply with these procedures each time I use the laser and/or laser operating system specified in this SOP. All individuals listed below affirm that they have read and agreed to comply with the attached SOP.

Name (Last, First)	Email (Chapman)	PI/Supervisor	Signature	Date

**Section M: Standard Operating Procedure Approvals**

These Standard Operating Procedures have been reviewed and approved by the PI and LSO. Future changes to this SOP must be submitted, reviewed, and approved by the LSO.

<b>Signature of Principal Investigator</b>	<b>Date</b>
<b>Approval Signature of Laser Safety Officer</b>	<b>Date</b>