**Laser Standard Operating Procedures**

*(Print a copy and insert into your Lab-Specific Safety Plan.)*

***This is an SOP template and is not complete until:***

* *lab specific information is entered into the box below*
* *lab specific protocol/procedure is added to the protocol/procedure section and*
* *SOP has been signed and dated by the PI and relevant lab personnel.*
1. **Specific Information:**

|  |  |
| --- | --- |
| **Department:** | Click or tap here to enter text. |
| **Date Written:** | Click or tap here to enter text. |
| **Date Approved by PI/Lab Supervisor:** | Click or tap to enter a date. |
| **Principal Investigator:** | Click or tap here to enter text. |
| **Internal Safety Coordinator/Lab Manager:** | Click or tap here to enter text. |
| **Lab Phone:** | Click or tap here to enter text. |
| **Office Phone:** | Click or tap here to enter text. |
| **Emergency Contact:** | Click or tap here to enter text.*(Name and Phone Number)* |
| **Location(s) Covered:** | Click or tap here to enter text.*(Building and Room Number(s))* |

1. **Type of SOP:**

[ ]  **Process** [ ]  **Hazardous Chemical** [ ]  **Hazardous Class**

1. **Process Description**

This Standard Operating Procedure (SOP) outlines the procedures for safely operating the laser setup (laser, amplifier, OPA, associated optics, etc.). The SOP also identifies all the laser related safety hazards as well as the methods to control the hazards.

1. **Personnel**

Only authorized personnel may work with this the laser setup. To become an authorized user individuals most meet the following qualifications:

* Receive approval from the Principal Investigator.
* Complete Purdue University’s online laser safety training.
* Receive hands‐on training for the laser setup from a knowledgeable supervisor.
* Read and fully understand this SOP.
1. **Hazards and Safety Controls**
	1. Beam Hazards

Permanent eye injury (blindness) and skin burns from direct, reflected and scattered laser radiation. Increased risk of skin cancer from exposure from direct, reflected and scattered UV laser radiation.

* 1. Engineering Controls

Laser Controlled Area (LCA) – All hazardous laser radiation must be contained within the LCA. Close all LCA doors and laser curtains/barriers (including those for windows).

Laser Warning Light – For LCAs containing Class 4 lasers, the laser warning light must be turned on when Class 4 lasers are operating and turned off when lasers are not operating. Light might include red bike light.

Entrance Barriers – For LCAs containing Class 4 lasers, a laser curtain/barrier must be used at the LCA entrance to prevent hazardous laser radiation from leaving the LCA when the door is open and to protect people coming into the LCA from hazardous laser radiation. Laser eye protection must be located at the barrier for easy access.

Beam stops/beam barriers/beam housings and enclosures – All of these control methods must be in place during normal operation to block laser beams and reflections.

* 1. Administrative/Procedural Controls

Only authorized personnel may operate lasers.

Only authorized personnel are permitted in the LCA during laser operation.

Visitors will be only allowed entry to the laboratory during laser operation with the supervision of an authorized user if:

* The visitor has obtained approval from the Principal Investigator.
* The visitor has been trained on the laser hazards present and how to protect themselves from the hazards.
* Appropriate protective measures are taken to ensure the visitor’s safety.

Lasers must be continuously supervised by an authorized laser user when turned on.

Perform physical surveys to determine if there are stray beams (specular or diffuse) emanating from each laser and its optics, and then take measures to control them.

Specular and diffuse reflections will be controlled using beam stops, beam barriers, beam housings and enclosures. All of these control methods must be in place during normal operation.

No jewelry or other reflective materials are to be worn while working with the Laser, especially on the hands and neck.

Personnel in the laser lab should avoid bending over or otherwise putting their eyes at the level of the beam path while the laser is in operation.

Laser alignment must be performed only by following the steps outlined in the alignment procedures.

If the beam path must be changed significantly by relocating the laser or optics, all users must be notified of the change.

The same precautions that are taken for safe operation of the laser must also be followed when adjusting any of the optics in use with the apparatus.

* 1. Personal Protective Equipment

Laser Eye Protection (LEP) – Laser eye protection is required to be worn for all beam alignments/beam manipulations or anytime there is an open beam that exceeds the maximum permissible value. LEP requirements can be found on the laser warning sign outside the LCA.

UV Skin Protection – When working in an LCA with UV laser radiation, wear a lab coat, long pants and closed toe shoes. You may also wear sunscreen on the hands and face.

* 1. Electrical Hazards

*Hazard* - Electrical shock or electrocution from contact with high voltage equipment.

*Controls* - Electrical work shall only be performed by knowledgeable individuals who have completed Purdue University’s high voltage safety training and who are using the proper electrical safety controls.

* 1. Chemical Hazards

*Hazard* - Laser dyes can be toxic, carcinogenic, or mutagenic.

*Controls* - Users shall utilize personal protective equipment (i.e. gloves, lab coat, closed‐toe shoes, long pants and splash goggles) when handling laser dyes.

1. **Pre-Alignment Laser Alignment Safety Procedures**
	1. Pre-Alignment Safety Procedures
	2. Remove all unnecessary personnel from the Laser Controlled Area (LCA).
	3. Ensure that all laser curtains/barriers and/or lab doors are closed.
	4. Remove all jewelry and potentially reflective objects from personnel.
	5. Remove all unnecessary equipment (e.g. tools, unused optics, etc.) from the optics table.
	6. All personnel in the LCA must wear the appropriate laser eye protection.
	7. Check for and remove any foreign objects in the beam path other than safety controls such as beam blocks.
	8. Only non-reflective alignment tools should be used. If reflective tools are required, be mindful to keep the tool out of the beam path.
	9. Never allow the beam to propagate beyond the point to which you have aligned and always be aware of the full beam path.
	10. Always block the beam upstream when inserting/removing anything into/from the beam path, such as alignment irises.
	11. As alignment proceeds down the table, a beam block should always be placed down-stream in a position to catch the beam directly after the pair of mirrors being aligned, preventing the beam from propagating through an unaligned path.
	12. Be aware that all transmissive optics generate back reflections and some reflective optics have substantial leak through. When working with these components be sure to track, block, and record all stray beams. This is a particular concern with filters which generate strong specular reflections that can propagate back up stream a long way before diverging off the beam path due to very slight miss alignments. When such a reflection travels back upstream and encounters a beam splitting optic a new beam path can be formed in an unexpected direction.
2. **Optical Alignment Procedures**
	1. Inspect all electrical and water connections for damage and connectivity.
	2. Close all doors and laser curtains/barriers.
	3. Verify that all engineering controls are in place.
	4. If applicable, turn on the 'laser in use' light.
	5. Ensure that the laser path will be blocked.
	6. Turn laser system (and the applicable laser cooler) on.
	7. If applicable, turn on the built-in low-powered (Class 3R) alignment laser.
	8. If a low-powered alignment laser is not available, adjust the beam power to the lowest possible power for alignment.
	9. Setup the optic and block the beam path downstream from this optic. Also place a barrier behind the optic to block beams that might miss the optic.
	10. Carefully release the original block and use a viewing card or an electronic viewer to view the laser beam.
	11. Make adjustments to ensure the beam is centered on the optic.
	12. Using a viewing card or an electronic viewer, check for stray beams (including those behind the mirror). Block these stray beams.
	13. Continue these steps until all optics are properly aligned.
	14. Check that all mounts are tightly in place and will not inadvertently shift, causing changes in alignment.
	15. Shutdown the laser system.
3. **Emergency Response**
	1. Turn off the laser system.
	2. For life threatening injuries, call 911.
	3. Inform the Laser Safety Officer (765‐494‐6371) as soon as possible.
	4. Obtain a medical evaluation at the Regional Occupational Care Center (ROCC) as soon as possible within 48 hours.
	5. Submit a First Report of Injury form.
	6. Submit a Supervisor’s Accident/Near‐Miss Investigation form.
	7. Do not operate the laser again until the Laser Safety Officer has evaluated the incident and corrective actions have been taken.
4. **– Documentation of Training** *(Signature of all users is required.)*
* Prior to conducting any work with lasers or laser systems, designated personnel must provide training to their laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
* The Principal Investigator must provide their laboratory personnel with a copy of this SOP and access to the laser user manual provided by the manufacturer.
* The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training within the last one year

**I have read and understand the content of this SOP:**

| **Name** | **Signature** | **Date** |
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