

General/Operation

The items below are tips to consider for all Class 3B and Class 4 use cases.

- Ensure laser warning sign at entry includes the laser type, wavelength, and OD for the laser(s) getting ready to be used. For labs with multiple wavelengths available, it is strongly recommended that the lab determines a way to communicate the current wavelength in use adjacent to the laser warning sign or in the lab near the eyewear storage. This may be a small whiteboard that can be written on or a sign holder in which a paper indicating the wavelength in use can be easily swapped.
- Ensure that the laser eyewear fits properly with no large gaps present between the lenses and the face.
- 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.
- Always block the beam when inserting/removing anything into/from the beam path. Also, use pairs of beam cards or index cards when checking the alignment of the beam so that you never have to leave the beam unblocked to move a card past a mirror.
- Always wear laser eye protection during alignment or operation when line of sight to any part of the beam path is possible.
- No laser eyewear is required for alignment or operation if **there is only a visible wavelength beam ≤ 15 mW present**.
- Remove any watches, jewelry, objects in shirt pockets, or lanyards that are reflective.
- Pull long hair back into a ponytail or similar to prevent it from passing through beam path
- Ensure miscellaneous reflective objects are removed from the optical bench.

Alignment/Setup

The items below are tips to consider during alignment/setup activities. Remember, laser alignments are where most laser injuries occur. Unexpected stray beams or reflections from unexpected angles cause most of these injuries.

- Ask another trained Laser User or Laser Supervisor to aid with alignment activities. At a minimum, the person conducting alignment activities should ensure another trained user is at least in a nearby lab or office so they can quickly provide assistance.
- DO NOT perform alignment activities unless you have been specifically trained to do so by the Laser Supervisor.
- Plan the beam path and sketch it out on paper before beginning alignment/setup
- DO NOT rush through beam alignment activities in particular; give yourself plenty of time. Alignment is the laser activity that poses the greatest potential for hazardous exposure.
- DO NOT hold and align an optic with your hands. All optics must be attached to the bench reliably with mounting screws/mounting clamps and tightened appropriately, and only one optical part at a time should be loosened slightly to be adjusted. Minimize the degree of freedom and range of motion to what is necessary for alignment. Immediately re-tighten the optic when alignment of this part is done.
- Walk the beam as you set up a beam path by setting up beam blocks just past the optic on which you are aligning to prevent beams from passing further on to other non-aligned optics, etc. Once that optic or short run of optics is aligned, move the temporary beam block just past the next and then proceed with alignment adjustments. Repeat this process until the beam is aligned on the intended sample/target location.
- ANTICIPATE UNWANTED REFLECTIONS FROM EVERY SURFACE IN THE BEAM PATH
- Block stray beams so that they do not leave the optical bench or the immediate vicinity of the beam path if no optical bench is used.

- 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 (e.g., ND and bandpass filters), which generate strong specular reflections that can propagate back upstream 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.
- When working with focusing elements, it is important to be aware that there may be sufficient intensity at the focus to burn skin and/or ignite combustible materials, such as index cards. At sufficiently high powers the focus may create plasma in the air resulting in a loud “popping” noise at the repetition rate of the laser, a glowing white spot at the focus where nonlinear optical processes are occurring, and the creation of ozone that smells like electric discharge. This can be disconcerting when unexpected. If this occurs simply block the beam upstream from the focusing element and either reduce the power of the beam or change the focusing element to a less tightly focusing optics.
- Routinely check for stray reflections terminate them with a laser barrier. Ensure all stray reflections and direct beams are properly terminated before high power operations.
- Especially when aligning invisible beams, consider whether a low-power visible laser can be used to do the initial optics alignment.
- Color-blindness can cause the visibility of the beam spot on beam alignment cards to be diminished. Determine whether anyone in your group that will be involved in beam alignment/setup activities is color-blind so that alternative alignment methods can be considered.
- Use only beam alignment cards that are undamaged.
- Be sure to confirm you have selected a beam card such that the emitted color is not blocked by your laser eyewear.
- When possible, use a holder for beam alignment cards instead of propping them against optics on the table to prevent them falling over. There may be cases where propping the card is a better option, but the user must exercise extra caution so as not to be distracted by these cards if they fall over.
- Use the back of a white business card to make dim visible beams appear brighter. For some UV wavelengths, the back of a white business card will fluoresce and render the beam location visible.
- Use a pair of beam cards when checking the alignment of the beam so that you never have to leave the beam unblocked to move a card past a mirror.
- Use phosphor cards or IR/UV viewers to see invisible UV and IR wavelengths.
- Eyewear specified only for alignment of visible beams is lower OD than needed for full protection and it will NOT protect your eyes from damage due to the direct beam or a specular reflection. It will only protect your eyes from the viewing of diffuse reflections and the beam spot on a diffusely reflecting surface. EXERCISE EXTREME CARE.
- If fully protective OD eyewear renders a visible beam spot difficult to see during alignment activities try the following before looking into alignment eyewear use.
 - Use a beam card or set up a camera feed viewed on a computer monitor to see if this renders the beam sufficiently visible for alignment while you are wearing the fully protective OD laser eyewear.