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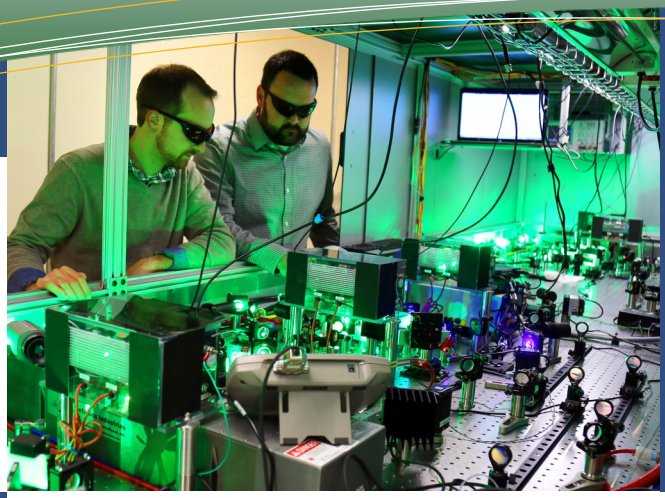
Laser Lessons News Letter



This issue:

"In reviewing these near miss scenarios, we must look at ourselves. There were faults at every level, from management down to the worker. Safety is a team effort and no program can endure without participation from all. Remember that you are only as safe as your last accident. No accident EVER happened without many ignored near misses leading up to it." Learn from these near misses and BE SAFE!"

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Introduction

2017 has been quite an impressive year. From completion and delivery of an all diode-pumped High-Repetition-Rate Advanced Petawatt Laser System (HAPLS) to construction of a 60J, 211nm Optical Thompson Scattering Laser (OTSL) within the National Ignition Facility, there have been significant achievements in laser technology. Unfortunately, we have also seen a few near misses along the way. This shows us, while making major breakthroughs in science, we are just a single mistake away from it all meaning nothing should someone be injured. This issue will refocus on laser safety and how we can apply these recent lessons learned in order to BE SAFE!

Lessons Learned

Is the other end of your fiber live?

On March 8, 2015, two laser workers were at an offsite operation where they were required to inspect the fiber end of a 1550nm laser prior to connecting. The delivery end of the fiber was in another room. Prior to inspection, neither of the workers verified that the laser was off.

A direct viewing magnifying optic (microscope) was used to inspect the fiber end. The live fiber was examined for a period of time before the workers realized that the laser was on. The worker did not feel any symptoms of an overexposure. A medical evaluation was performed and the results were negative. Calculations by the laser safety officer (LSO) showed that the output levels were below the Maximum Permissible Exposure (MPE) limit.

Let's take a little closer look at this scenario to see just how lucky they were.

First – In the initial hazard analysis, this operation was described as an enclosed fiber (Class 1). No troubleshooting or off-normal operations were relayed, so the analysis ended there. There were no procedures for performing the fiber inspection AND the worker who viewed the fiber end was not listed on the work control document.

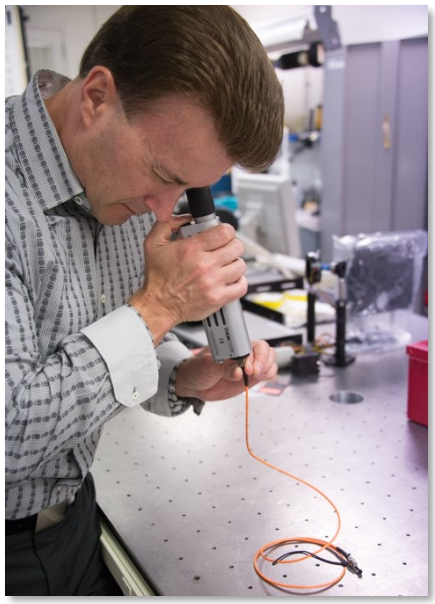


Figure 1. Correct use of direct viewer (both ends of fiber under control of the worker)

Second – Direct view microscopes for inspecting fibers were relegated to activities where both ends of the fiber are in the workers possession (Figure 1). This was because of a previous lesson learned where a worker "thought" they viewed laser light through a very long fiber run.

Third – The laser was split over several fibers, so the output was actually below the MPE. Also, the microscope viewer contained a 1550nm optical density (OD) filter. This was not known by the workers at the time of the incident, nor was it part of a hazard analysis because the reviewer didn't know that fiber inspection was part of the task.

Taken in full, this "near miss" could have resulted in a serious eye injury had it not been for chance and good fortune.

This should be the end, except that this happened again on August 8, 2017 at another DOE Lab. Pay attention every step of the way and BE SAFE!

Will that laser eyewear protect me?

On April 3, 2017, a pair of alignment laser protective eyewear (LPE) was found comingled with those specified for the designated work. The eyewear was clearly marked with "Visible Alignment" (See Figure 2).

They were called to the attention of the LSO after being discovered in a pre-job inspection. The specific filtering requirements for this procedure were to provide protection against 1053nm, 808nm, and 527nm. This eyewear provided protection at a reduced level (alignment) for the 527nm (green light). It is assumed that

Figure 2. LPE on left, designated "Visible Alignment" found with full protection eyewear

Figure 3. Specially marked eyewear

the LPE was brought into this area because it appeared visually similar to that of the correct eyewear.

The story should end there with a lesson learned and instilling correct behavior upon the workforce. Unfortunately, this same incident occurred about eighteen month earlier. Yes, you read that correctly!

Humans are always looking for a shortcut. It appears someone took one here when bringing the eyewear over to this Laser Controller Area (LCA). What would have happened had someone been exposed to levels higher than the protection level afforded? It is paramount when using "community" LPE that you know what you are wearing. Never assume eyewear in the bin is correct...VERIFY!

This LCA now requires that specially marked eyewear be used. Alignment eyewear has a red band and full protection a yellow one (See Figure 3). LPE is your last line of defense. It is very important that you never select them based on the filter color. There are many formulations of filters available for the same wavelengths that will NOT provide you satisfactory protection. Prior to using any type of PPE, you want to be sure that it is adequate for the task. Verify your LPE by Wavelength AND OD and BE SAFE!

Does that sign pertain to me?

On August 8, 2017, a worker entered an active LCA for a non-laser related task. The area was properly posted with a laser warning sign and flashing beacon. While looking down and not paying attention, the worker walked past the sign and beacon. They reported that this area was not an active LCA (beacon on) during that particular shift. The worker was also distracted with other work and personal items.

A worker behind the curtain immediately noticed and directed the individual to leave. Fortunately, the worker was not exposed to laser radiation above the MPE. Think of what would have happened had they been. Pay attention at all times and BE SAFE!

Is housekeeping really that important?

On October 5, 2017, normal work processes were interrupted when the optical table was covered in fragile fiber optics for inspection and paperwork and small items, normally kept in this area, were placed on a laptop keyboard. A train wreck waiting to happen? Read on.

At one point, the worker placed an object on the keyboard, pressing the mouse button while the cursor was on the graphical user interface (GUI). This GUI was used to run the invisible laser. While visually inspecting the fiber, the worker noticed that the power meter indicated that the laser was on (Figure 4).

Fortunately (a familiar word in each of these incidents), output of the laser was at Class 1 levels and no injury resulted. Clutter is the culprit here. How many of us use computers to run our lasers? How many of these are laptops that are kept in a cluttered area? Finally, how many of these use a single keyboard stroke to activate the laser?

A tool in the hand or in the right place will keep you safe in every case. Avoid clutter, keep your work area clean and BE SAFE!

Review

These four lessons reveal what can happen when you do not pay attention. Fortunately (there's that word again), none of these resulted in an exposure to the worker. They could have just as easily ended in a very serious injury. With lasers, there is a very little margin of error. Each of these incidents involved visible/near infrared wavelengths.

These are magnified by the cornea/lens and will result in a lesion on the retina. This means permanent vision loss. Practice good situational awareness and BE SAFE!

The first scenario revealed several failures.

- Not enough information was gathered to perform an adequate hazard analysis for required controls.
- The worker was not listed on the work control document, so they did not know what any of the controls were. Each of us is responsible for our own safety and need to know what the controls are.
- If you cannot see both ends of the fiber (disconnected) use an indirect viewer. There is no reason to bare-eye potential laser hazards. Use a camera!

The second showed how shortcuts are bad.

- Alignment eyewear is stored separately from regular protection LPE. Somebody found them, did not read the OD/ wavelength, and brought them to the "community bin" for this LCA. The shortcut was relying on the color of the filter alone. This is s big NO-NO!

The third was about not paying attention AND the importance of signs.

- The beacon was flashing and the sign stated that controls were required in this mode of operation. Stay focused and pay attention to ALL signs that you encounter. Again, everyone is responsible for their own safety.

The fourth showed just how important housekeeping really is.

- Looking for a horizontal space in which to put something, the worker incorrectly chose to set it on the laptop.
- Take care when determining what you will use to activate your laser. Is a single key stroke really the safest way?

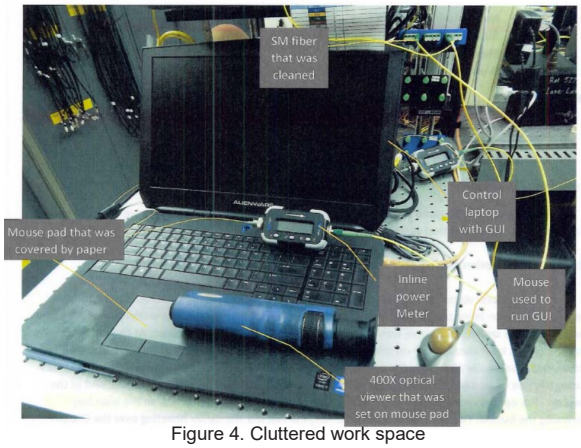
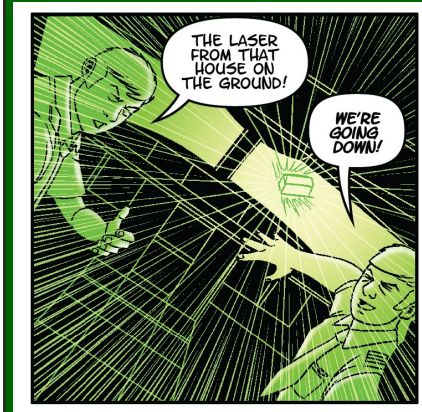
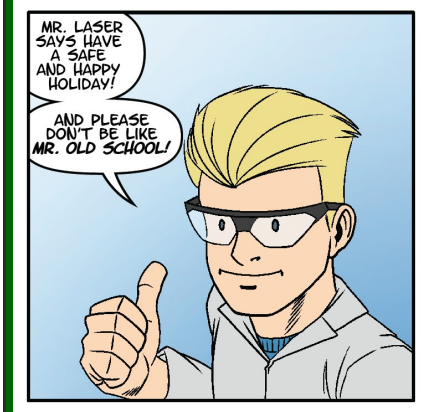


Figure 4. Cluttered work space





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Lab planning will prevent back injuries and other ergonomic problems

Contributing Author: Ken Barat

The three basic ergonomic factors in the lab are position/posture, repetition/duration, and force. Covered here is position and posture. Remember your mother saying to sit up straight? The most common issue in the laser lab relates to reaching for optics, equipment, and the strain it can place on one's body. Since one never has sufficient room in their laser work space, being able to reach all optics and components can pose a challenge.

Many times, one cannot arrange the optical table to make access possible from all sides. In some cases, equipment on the table becomes the instrument that makes accessibility difficult. This might not seem like a concern, unless one must reach these optics regularly. Keep in mind that one minor torqueing of your back or body may be the start of a lifetime of pain and discomfort. What are some solutions? Each of these deserve some consideration and will not be the answer to all sets ups, but worth considering:

1. *Motorized mounts – Controlled off the table, make reaching unnecessary. Should be used with remote viewing cameras.*
2. *Raised platforms – These come in different heights and are available for reaching in.*
3. *Vertical bread boards – Can bring optics within reach of users. Watch out for beams at eye level.*
4. *Set up to reach from three or four sides – This is just good planning, take advantage of building codes to get extra room.*
5. *Over the table shelves – These give access to needed equipment and reduce clutter on the optical table.*
6. *Optical table modifications – Configure with a hole in the middle, allows power and other utilities to be cleanly routed in.*
7. *Classical ergonomics – Standard ergonomics for the lab; height and position of monitors, where keyboards are placed, the type of mouse used, etc. The same as routine office ergonomic safety, but rarely considered in lab setups.* These should be reviewed by someone familiar with ergonomics. The typical rules are:
   - Monitors should be directly in front of you with the upper edge at eye level or slightly below and should be adjustable.
   - Use a document holder for hardcopies and keep in front of you, between monitor and keyboard.
   - Keep the keyboard and mouse in front of you and as close as practical to prevent over reaching.
   - Wrist straight as possible.
   - Don't create trip hazards. This can be done by "bridges" designed to contain wires and hoses. The Occupational Safety and Health Administration provides a review and recommendations through its eTool on ergonomics.

Note*: This article was inspired by an article by Vince McLeod in Lab Manager Vol 12 #4 May 2017*

The Department of Energy Laser Safety Officer (LSO) Workshop will be held May 8-10, 2018 at the University of Rochester, NY. The workshop is for individuals with responsibility for, or interest in, Laser Safety in a research or academic setting. This 2.5-day workshop will include both invited and contributed talks on current laser applications, and associated laser safety issues and solutions. The final day of the workshop serves as the official meeting of the U.S. Department of Energy—Energy Facility Contractors Group (DOE−EFCOG) Laser Safety Task Group.

The Board of Laser Safety is also offering its Certified Laser Safety Officer (CLSO) examination prior to the workshop. Certification Maintenance points for Workshop participation will be available. The request to approve points/credits for the 2018 DOE LSO Workshop will be made at the conclusion of the workshop. BLS has previously awarded 2.5 CM points, AAHP has awarded 20 CECs, and ABIH has awarded 16 hours of CM credit. Mark your calendars!

Acknowledgement:
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