Yale *Environmental Health & Safety*

Shop Safety Procedure

Equipment/Task Name:	LASER CUTTER
Equipment/Task Hazard Class:	2 http://ehs.yale.edu/forms-tools/tool-classification-matrix
Shop Name:	
Shop Hazard Class:	

Purpose

Laser cutters are versatile enclosed computer controlled machines used to cut a variety of materials into complex 2-dimensional shapes using high powered lasers. Laser cutters come in a variety of capabilities that vary based upon the physical bed size of the machine and the power of the integrated laser(s). All units on campus have an enclosed cutting bed with interlocked doors that prevent the cutting laser from engaging unless the doors are closed. Additionally, these units must be connected to an exhaust system to remove the smoke and fumes generated during cutting.

Hazards

As with all shop tools, there are many potential hazards associated with the use of a laser cutter. Computer-controlled, door interlocked laser cutters are Class 2 tools (http://ehs.yale.edu/forms-tools/tool-classification-matrix). There are a number of particular hazards associated with the operation and use of laser cutters.

Laser light source:

- High energy light beam can burn /sever flesh and serious damage the eyes.
- NEVER operate the laser unless all covers are in place and in good repair.
- NEVER attempt to bypass any safety interlocks.
- Any damage to the laser cutter enclosure or window could allow laser light to escape and cause serious eye injury including blindness and serious burns to the skin from any contact with laser light.

Hot objects/ fire :

- During cutting and engraving operations, substrate material is burned away, generating significant amounts of heat.
- Allow materials to cool on the cutting bed prior to opening the lid and touching material scraps or the work piece.
- Despite computer controls, it is essential that users remain with the laser during operations to ensure that any flame/flare-ups of material are properly contained.

Hazards (cont'd)

Hazardous vapors and fumes:

- Laser cutting and engraving will generate vapors and fumes from the substrate. Plastics and other combustible materials generate more fumes than metals, and can produce toxic by-products. Every laser system must be equipped with a fume exhaust system that vents to the outside and is not recirculated into the room.
- The exhaust system must be fully operational before any laser operations may occur.
- While the primary reason for an exhaust system is to protect the operator and others nearby, these systems also serve to protect the laser equipment itself and sensitive laser optics.

Moving cutting head

- During setup operations, the moving laser head is exposed and can travel at high rates of speed. Injury can occur if contact is made with the moving head.
- Never place hands or other body parts inside laser enclosure during any operations or setup.
- Potential for loose clothing, jewelry, hair, or other items to become entangled in moving parts.

Eye hazards & sharp edges on workpiece

- Similar to other cut objects, those cut by a laser have the potential for sharp edges that could result in cuts, lacerations, and puncture wounds.
- Fresh cuts on work piece may produce burrs and other sharp edges.
- Students may attempt to "break out" partially cut thru material with the high potential for small sharp object to fly into unprotected eyes or cause cuts on fingers and *hands.*

Limitations

- Laser cutters on campus are essentially limited by size and laser energy to cutting a variety of woods, plastics, and natural fiber and other materials.
- Due to their toxic by-products and often fouling smoke, several common materials must not be cut or engraved on a laser include:
    - Any PVC (Poly Vinyl Chloride) containing materials
    - Polycarbonate materials (common trade name Lexan)
- Other limitations of laser cutting are based on the physical size, thickness and the particular work piece material. Any materials to be processed must be able to sit flat within the laser bed and not have any vertical components that might interfere with the rapidly moving laser head.

Required Personal Protective Equipment

- Refer to the Shop Safety Postings and instructions provided by the Shop Supervisor.
- Safety glasses
- Shop specific required PPE:

Required Training

- Applicable Shop Rules
    - **Student Shop Rules** (http://ehs.yale.edu/forms-tools/shop-rules-student-accessible-shops)
    - **Professional Shop Rules** (http://ehs.yale.edu/forms-tools/guidelines-professional-shops)
- For Class 2 through 5 Student Shops, review and signing of the **Yale University Shop/Tool Use Safety Agreement** (http://ehs.yale.edu/forms-tools/shoptool-use-safety-agreement).
- Shop Supervisors or Instructors must evaluate the tool user based on successful demonstration of the Training Competencies listed below as applicable.
    - □ and proper setup of physical laser and determining appropriate laser speed/ power and other parameters to ensure appropriate operations.
    - □ Be able to correctly observe laser operations and know when intervention is required and perform appropriate interventions including knowledge of fire extinguisher operation.

Required Training (cont'd)

Training Competencies:

- □ Understand the uses, limitation, and hazards of the laser cutter/engraver.
- □ Dress appropriately and don correct personal protective equipment.
- □ Know how to inspect the laser and setup for selected operation.
- □ Show good judgment in laser preparation and start-up process.
- □ Know how to determine proper placement of workpieces and secure as needed.
- □ Be capable of effectively and safely performing the laser operations, including importing files

- Shop specific training requirements:

Authorized Tool Users

Shop Supervisor, Shop Monitors and those authorized by shop supervision to operate the tool.

Tool Safety Rules

- Observe and follow all Yale Professional or Student Shop Rules as posted.
- Understand and follow manufacturer operating procedures.
- Inspect the tool for damage prior to use.
- Verify all guards are in place and adjusted properly.
- Do not bypass any safety devices.
- Always stay at the machine while it is running.
- Clean the tool after use.
- Report any malfunction or damage to the Shop Supervisor after tagging the tool "Out of Service, do not use".

Shop specific rules:

Proper Setup and Use

Prior to approaching the laser cutter you should have:

- Verified that the workpiece is made of an approved material and is safe to use and has appropriate geometry for use on the particular Laser cutter.
- Prepared drawing file prior to intended use of the laser.
- Identified the operations that are intended for this workpiece.
- Identified the appropriate laser settings for the material and intended operations.
- Removed any protective coatings from the workpiece (these tend to cause flare-ups).
- Prepared for laser operations by verifying again that any loose clothing or jewelry has been removed or secured, and hair (including beards) tied back and away.
- Donned personal protective equipment (safety glasses).
- Confirmed location and condition of the nearest exit and fire extinguisher.

At the laser:

- Turn on laser following local shop procedures.
- Ensure that laser starts appropriately and that the cutting head and laser bed are in correct home positions and have stopped all motion.
- Open cover and ensure that there is no debris or objects on laser bed.
- Place workpiece on laser bed in correct orientation/location.
- Log into laser computer and load drawing file according to local shop practices.
- With laser cover open (to prevent cutting laser operation) perform a test run to determine proper workpiece placement and file settings. Reposition workpiece as needed.
- Ensure/start laser exhaust system and confirm proper exhaust flow.
- Close protective cover and confirm all interlocks have been satisfied (no flashing red lights)

Proper Setup and Use (cont'd)

Cutting/ engraving process:

- Confirm that laser interlocks have been satisfied and that the exhaust blower and any purge air devices are operating properly.
- Start laser operations.
- Observe all laser operations but don't stare at cutting beam.
- Ensure that there are no continued flare-ups during cutting and that all flames self-extinguish when the laser is not engaged.
- At completion of laser operation, allow workpiece to cool and exhaust fan to purge fumes for several minutes according to local shop practices.
- Raise interlocked cover and carefully remove workpiece from laser ensuring that it has cooled adequately to prevent operator burns.

Completion:

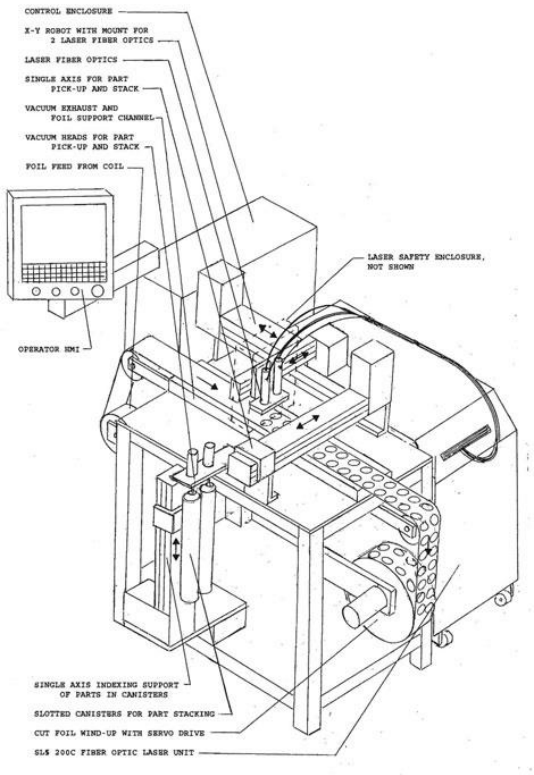
- Allow exhaust fan to continue to operate for several minutes.
- Clear laser bed of all debris and scraps.
- Police area around laser and remove any materials that do not belong there.
- Log off the computer
- Record laser cutter use on local log sheet per shop procedure.
- Be sure to note any issues or problems with the laser and notify shop supervisor.

Shop specific procedures:

http://ehs.yale.edu/training/embedded-laser-safety-program-ceid-personnel
http://ehs.yale.edu/training/embedded-laser-safety-training-school-architecture

Diagrams/Illustrations

Typical laser cutter



Creation/Revision Dates:	

Suggestions, questions, or comments? Please contact your shop supervisor or EHS.