Industrial 6090 Laser Cutter Policies

Only authorized persons may use the Industrial “6090” laser cutters without supervision. Authorized persons may allow others to use the machines, but are responsible for adherence to safety policies and must directly supervise at all times.

Failure to comply with policies may result in revoking privileges to this or other machines.

Motivation

The large Industrial 6090 laser cutters with 150W CO2 lasers can be quite dangerous to the operator, the facilities, and to innocent bystanders. These policies are meant to protect the safety of all. In addition, these systems are complex and expensive to repair or replace. As such, it is important to protect them so that our community can continue to offer this resource.

Process

In order to be granted authorization to use these machines, you must:

- Review this policy document and agree to the provisions.
- Review training materials and safety reminders documents and agree to follow them.
- Demonstrate safe operation by running a job under supervision by an already authorized person. That person must observe and agree that you have followed safe operation. That person may grant access by revealing the combination to the lock-box containing the lock-out key.

General provisions

- Operators must always maintain line-of-sight to the laser machines as the equipment is running a job.
- Operators must provide their own materials to cut
- Only one user may operate one machine at a time
- Operators must not operate the machines while under the influence of any intoxicant as defined by ORS301.321
- Machine doors and panels MUST remain closed during operation
- Only approved materials are permitted inside the laser machines (see below)
- No open food or drink is permitted in the lab and near the equipment
- Users must clean up their space and the inside of the laser beds after usage
- Each laser must be operated at no more than 50% of its maximum power rating in order to prevent fires and also extend the life of the laser tube.
- Use of machines MUST be logged.
- In case of fault or emergency-stop, the reason MUST be logged.
- After use, the machine must be locked and the key returned to the lockbox
- The combination to the lockbox must not be shared with unauthorized persons.
- All procedures for unsafe conditions must be followed (see below)
- Vents must be opened and facility ventilation must be active during operation.

- Follow the provided operations checklist when operating the machine.

Approved materials

Material	Examples	Notes
Medium-Density Fiber Board	MDF from hardware store	Up to 1/8 inch Can smell bad, but usually cuts reasonably well with ventilation.
Plywood		Up to 1/8 inch
Acrylic	Plexiglass (make sure it is acrylic)	Cast acrylic gives a better surface-finish
Cardboard	Most ordinary cardboard	Can be a fire hazard, so use with care and be prepared to halt machine and extinguish flare-ups
Glass		* For engraving/etching only.
Ceramic tile		* For engraving/etching only.

If you believe a material is safe but is not on this list, please present it along with the Material Safety Data (MDS) sheet to the Board and ask them to approve it. If a material is not on the list, it must not be used (even if you think it is safe).

Banned materials

Some materials present hazards such as fire (papers), toxic gas (some polymers), or laser exposure (metals). These materials are NOT approved and are likely NEVER to be approved because of the hazards they present.

Material	Examples	Reason
Paper	Printer paper	Fire hazard
Metal	Steel, Brass, Aluminum, chrome, gold, silver	Laser reflection hazard
Mirrored surface	Any type of reflective device	Laser reflection hazard
Polystyrene	Styrofoam	Toxic (Chlorine) gas
Polycarbonate	Lexan	Toxic gas
ABS	3d printed ABS parts	Toxic gas
Fiberglass		Hazardous glass particles in air and/or toxic fumes from epoxy
Pressure-treated wood	Wood with chemical preservatives	Fire hazard, toxic gas from treatment chemicals
PVC	PVC Pipes, parts, tubes	Toxic (Chlorine) gas
Nylon	Plastic, vinyl, pleather, Sintra, Kydex	Toxic fumes

[
This list was partially taken from another similar policy:
https://campus.kennesaw.edu/colleges-departments/cacm/docs/laser_cutter_approved_and_banned_materials_list.pdf
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Most laser jobs should be prepared in advance for use on the standard size (60cm by 90cm) laser cutters. Files to be cut should be SVG (vector) files processed through Lightburn or Gcode files for direct machine instructions.

Unsafe Conditions

It is unlikely, but possible, that during normal operation of the machines, faults may arise that present safety hazards. In these cases, it is extremely important that these procedures are followed to protect operators, nearby persons, the machine, and facilities.

Fire

CO2 lasers are powerful and operate by "burning" material. This can, in some cases, result in an uncontrolled burn of the workpiece or components of the machine. If handled quickly, these flare-ups can be managed, but if allowed to progress can pose a threat to the operator, nearby persons, the machine, and the facility. In case of fire:

- Turn off laser quickly using the Emergency Stop button
- Use the nearby CO2 extinguisher to extinguish the flame.
- Remove work piece and revise power and feed-rate to prevent fire in future cuts.
- Log the fire in the operation log.
- If the fire cannot be extinguished, call 911 and request fire assistance from emergency services.

Laser Lens Vaporization

The laser lenses are made of Selenium. If smoke, debris, or other impurities condense on the focusing lens, the CO2 laser light may vaporize the lens resulting in a reddish-pink residue on the work piece or other surfaces. Because Selenium is a highly toxic material, the following procedures must be followed:

- Turn off laser quickly using the Emergency Stop button.
- DO NOT REMOVE YOUR WORKPIECE, it is toxic and should be considered lost.
- Leave lid closed and ventilation turned on to vent potentially toxic selenium vapor.
- Notify a Spark Studio Board Member
- Turn key to OFF position and leave it locked.
- Place a sign on the machine warning that it has malfunctioned.
- Log the failure in the operation log
- A board member or other person delegated to clean the residue will don protective equipment (bunny-suit, gloves and respirator) and commence cleaning the area. The machine MUST NOT be operated until it has been cleaned and cleared to operate by the board.
- If you suspect that you have been exposed to Selenium vapor, you are advised to seek medical attention.

Laser Tube Malfunction

The CO2 laser tubes can last a long time, but ultimately they do wear out. In this case, they may physically develop a crack. This may also occur if impurities (such as algae or mold) make their way into the coolant water. If an unusual noise (crackle or pop from the back of the machine) occurs, the laser tube may be failing and you should:

- Turn off laser quickly using the Emergency Stop button.
- Notify a Spark Studio Board Member
- Turn key to OFF position and leave it locked
- Place a sign on the machine warning that it has malfunctioned.
- Log the failure in the operation log
- A board member or other person delegated to maintain the machine will evaluate the failure and work toward remediating it.

Authorization to use Industrial 6090 150W laser cutter/engraver

I, _____ (person to be authorized) have read and agreed to the safety and operation procedures and is now authorized to use the Industrial 6090, 150W laser cutter/engravers.

Signed (person to be authorized) _____ Date _____

I, _____ (name of witness) have agreed that the person named above has demonstrated safe operation and agreed to the safety and operation procedures.

Signed (witness) _____ Date _____

Congratulations!

Safety Reminders

The CO2 lasers are inherently hazardous and expensive. Please exercise appropriate caution.

NEVER leave machine unattended while cutting is in progress. If fire occurs, it will spread rapidly and can entirely consume the machine in a matter of minutes.

Follow Operation Checklist in order to keep machine safe, operational, and in a "known" working condition. Report ANY safety or machine damage incident to Spark Studio board members promptly so that safety issues can be mitigated.

NEVER open the hood while the laser is cutting. While there is a safety mechanism to disengage the laser if the hood is open, this should not be relied upon. The infra-red laser beam is not visible to the human eye, but can still cut flesh and cause permanent blindness. Wearing CO2 eye protection (not provided) is also advised to avoid laser exposure. All panels including front hood, back laser tube access and front panel MUST remain closed during operation to avoid direct laser exposure.

In case of fire, laser malfunction, or lens vaporization, E-Stop buttons must be used to turn off the machine. Power off laser and controller and air assist and douse fire with CO2 extinguisher immediately. If fire is not extinguished, call 911 immediately to report the fire and evacuate the building. Report ALL fires to a board member also.

Some materials present safety hazards in the form of toxic gas, fire, and laser light reflection. Do not use any materials not listed on the approved materials list.

The lenses are made of Zinc Selenide and if dirty can vaporize during operation leaving a reddish-pink residue. This substance is acutely toxic. If this occurs, immediately power off machine and leave hood closed with ventilation on. Don personal protective equipment (gloves, respirator, and gown) and scrub down machine to remove residue to avoid possible exposure.

Do not touch lenses or mirrors. Mis-alignment and dirty optics can cause hazards. These are sensitive components and should be handled as little as possible when in normal use. Special alignment procedures are required to clean and re-align optics.

Operation Checklist

1. Add your name, date and time to the operation log.

2. Turn on power to controller (top switch) on right side of machine.

3. Place work piece inside cabinet

4. Set origin point for job using arrow buttons and press “Origin” button. Press “Reset” to confirm origin is set to correct location, machine will re-home and return to the origin.

5. Set Z-distance from laser carefully using the green Z up/down buttons. This is normally a 7mm gap between the laser head and work piece although depends on the focal length of the lens. Use the step gague block to set gap distance.

6. CLOSE ALL PANELS to avoid laser exposure.

7. Load job onto machine either through PC or USB stick. Job should never specify a laser power of over 50% because it significantly reduces the life of the [expensive] laser tube. When cutting jobs, it should be for a RUIDA controller G-code.

8. Open the vent located on exhaust tube above back of machine.

9. Turn on power to exhaust fans (located near the breaker panel).

10. Turn on air assist pump.

11. Verify water chiller is operating (nominal 15 degrees C temperature). Top off with distilled water if level is low.

12. Turn on laser power supply (middle switch on right side of machine).

13. Select file and press green “Start/Pause” button to start cutting.

14. When job is finished, remove work piece.

15. Turn off exhaust fans and close vent.

16 Turn off air assist pump.

17. Turn off laser tube and controller power.

18. Leave the machine clean: empty chip tray and wipe down residue from cut.

19. Log end date/time and any malfunction or incident in the operation log.

Machine Operation Log

Name	Date/Time Started	Date/Time Ended	Safety incident (Y/N)

Pro Tips

This is not an exhaustive list, but there are a few tips for achieving a better surface finish. Some experimentation may be required, but a quite good surface finish is possible with some setup and care.

Cast acrylic leaves a better surface finish and less deformation than extruded acrylic. If surface finish is important, use cast acrylic.

Higher pressure air assist removes residue from work piece more efficiently and leaves a better surface finish with less post-processing. If available, using an air compressor to feed the air assist will provide a better surface finish.

Flashback (reflections from the holders that scar the back of the work piece) can cause residue to form on the back/bottom of work piece. Consider using the “Slats” or a “pin bed” to hold the work piece in order to reduce flashover and leave a better surface finish on back.

When etching glass, the 150W lasers are usually too powerful. Use a low power setting and consider de-focusing the beam slightly. Also, applying a thin layer of dilute dish soap to work piece to facilitate cleaning of small glass particles formed during etching process.