Laser Cutter Training Manual

The Foundry

Last Updated: 08/27/19

Foundry Laser Cutter: Epilog Laser Mini 18” x 12”

A laser cutter focuses a high energy laser beam downwards onto a flat material, resulting in a fast and accurate cut. The cutter can perform two different operations, or a combination of the two:

In a **Vector Cut**, the laser travels along a path and fires a powerful beam that cuts all the way through the material.

In a **Raster Etch**, the laser travels back and forth rapidly and fires a less powerful beam, engraving a shape row-by-row.
SAFETY

For the digital fabrication shop in general...

- **Shop Buddy:** You cannot use the laser cutter alone. For the laser, your shop buddy can be in the room with you or in the main workspace in a position where they can see you. If your shop buddy is not in the room, you must work with the door open.
- **Eye Protection:** You must wear eye protection when working in any shop space, to protect your eyes from anything that comes out of the machines.
- **Close-Toed Shoes:** Tools, bits of hot material, and even the machine itself can fall and close-toed shoes will protect your feet from cuts, bruises, burns, and breaks.
- **Long Pants:** Long pants will protect your legs from cuts, bruises, burns, and splinters that might come from handling these tools.
- **No Jewelry:** Rings, bracelets, dangling necklaces, watches, headphones and sweatshirt strings can all get caught in the machine, which can drag the machine off the shelf or drag you towards the machine.
- **Long Hair Secured:** Like jewelry, long hair can also get entangled, and potentially drag you into the machine.
- **No Food or Drink:** Some laser material and fumes, especially acrylic fumes, are toxic if consumed, and the residue can contaminate food and drink. Residue from food or drink will also make the machines gross.

For the Epilog Laser specifically...

- **Fire Hazard:** The laser can ignite flammable materials, including most of the materials it is used to cut. Be aware of potential fires, and always be able to access the spray bottle and the fire extinguisher.
- **Toxic Fumes:** Some fumes are toxic, and even ordinary smoke is hazardous to breath. Only cut with the ventilation on and connected to the laser. If something smells strange, turn off the machine, leave the vents on, and tell a Scout.
- **Bright Lights:** The laser beam's point of impact is very bright and can cause eye damage if you look directly at it.
- **Watch Actively:** The laser is an automatic machine but not a passive one. Never leave the laser when it is running: you must always be aware of what is happening in case of a fire.

Which fires are dangerous?

- A laser beam is very hot, and some small fires are expected. All fires should go out soon after they are lit, so the fire will look like it is following along with the beam. This type of fire is okay, as long as it is no bigger than the flame of a match.
- A fire that is larger than a match is a danger, as is a fire that doesn't follow the beam. In either of these cases, open the lid and spritz the flame with the spray bottle. The laser will automatically stop firing when the lid opens.
- If the spray bottle doesn't put out the flame, use the fire extinguisher. Don’t worry about hurting the laser cutter: it is tough enough to take a hit, and your safety is always more important than the machine.

**MACHINE ANATOMY**

- **Laser Head**: The part that moves to project the laser.
- **Lens**: Focuses the beam towards the material.
- **Depth Finder**: Determines the height of the bed during Auto-Focus.
- **Air Assist**: Extracts fumes at the beam’s point of contact.
- **Magnets**: Detect when the lid is open or closed.
- **Control Panel**: Set of buttons for setting up the laser.
CUTTING PROCEDURE

1. **Create a Vector file of what you would like to cut**
   a. Adobe Illustrator is a software that lets you create designs or import images and transform them into vector patterns. It also interfaces directly with the laser cutter. In Illustrator, create what you want to cut, or open an image and click “Image Trace.”
   b. The laser cutter recognizes any line with a stroke of 0.001” as a line meant to be cut. It recognizes any shape, or any line with a different stroke, as a shape that is meant to be rastered. This includes white shapes, but not transparent shapes – be careful of white shapes that the software is aware of, but that you can’t see.
   c. Set your strokes according to which lines are meant to be cut. With an Epilog laser like the one at the Foundry, the color of the illustrator file doesn’t matter. You can make your design in whatever colors you want, but be aware that they won’t come through in the rastering.
   d. If you are cutting multiple pieces, tessellate them closely to save material. Don’t let the pieces actually touch, but get them pretty close together.
   e. Using the artboard tool, shrink the board to be just barely bigger than your piece. The artboard is the material you will use, so you don’t want to use more than you need. Make a note of your artboard size – you’ll
need to know it later.

2. **Set up Settings (Foundry Computer in Illustrator)**
   a. Under "File," click "Print" to pull up a menu like this:

   ![Print menu](image)

   b. The only setting you need to choose here is the placement. It defaults to the center, but you should switch it to the upper left corner. It is much easier to line up a piece by the corner than by the center.

   c. From that window, click "Setup" to pull up this one:

   ![Setup window](image)
d. Make sure “Epilog Engraver WinX64” is selected. If it isn’t, select it. Then click “Preferences” to bring up the last window.

![Image of Preferences window]

e. This is where you will input most of the settings.
   i. The higher your Resolution, the higher quality your pattern will be, but the longer the cut will take.
   ii. Under Options, check the “Auto Focus” box and leave everything else as is.
   iii. For Job Type, indicate whether you are only vector cutting, only raster etching, or doing both.
   iv. For Piece Size, enter dimensions matching the size of your artboard.
   v. The last setting category is the most important. Raster Setting and Vector Setting are where you will set the Speed, Power, and Frequency of the cut, by consulting the chart on the wall.

f. What does each setting mean?
   i. Speed is how fast the head travels. A slower cut is more powerful but more likely to start a fire, since the laser fires in the same place for longer.
   ii. Power is actually misnamed. It's a setting that takes a lot of things into account, but it's also the one we care about the least. For most jobs, you will set the power to 100%. A few materials will warrant lower power for engraving.
   iii. Frequency is how quickly the laser beam oscillates. Without getting too much into the science, a higher frequency beam carries more energy, and is therefore hotter and can cut through more, but also carries a greater risk of catching on fire.

3. Setting up Laser Cutter (Before Cutting and Printing)
   a. Choose your material. If your piece will fit on scrap, please use scrap! Make sure the piece you have chosen is not warped or torn in the area you are cutting.
b. Press “Height Adjust” to unlock the bed. Press the down arrow to lower it a short distance – at least equal to the thickness of your material.

c. Square your material up to the top left corner of the honeycomb laser bed.

d. Press “X/Y Unlock” to enable the head to move freely. Press “Pointer” so you can see the location of the head, and manually move it to the upper left corner of your cut. As you do this, be careful to only push the head by the metal, without touching the mirror or the lens.

e. Note that the upper left corner of your cut is not necessarily the upper left corner of the bed, if you are cutting somewhere else on the piece. Once you have the head where you want it, press “Set Home.”

4. Test Run

a. With the pointer on, and the laser cutter lid open so that the beam cannot fire, press the green “Go” button. The laser will move as though it is cutting, but without actually firing.

b. There are two things you are watching out for here. First you want to make sure the laser won’t go off the bed and hit the metal frame. You can see scars where the laser has gone off the bed before. It’s bad for the machine, and your piece will turn out wrong.

c. Second, you want to make sure it cuts the right cuts, and in the right order. The laser is smart enough that it almost always gets the order right, so if it is cutting multiple lines it will cut the inside ones first so no piece gets cut loose and drifts around.

d. If you notice anything that shouldn’t be happening, adjust the file or the location of the zero, and do another test run.

e. At the end of each test run, the laser head should automatically return to the home position. If you pause a cut for some reason, it won’t do this automatically. Press the “Reset” button to return the head to home.

5. Doing the Cut

a. Once you have done a test run that you are satisfied with, let the head return to home, then close the lid. Closing the lid will engage the magnets, enabling the laser to fire.

b. Make sure you still have your PPE on – it’s easy to take your safety glasses off while prepping the cut, so double-check. Also make sure your shop buddy can still see you, since you’re about to do the dangerous part of the operation.

c. Turn the ventilation on using the box on the wall. Press “Reset” and then “Start.” The light should turn green and the vents will start sucking fumes out of the laser.

d. When you’re sure that all the safety protocols are in place, press the green “Go” button again. It will do the same path again, but this time the laser will fire.

e. As the cut is happening, watch it closely. Make sure it doesn’t catch on fire, and if it does, follow the fire extinguisher procedure – open the lid, use the spray bottle, and if that doesn’t work use the fire extinguisher.

6. Clean Up

a. When the cut is done, wait a little bit so the vents can take care of the last few fumes. Then you can turn off laser and the vents and open the
lid of the laser cutter. Remove your piece as well as any other material, like the piece you cut it out of. Don’t worry about touching the bed – because of its shape, it is not hot.

b. If the leftover material is usable, put it on the scrap shelf. Otherwise, either recycle it or throw it away, depending on the material.

c. When the looks like you would want to find it, you’re all done!

CUTTABLE MATERIALS

The Foundry provides these materials:

1. Plywood
2. Cardboard
3. Fiberboard
4. Paper
5. Acrylic

You can also cut some other materials, with assistance from a Scout:

1. Other Woods
2. Leather
3. Fabric
4. Cloth
5. Plastic
6. Delrin
7. Mylar
8. Fiberglass
9. Corian
10. Cork

Some materials can be engraved, but not cut:

1. Glass
2. Clay
3. Tile
4. Marble

Certain materials are extremely hazardous, and should never be cut:

1. PVC
2. Vinyl
3. Artificial Leather
4. Polycarbonate/Lexan
5. ABS Plastic
6. HDPE
7. PolyStyrene Foam
8. PolyPropylene Foam
9. Fiberglass
10. Carbon Fiber

Two types of material are special cases. Some metals are okay to engrave, but others can create toxic fumes and start fires. If you want to cut metal, ask a Scout. Painted materials can be used the same as the unpainted version, but check with a Scout first to make sure the paint isn’t a toxic or flammable one.