



**LASER SERIES:**

**Laser Cutting and  
Etching Safety and Basic  
Use**

**COURSE # LAS-101**

**Version 2.4**

## The Fine Print

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## Colophon

These materials were created electronically using Microsoft Word®. Art was produced using Adobe Illustrator®, Adobe PhotoShop® and SnagIt® for screen captures. The Arial® family of typefaces is used throughout these materials. These materials were written by Laura Mappin.

## Course Synopsis

In this Safety and Basic Use class (SBU), you will learn how to safely use the Laser Cutter/Etcher/Engraver to cut a shape out of paperboard. What you learn about the process for this material can be applied to any other materials you may use in the Laser Cutter. You will also have an opportunity to raster text onto an anodized aluminum tag.

***Time Required: 1.5 Hour***

### Tools Required

- Epilog Laser Cutter
- Computer with CorelDraw
- Ruler (or tape measure)
- Note taking paper and pen/pencil

### Materials Required for Class (Provided)

- Material to cut and etch/engrave

### Materials to bring when you use the Laser Cutter as a TechShop Member

- Material to cut or etch/engrave
- Notebook to record results/parameters for next time
- Ruler or tape measure
- Washers or quarters to weigh down light materials

## SAFETY

### General Safety

- ◇ Eye protection is required when working with anything that might get into your eyes, like metal shards, chemicals, sawdust
- ◇ Closed-toe shoes must be worn at all times
- ◇ Long sleeved shirts should be worn when working with chemicals, short sleeved shirts should be worn for anything with a rotary motor (saws, mills, lathes, etc.)
- ◇ Never leave a machine running and unattended

### Shop Etiquette

- ◇ Never talk to anyone while they are working with a piece of equipment
- ◇ Leave the area you are working in cleaner than when you arrived
- ◇ Never leave a machine running and unattended
- ◇ Begin final clean-up and store your project no later than 11:30 pm

### Equipment Specific Safety

- ◇ You can cause great harm to yourself and burn the building down with these machines. If you follow the safety rules, the chance of you causing this should be close to zero
- ◇ Laser has its effect by heating your material. Your job can change in seconds with the accumulation of energy – HEAT – in your material. ALWAYS MONITOR YOUR LASING JOB! NEVER leave the room while a job is running.
- ◇ Some materials, like wood, are burned in order to achieve an etch or cut. Some materials, like acrylic change their chemical structure given the addition of this laser applied focused heat. In all cases, some light may be visible. This light at the point of lasing may be ok as long as it stays with the motion of the laser. If a flame appears while the laser is in operation, you probably have the power set too high or the speed set too low. Any flame that lingers is cause for concern.

## Follow steps below to get rid of lingering flame.

### Degrees of fire and possible responses:

- Stop the laser by opening the lid, turning off the on-off switch, or pushing the “Stop” button. Opening the lid stops the laser from lasing although the head will keep moving and you will lose the data you were working on and will need to start again.
- Opening the lid is preferred because if the flame continues, you’re ready for the next step:
  1. Blow it out!
  2. Snuff it out while still in the machine, using a fire blanket, coat, or other such item that may be at your immediate disposal.
  3. Turn off laser.
  4. Call 911, alert others, and evacuate building.

Use wise judgment and common sense when responding to a fire.

- ◇ You **MUST** stay in the room while you are lasing, no matter how long your job takes. If you need to leave, you **MUST** either pause the job or get a qualified person to monitor your job for you. The danger of fire is ever present.
- ◇ Remember you could be in this room while someone else is carelessly lasing and have to deal with their fire. Do not put yourself or your fellow TechShop members in jeopardy. If you see that someone else has left their job, for the safety of everyone in the building, bring it to the attention of TechShop staff.

## Epilog CO<sub>2</sub> Lasers at TechShop



<b>Helix Laser</b>
45 watts
Faster relative maximum speed
24" x 18" bed size
CorelDraw X3
Easier registration
Sending job to "printer" – user must press "Go" button to run job.
Laser machine stays in focus mode until user presses "Reset"
Ready to receive a job if it says "Job:" on screen. Press "Reset" button if needed.
Recommended for jobs that require finer quality cuts

As a finer point to the overall TechShop rules, to send jobs to the lasers, you must use the PCs next to each laser. You may not use your own laptop or any other PCs. This is a safety issue to ensure that the job sent to the laser is the one expected by the person physically loading the laser. Use a thumb drive to transfer your work from your design computer to the laser cutter computer.

Design work is not permitted at the laser computer. These are provided for running laser jobs. Either work on your own personal computer, or use one of the computers in the computer lab or the hub.

## Machine Tour

This is the front panel of the laser cutter:



The **Go** button starts printing the job – Go will also continue a job that has been paused using the Stop button.

**Stop** is a pause button; it stops the job at the end of the current vector. Pressing the Go button will continue the job exactly where it left off.

The **Reset** will move the head back to the origin.

The **Job** button changes the machine to the mode it needs to be in to lase a job.

The **Focus** button changes the machine to the mode it needs to be in to set or adjust the focus.

The **Up** and **Down** arrows move the bed up and down to set the focus.

The **Pointer** turns on/off the red pointer light.

### Inserting the Tray into the Laser Cutter:

1. Push on the black back on the edge guards to flip them up to insert or remove the tray (this is FAR easier than trying to lift them by the front edge). Don't forget to flip **all 3 guards back down** once the tray is in place.
2. The bottom of the tray has a thin strip of aluminum around the outside edge; the tray goes in with these up in the machine.
3. Put the tray in back edge first, and push back and down gently so it sits properly and avoids hitting the focus head. Don't forget to flip **all 3 guards back down** once the tray is in place.

**NOTE:** The red tape tells you that the edge guards are still up!

RED tape means the edge guards are UP!



## MATERIALS LISTS

Start with clean material on the Approved Materials List. Avoid any toxic or flammable coatings on your materials.

### Laser Approved Materials List

MATERIAL	ENGRAVE/ETCH	CUT
Wood	YES	YES
Wood Veneer	YES	YES
Acrylic	YES	YES
Delrin (hard plastic)	YES	Only if it's thin enough
Melamine	YES	YES
Mylar	YES	YES
Corian	YES	YES
Rubber	YES	YES
Glass	YES	NO - cannot cut glass
Ceramic	YES	NO - cannot cut ceramic
Tile	YES	NO - cannot cut glass
Marble	YES	NO - cannot cut marble
Coated Metals	YES	NO - cannot cut metals
Anodized Aluminum	YES	NO - cannot cut metals
Painted Metals	YES	NO - cannot cut metals
Cloth of natural fibers	YES	YES
Leather	YES	YES
Matte Board	YES	YES
Paper	YES	YES
Pressboard	YES	YES
Cork	YES	YES
Chocolate	YES	NO - it just melts onto the metal bed
Pumpkin	YES	NO - too much water in pumpkin to be effective
Swiss Chard	YES	NO - too much water in swiss chard to be effective
Potato	YES	NO - too much water in potato to be effective
Tortilla	YES	YES

## Laser Unapproved Materials

Some materials are not lase-able because they:

- Flash fire
- Melt
- Give off poisonous gases

PVC	Contains chlorine, will produce hydrochloric acid and damage you and the machine's optics!
Vinyl	Contains chlorine, will produce hydrochloric acid and damage you and the machine's optics!
PVC Foams	Contains chlorine, will produce hydrochloric acid and damage you and the machine's optics!
Foam Core	Modern foam core is usually made of PVC, so it contains chlorine, will produce hydrochloric acid.
Thick Styrofoam	Thicker than about 1/2" is past the laser's focus range, so the energy spreads out and can set the foam on fire!
Polycarbonate or PETG	Does not cut. TAP Plastics sells both polycarbonate and acrylic. Be Careful! Read your label. Polycarbonate trade name is Lexan
ABS	Gives off hydrogen cyanide
polymer clay	Contains pvc.
Silver	NO NO - cannot cut metals
Fiberglass	Get approval from TechShop staff
Metals	Cannot be etched by this laser; some metals may change appearance but not predictable enough to usually be usable as an engraving. If someone claims they are etching metal, they are probably etching a metal with a plastic coating or anodized surface or other etchable covering.

Do not lase anything that is not on the Approved Materials List.

If you do not know what your material is made of, **DO NOT lase it**. Research it. Ask the vendor who sold it to you. Research MSDS (more info on last page of this handout) – Materials Safety Data Sheet – to find out what gases are created when it combusts. MSDS documents are often available on the website of the vendor that sells the material. Ask TechShop staff if you are not sure.

**NOTE:** Tap Plastics sells a variety of plastics. Be sure you buy "acrylic" and not ABS or PVC. Ask Tap Plastics staff before you purchase. Use other ways like a bandsaw, the CNC mill, or the plasma cutter at TechShop to cut unlaserable materials.

**NOTE:** Generally the plastic with the brown paper on the back that says Chemcast is fine to etch. But be careful... The extruded acrylic with the blue paper might be polycarbonate, and that is NOT OK to etch!

## Speed and Power Recommendations

Material	300 DPI RASTER ENGRAVING	400 DPI RASTER ENGRAVING	600 DPI RASTER ENGRAVING	VECTOR CUTTING
	SPEED/POWER	SPEED/POWER	SPEED/POWER	SPEED/POWER/FREQUENCY
Wood - Cherry - Alder - Walnut	25/90	35/90	45/90	1/8" (3mm) - 35/90/500 1/4" (6.4mm) - 10/90/500 3/8" (9.5mm) - 4/90/500 (two passes may produce better results)
Acrylic	100/55	100/45	100/35	1/8" (3mm) - 15/90/5000 1/4" (6.4mm) - 6/90/5000 3/8" (9.5mm) - 3/90/5000 (two passes may produce better results)
Anodized Aluminum	100/90	100/80	100/70	N/A
Brass - Painted	100/55	100/45	100/35	N/A
Marbelized Painted Brass	100/65	100/55	100/45	N/A
Corian or Avonite	25/90	30/90	35/90	1/8" (3mm) - 30/90/5000
Delrin Seals	100/60	100/50	100/40	70/90/1000
Glass	25/90	35/90	45/90	N/A
Laserable Plastic	100/65	100/50	100/40	30/75/500
Leather	100/55	100/45	100/35	1/8" (3mm) - 40/50/500
Marble	20/90	25/90	30/90	N/A
Mat Board	100/65	100/45	100/30	50/50/500
Melamin	50/90	60/90	70/90	N/A
Stainless Steel W/ Cerdec Coating	20/90	25/90	30/90	N/A
Rubber and Rubber Stamps	20/90	30/90	40/90	20/90/100

## BASIC OPERATION

A laser cutter is used to etch, engrave, or cut a variety of materials. Be sure to see the approved and unapproved lists of materials for the laser cutter before purchasing or working with the material in the laser cutter.

Operation of the Laser Cutter:

- ◇ Do not use auto focus, **DO NOT USE AUTO FOCUS, DO NOT USE AUTO FOCUS!!!** – It can fail and then the machine is unusable for hours or days until external support fixes it.
- ◇ Each TechShop laser cutter is equipped with an external fan to remove toxic fumes. For your safety, always make sure the fan is running when operating the laser cutter. It should come on when you turn on the laser. If you do not hear it, check with TechShop staff before running a laser job.
- ◇ Each TechShop laser cutter is a finely calibrated piece of machinery. Please close the lids quietly and do not push or jar the machines at any time. Do not lean on or press on the tray. **BE SURE** the edge guards are in the down position before operating.
- ◇ Raster - Raster will account for gray-scale or colors. Lighter colors and lighter gray scale will receive less laser energy.
- ◇ Vector - Vector parameters will be applied to every object in your data file that has the attribute of “Hairline”. Raster parameters will be applied to everything else. Think of Raster as photo or GIF, JPG, BMP – pixel-based. Think of Vector as curves, lines, geometric objects. But remember – just because you might think of it as vector, if it does not have the attribute of “Hairline”, it will not be cut; it will be etched instead.
- ◇ When using the Speed and Power Recommendations, it is best to start on the low end of the Power spectrum. You are less likely to have a fire situation, and it causes much less duty cycle on the laser tube, which will ultimately cause the laser to run better for longer.

### Set home to a different table location

Set home for a material that doesn't fit underneath the laser's standard home location.

Examples:

- you want to engrave on a particular wood grain location
- you want to work in an already used piece of material
- you want to lase something that cannot be butted up square with the table straight edges (leather case, bowling ball?)

To set home for these conditions, use “X/Y Off”:

- a. Make sure Laser is on and ready to go.
- b. Press the X/Y Off button on the front panel of the Laser.

- c. Press the Go button on the front panel of the Laser.  
If the carriage or lens doesn't move easily, **SOMETHING IS WRONG**.  
Check the panel for a message.
- d. Turn on the pointer to see where the laser will be.
- e. Move the carriage and lens to desired location. **DO NOT TOUCH OPTICS!**
- f. Press the Set Home button on the front panel of the Laser.  
This establishes a new home position that matches with the upper left corner of your file in CorelDraw.

**NOTE:** Pressing the RESET button now will move the carriage to the home position you established. To get back to the Laser's original default home position from power on, press the Set Home and Reset buttons simultaneously and then press the Go button.

## PROJECT DESCRIPTION

For this class, you will be given paperboard, and you will send artwork to the laser cutter to cut and etch on the paperboard.

If you have **ANY** questions about any operation or task, be sure to ask your instructor or another TechShop staff member before proceeding.

### Preparing for this project

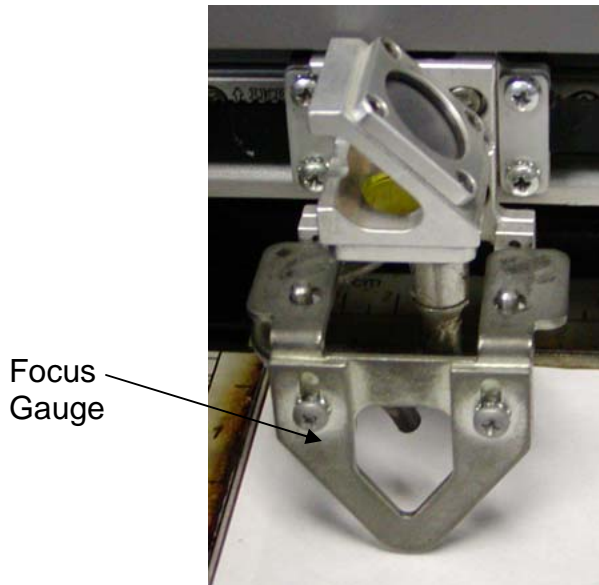
The Epilog Laser cutter is controlled by software and is installed as a printing device.

1. Prepare the computer:  
The computer is normally on. Make sure the monitor is also on.
2. Turn on the laser cutter:  
The On/Off switch for both laser cutters is on the left side. Make sure you hear the exhaust fan running. If not, talk to TechShop staff before running any laser job.
3. Check the lens:  
A dirty lens can affect your power settings significantly and can also be a source of fire. If dirty, alert TechShop staff so they may clean it.
4. Check the metal bay, under the vector grid (sometimes called “the tray” – the metal mesh table top), and clean with a vacuum if necessary. Bits of material lying about can be a source of fire. Clean throughout your work session if you are creating small bits of material.

**NOTE:** Don't forget to lower the **3 edge guards** after placing the vector grid.

5. Place the cardboard provided at the upper left corner of the grid. **BE SURE** to use only approved materials
6. Set the focus manually:  
Perform these steps in the following order to ensure that you **DO NOT** bump the lens assembly with your material or with the laser table:
  - i. Choose Focus mode by pushing the **Focus** button on the front panel.

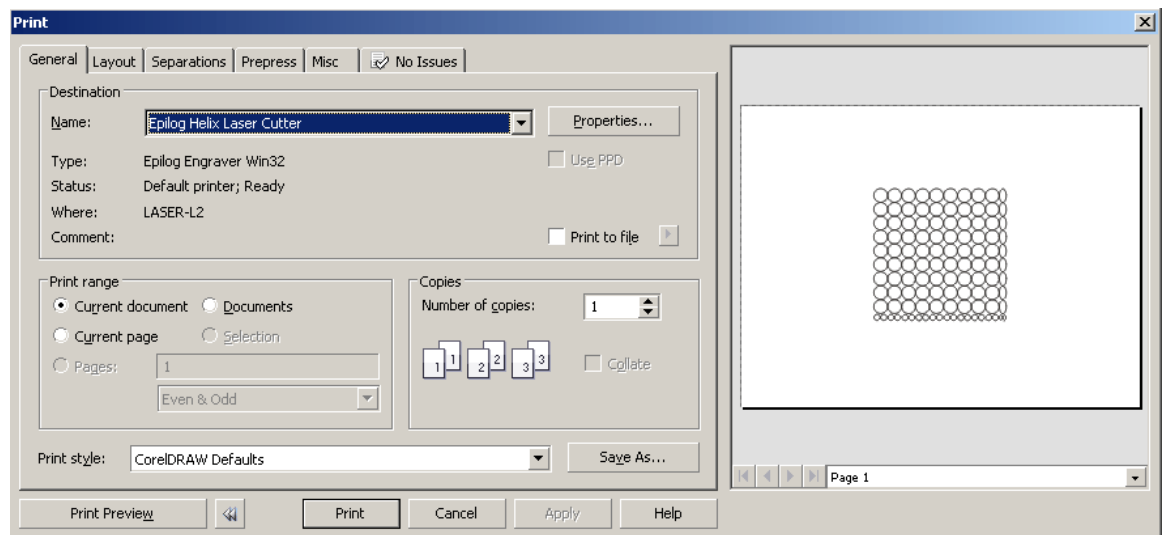
- ii. Press the **Down** arrow button on the front panel to move the table down more than enough to accommodate the thickness of your material.
- iii. Place the focus gauge on top of the magnetic plate (near the front of lens assembly) so that the tip hangs straight down. The focus gauge is magnetically held onto the top of the lens assembly.
- iv. Place your material under the focus gauge.



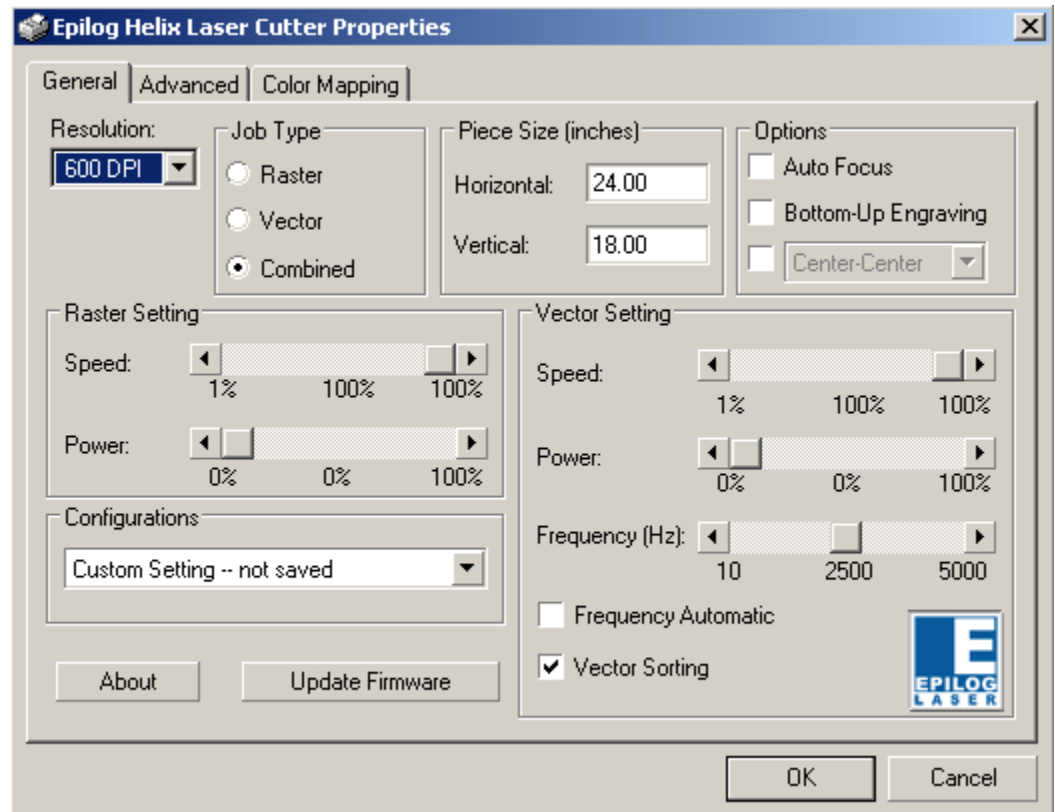
- v. While in focus mode, press the **Up** arrow button and **CAREFULLY** move the bed up, being sure not to run into the lens assembly. When the table gets close to the focus gauge, move in small increments to set the focal plane to be the top corner of your material if you are etching or if you are cutting thin materials; set it to the middle of your material if you are cutting 1/4" or 3/8". You may look for motion at the top of the focal gauge rather than watching the bottom to touch your material.
- vi. **BE SURE** to turn the focus gauge over after you have set the focus.

## Getting Started

1. Attach your USB thumb drive to the computer.
2. Launch CorelDraw on the computer.
3. Bring in your file:  
From the File menu, choose Open, locate your thumb drive and select your file. Click import.
4. Setting the parameters:
  - a. From the File menu, choose Print. The laser will show up as a printer.



b. Click the Properties button. The Properties window appears:



- i. Set the following for this job, using the chart on page 12 as starting place:
  1. DPI (dots per inch) – affects both raster and vector art.
  2. Raster / Vector / Combined
    - a. To lase just raster work, choose Raster.
    - b. To lase just vector work, choose Vector.
    - c. To lase both at once, choose combined.
  3. Raster Speed
    - a. Refer to the chart on page 12 or posted in the Laser Room to identify the starting speed for the material you are working with.
  4. Raster Power
    - a. To see where your job will be lased without actually lasing it, set Power to 0.
    - b. Refer to the chart on page 12 or posted in the Laser Room to identify the starting power for the material you are working with.

5. Vector Speed

- a. Refer to the chart on page 12 or posted in the Laser Room to identify the starting speed for the material you are working with.

6. Vector Power

- a. To see where your job will be lased without actually lasing it, choose Power of 0.
- b. Refer to the chart on page 12 or posted in the Laser Room to identify the starting power for the material you are working with.

7. Frequency should be set to 2500.

8. Frequency Automatic should **not** be checked.

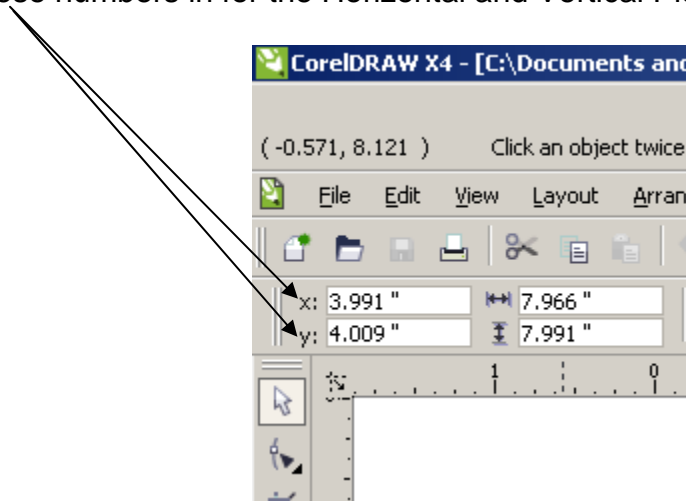
9. Vector Sorting should be checked.

10. Auto Focus should **NEVER** be checked.

11. Piece size should be set to your document dimensions:

- a. To change the size of the cutting dimensions, at the top of the screen, type in the vertical and horizontal sizes and make sure to press Enter to set the new dimensions.

**HINT:** If your artwork is selected (Ctrl-A to select All), the x and y size of it will be displayed on the top line of CorelDRAW, you can just type these numbers in for the Horizontal and Vertical Piece Size:



**Vector** parameters will be applied to every object in your data file that has the attribute of "Hairline". Think of Vector as curves, lines, geometric objects. But remember – just because you might think of it as vector, if it does not have the attribute of "Hairline", it will not be cut; it will be etched instead.

**Raster** parameters will be applied to everything else. Think of Raster as a photo or GIF, JPG, BMP – pixel-based. Raster will account for gray-scale or colors. Lighter colors and lighter gray scale will receive less laser energy.

DPI – dots per inch:

#### RASTER

- affects raster quality
- if you increase the DPI, you linearly increase the energy applied to rastered areas
- **EXAMPLE:** an increase from 300 dpi to 1200 dpi is an increase of 400% - A LOT! You probably don't want to increase this much at one time

#### VECTOR

- affects vector smoothness
- does not affect energy applied
- does increase time but not as high as linearly

Consult the documentation posted on the wall in the Laser Room or on page 12 of this handout to determine what speed and power settings might work for your material. Remember, these are just a starting place, you will need to experiment.

**IMPORTANT NOTE:** Some experimentation will be required to get the desired result. Start at a lower energy level and work up to those parameters.

Always bring extra scrap material with you that is identical in quality to what you want to finally lase. Use this scrap to test and verify that the machine and your material are behaving as you expect.

5. Print the job
  - a. Click the Print button on the Print screen.
  - b. Wait for the green Data light on the laser's front panel to go off. Your job is now downloaded to the Laser Cutter.
  - c. Push the Go button to start cutting.
  - d. Watch your job as it is lased. Ensure that everything is going correctly.

## DOG TAG PROJECT DESCRIPTION

For this project, you will need several anodized aluminum dog tags (available from the MakerShed in TechShop) and the Dog Tag jig that is available for checkout from the Front Desk.

If you have **ANY** questions about any operation or task, be sure to ask your instructor or another TechShop staff member before proceeding.

### Preparing for this project

You will want to spend some time on one of the Hub Computers, designing your graphic or text. Locate and open the CorelDraw file named DOG\_TAG\_Names.cdr

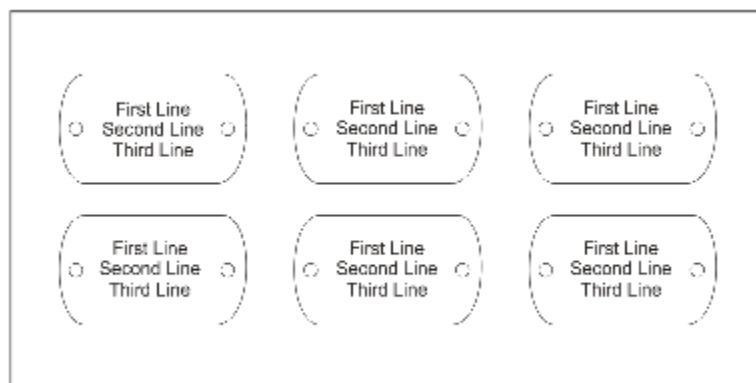
Use your thumb drive to take your finished work to the Laser Cutter (don't forget to reserve time via the front desk, the laser cutters are in very high demand).

### Getting Started

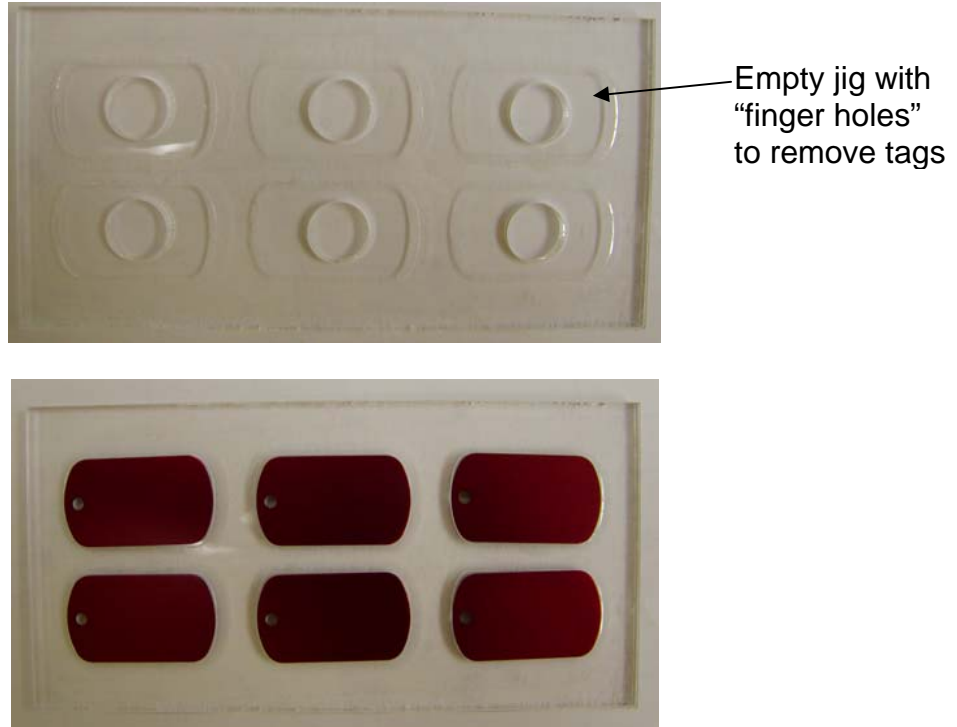
1. Check out the Dog Tag Jig from the Front Desk.
2. On the Hub Computer, open the file TAG\_Names.cdr and enter the text you want to engrave on your 6 tags.

**NOTE:** If you want to print less than 6 tags at once, BE SURE to delete the other text blocks so they don't engrave on the jig.

Each tag has room for up to 3 lines of text. Be sure to check all of your text before printing to the Laser Cutter...if you put too much text on a line, it may bunch up or overwrite other letters.



3. Place the tags in the jig and the jig in the upper left corner of the bed.



4. From the File Menu, choose Print. The Print window will appear.
5. Click the Properties button on the Print window.
6. The tags are **anodized aluminum**, so, you should set the Resolution to your desired output (300DPI, etc), the Job Type to Raster, and the Raster Speed and Power to:

DPI/Speed/Power	DPI/Speed/Power	DPI/Speed/Power
300/100/90	400/100/80	600/100/70

NOTE: This info came from the chart on the bulletin board in the Laser Room and/or page 11 of this handout.

7. The Piece Size is 8 x 4, which is the size overall of the jig.
8. Click OK to accept the new Properties you have just set.
9. Click Print to print this job.

BE SURE to return the jig to the Front Desk along with the Laser Tray and Focus.

## **Last Step: Cleanup**

1. Vacuum under the wire mesh table if your session produced small parts that fell through the mesh.
2. Check the lens: This lens is NOT user cleanable. If the lens is dirty, alert the Front Desk or other TechShop staff so they may clean it.
3. Return the tray and focus to the Front Desk.

## **Questions:**

- Given all other things equal, if you increase DPI, what effect will that have on your vector art? What changes might this make you consider for your vector art?
- Given all other things equal, if you increase DPI, what effect will that have on your raster art? What changes might this make you consider for your raster art?
- Power setting can range from 0% to 100%. What is the lowest energy setting you could choose for Power?
- Speed setting can range from 1% to 100%. What is the lowest energy setting you could choose for Speed?
- The Summit laser is 25 watts but moves slower than the Helix, a 45 watt laser. How do the speed and power parameters of these two lasers compare? In other words, if you knew how to set speed and power parameters to cut a material on the Summit, how would you modify the parameters to cut it on the Helix?

## COOL LINKS

[www.EpilogLaser.com/tech\\_library.htm](http://www.EpilogLaser.com/tech_library.htm) has great technical info and projects for use with the Epilog Laser.

[www.epiloglaser.com/sample\\_club.htm](http://www.epiloglaser.com/sample_club.htm) has great projects for the laser Cutter.

[www.laserbits.com](http://www.laserbits.com) offers laser specific materials for etching and cutting.

[www.instructables.com](http://www.instructables.com) offers many projects that would be suitable for the laser cutter.

[www.tapplastics.com](http://www.tapplastics.com) to research whether your material can be used on the laser cutter and it is also a good place to purchase acrylic of all kinds.

Check out the TechShop store for cool anodized aluminum items, like luggage tags, golf divot tools, license plates, and much more!

## WHAT'S NEXT?

After successfully completing this **LAS-101 Laser Cutting and Etching SBU**, you might be interested in these classes:

**LAS-201 Laser Engraver Rotary Attachment SBU**

**LAS-203 Laser Cutting and Etching 2**

**LAS-301 Fabric Etching and Cutting on the Laser**

**LAS-302 Make a Messenger Bag with the Sewing Machine and Laser Cutter**

**WLD-104 CNC Plasma Cutter SBU**

**MIS-104 Powder Coating SBU**