

Laser Cutting and Engraving

True to its name, a laser cutter is a machine which uses a high powered laser to burn into and sometimes through materials. The machine used in the Library is an **Epilog Mini 12"x18" laser engraver**. People refer to these machines as either "laser cutters" or "laser engravers", but they can do both! We will refer to these two modes as engrave and cut



Engrave - engraves photographs, shapes, and text into the top layer of a material

Speed and power settings determine the depth and color of the engraving. Some materials darken when engraved (sometimes dramatically) and some do not. Image resolution also affects color and depth- an image engraved at 600 DPI has twice as many dots as one engraved at 300, and will look sharper, build up more heat and remove more material.



Cut - cuts a thin line all the way through a material

Generally, our laser can cut materials up to 1/4" thick. Speed and power settings determine the depth of the cut, while frequency affects how much heat builds up on the material. Low frequency is desirable for materials like wood and paper that can char, while high is best for materials like acrylic where melting creates a clean edge.



Combined Mode

In combined mode the laser will engrave first and cut second.

Here are some examples of things you can make →

They can be 2D or 3D, soft or hard, organic or synthetic, and even flat or round!



Laser Cutter: Dangers and Mishaps

The Laser Cutter is quite safe and you are *almost totally free to experiment without risk*. This page lists the exceptions to that. Aside from these items, the worst thing that can happen is losing a bit of time or material. Plus, they're all pretty obvious once you know them 😊

1. The laser can start fires 🔥

- The laser cutter **must always** be monitored while in use. Pause before leaving the room.
- Small fires (a few birthday candle sized) are **OKAY**
 - If you're worried, just pause the print and blow them out
- Big fires (spreading) are **BAD**
 - Stop the machine
 - There is a tech-safe fire extinguisher beside the whiteboard, or
 - Notify staff, and exit the building

2. Appropriate *materials* and *power settings* must be used

- Failing to do so can create ☠️ **poisonous gasses** ☠️, 🔥 **fire** 🔥, or damage the laser
- A table of materials can be found on *Page 24*. Material settings can be found on *Page 27*.

3. The laser creates fumes

- The secondary exhaust fan **must always** be used for cutting
- Doors **must be** closed
- Windows *must be* closed, especially if there are strong winds

4. The laser is bright

- Looking at it is fine, but be mindful of how long you stare (not all day every day)

5. The laser is hot

- Be careful when removing materials such as glass or metal immediately after they've been engraved

6. Don't reach in while things are moving

- Fingers can get pinched, the machine can get hurt too. Pause the job first!

7. Engraved glass creates *glass powder*

- Clean glass projects before touching the engraved area

Table of Contents:

| | |
|--|----|
| 1. Project Considerations..... | 4 |
| 2. Basic Adobe Illustrator Laser Project..... | 5 |
| a. The Goal (Rasters and Vectors) | |
| b. Starting a New Project | |
| c. Basic Computer Commands (Copy, Paste, Undo) | |
| d. The Workspace (Artboard) | |
| e. Window Panes (Properties, Layers, Align) | |
| f. Basic Tools (Move, Shapes, Rotate, Text, etc) | |
| g. Cutting Stroke Width (less than .08 pt / .001 in) | |
| h. Print Settings | |
| 3. Running the Machine..... | 12 |
| a. Power On | |
| b. Choose Your Print | |
| c. Choose Your Material | |
| d. Choose Your Printing Setup | |
| e. Place Your Material | |
| f. Control Panel | |
| g. Uploading and Running the Job | |
| h. While the Job Runs | |
| i. When Done (Cleanup) | |
| j. Finishing Artistic Touches | |
| 4. Advanced Machine Techniques..... | 16 |
| a. Changing the Insert | |
| b. Printing at Arbitrary Locations | |
| c. Resetting to Top Left Corner | |
| d. Centering a Print at Arbitrary Locations | |
| e. Manual Focus | |
| f. Rotary Printing | |
| 5. Common Tech Issues..... | 22 |
| a. Print Beeps Complete Having Done Nothing | |
| b. Vectors are Being Etched Instead of Cut | |
| c. Laser Not Cutting All the Way Through | |
| d. Plunger Folded, Machine Jammed | |
| e. Laser Starting in Wrong Position | |
| f. Print Showing Up in Wrong Location | |
| g. Position Error | |
| h. If All Else Fails | |
| 6. Table I: Printing Materials - Good and Bad..... | 24 |
| 7. Table II: Material Settings..... | 27 |

1. Project Considerations

For the most part, you can create whatever your imagination is inspired by, but there are a few limitations and considerations which are great to start with:

- **It always takes longer than you'd expect**
 - Give your time estimates ample tolerance (1.5x)
- **Reservations take priority**
 - While it is totally okay to drop in during Library Hours, you'll still have to put in a reservation
 - You can reserve time at <https://estesvalleylibrary.org/makerspace/>
- **There is a maximum size for materials**
 - 12" x 18" for flat materials and ¼" maximum thickness
 - The size of a wine bottle for rotary printing
 - If your project is too big, ask staff for ways to make it work
- **Low contrast printing is hard**
 - Projects are best if they are *black and white*, with no grays or gradients
 - Getting projects with more colors than these two requires *Advanced* strategies that can be found in the "Advanced Laser Software Strategies" Binder
- **The Laser needs to heat up**
 - If you start a project from a cold laser, the first few seconds of the engraving will be blank. Testing on cardboard is recommended.
 - It takes about *5 seconds of cutting* or *45 of engraving* to heat the laser
 - Once heated, it should stay so for a few hours
- **The printing program "Adobe Illustrator" requires specific file types**
 - The types are typically `.svg` or `.ai`
 - All standard image types can be imported (`.png`, `.jpg`, `.bmp`, etc)
 - For other file types, you may encounter issues with the scaling and size on import
- **Know your materials**
 - Bad materials can create ☠ **poisonous gasses** ☠, or damage the laser
 - Review the table of materials which can be found on *Page 24*
 - If you're unsure, ask staff
- **Have enough material**
 - Bring more than you think you need
 - There are often scrap materials in cabinet 10
- **Test on real material if you can**
 - Testing on cardboard is great, but many things change when using the real material

2. Basic Adobe Illustrator Laser Project

2a. The Goal (Raster vs Vector)


The overall goal of using Adobe Illustrator is to make a project containing layers for **etching** and layers for **cutting**.

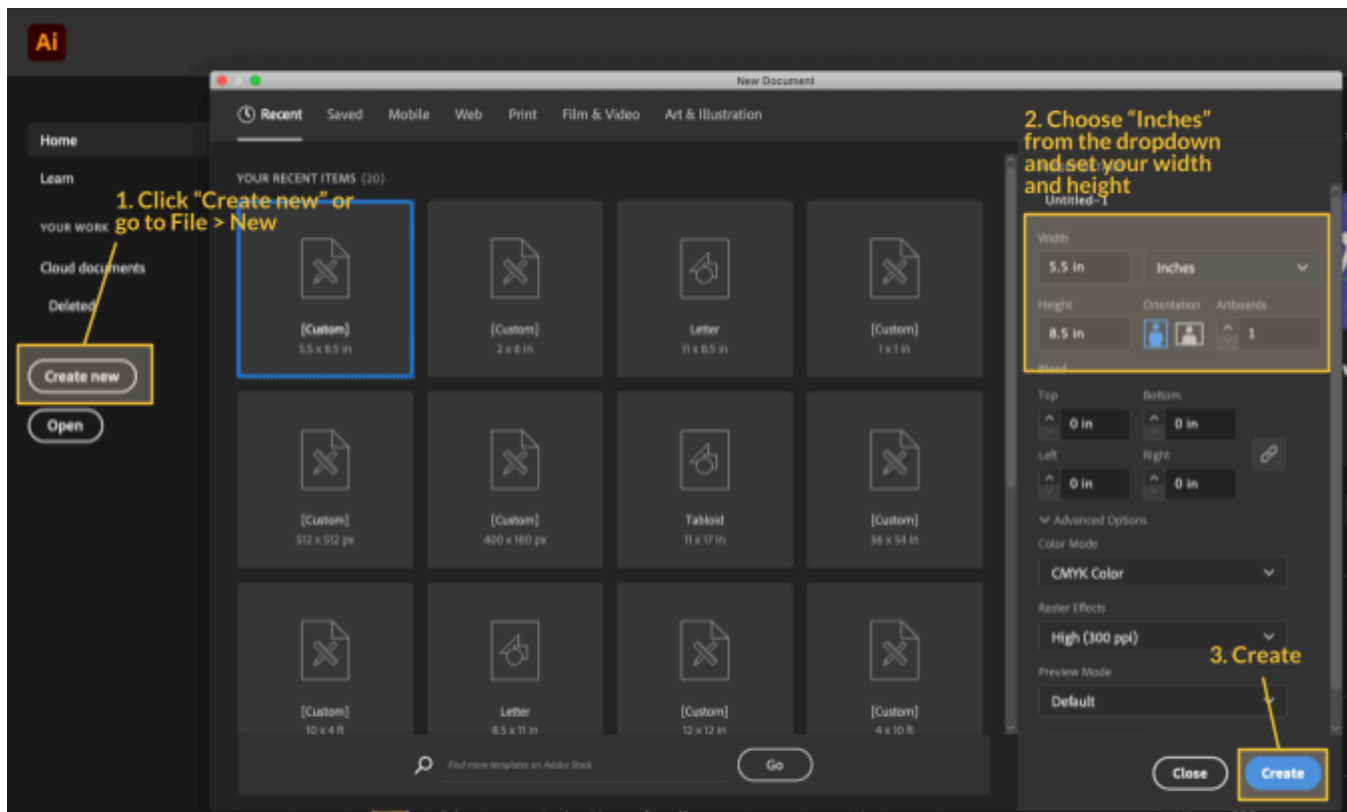
In order to create these layers, we use two different types of computer imagery called **raster** and **vector**. A **raster** image is just a basic picture: it is like handing someone a photograph. But a **vector** image is different. It is like teaching someone how to draw a 5-point star. Once they know the set of instructions on how to do it, they can draw one in any size and any color with any tool. This is the value that **vectors** have over **rasters**. As the saying goes: "Teach a person to fish..."



We can also use these **vector** layers to tell the laser what lines to cut. There is more information about cutting in the **Stroke Width** section on Page 10

2b. Starting a New Project

1. Open Adobe Illustrator by finding and double-clicking its icon on the desktop → 
2. In Adobe Illustrator, use the **Create New** button or go to **File > New**
3. There are options on the right to make your **artboard** the same size as your material piece. This will help you place your designs exactly where you want them to appear on the material.
 - You can also resize your **artboard** later (details in Section 2f)
4. In the bottom right hand corner, click **Create**



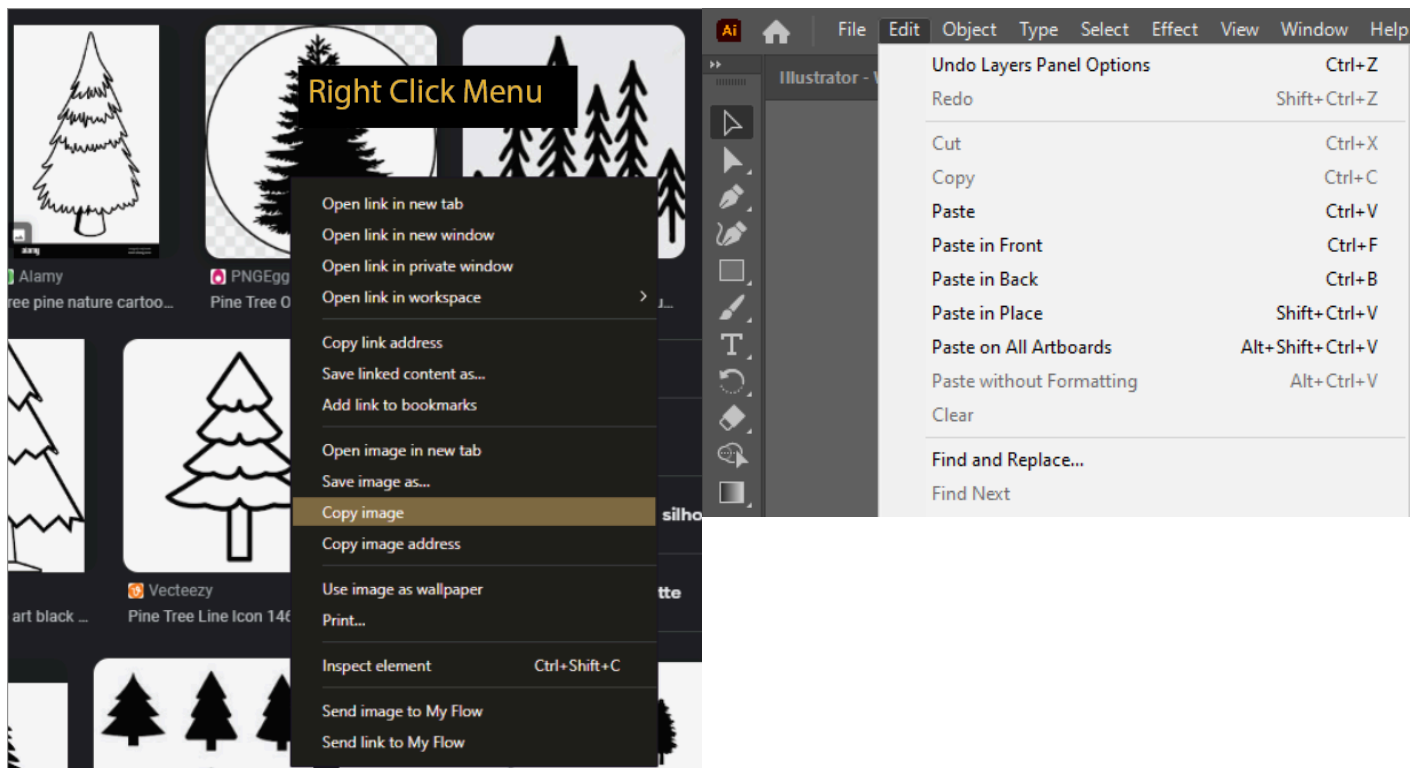
2c. Basic Computer Commands (Copy, Paste, Undo)

There is a set of standardized computer commands that are used by almost all programs and are essential to know about. These commands relate to three concepts:

- **Selection** is whatever text or images you're currently highlighting.
- **The clipboard** is a temporary storage space for moving things from one place to another. Imagine a box on your desk that can only contain a single thing at a time.
- **Edit history** is a list of actions you've taken within a program. They allow you to go back in time.

In order to interact with **the clipboard** and **edit history**, there are various **commands** which can be found under the **Edit** menu located in the **topbar menu** at the top of your program. Alternatively, these **commands** can often (but not always) be found by *right clicking* things you want to copy or places you want to paste. If one way doesn't work, try the other. The commands are:

- **Copy** - Takes a highlighted or selected item and puts it on your **clipboard**. Anything already there will be replaced.
- **Paste** - Duplicates whatever is on your **clipboard**. This can be done as many times as you like.
- **Undo** - Goes back in **edit history** *one action* at a time. If you make a mistake, do not fret! Undo is here to help!
- **Cut** - Similar to **Copy** but it removes the selection from where it is when moving it to your **clipboard**

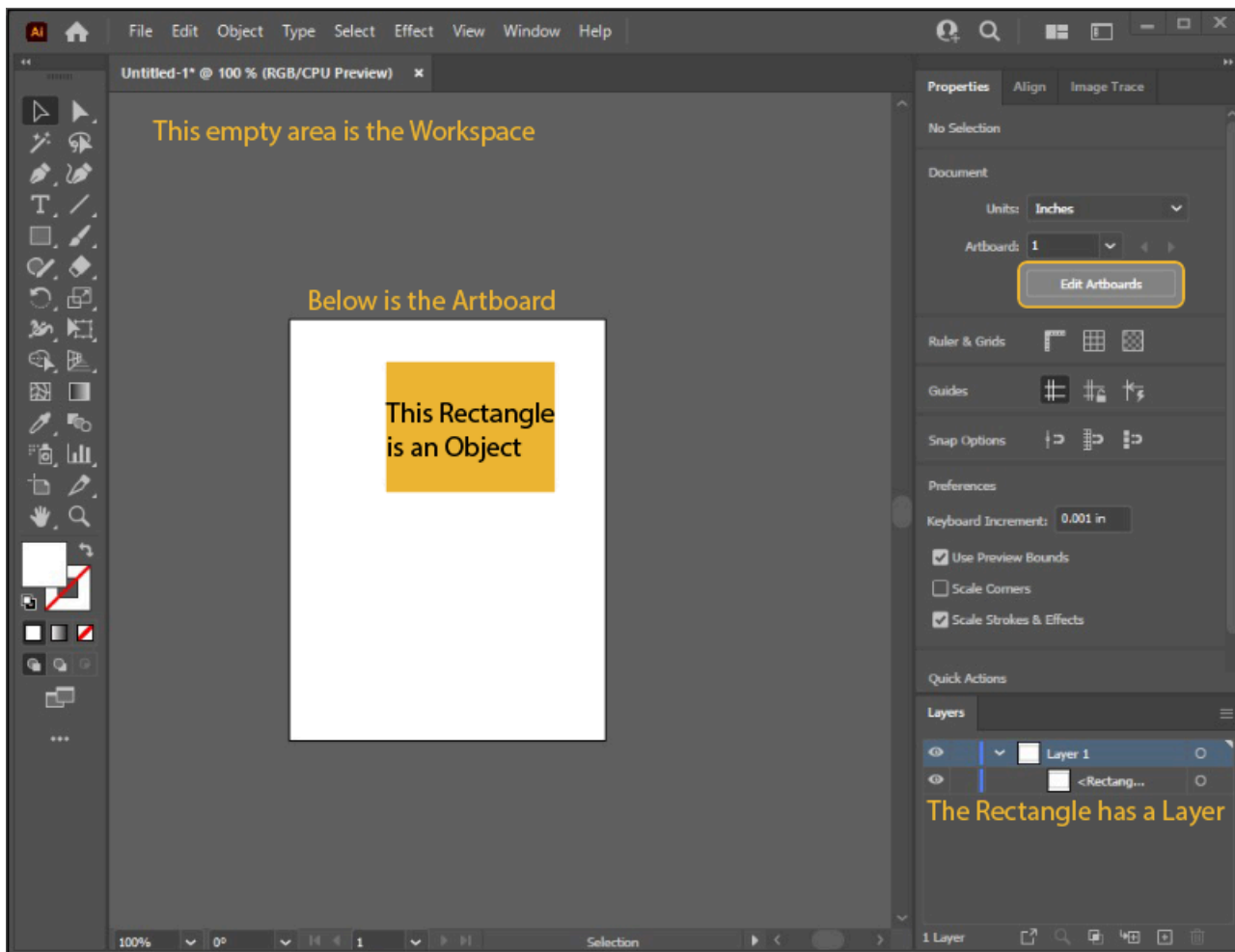


2d. The Workspace (Artboard)

Imagine a desk with a sheet of paper that you're pasting various cut-outs and clippings on in order to create a collage.

In this metaphor, your desk would be the **Workspace**, your sheet of paper would be the **Artboard** and the cut-outs and clippings would be **Objects** which each exist on different **Layers**.

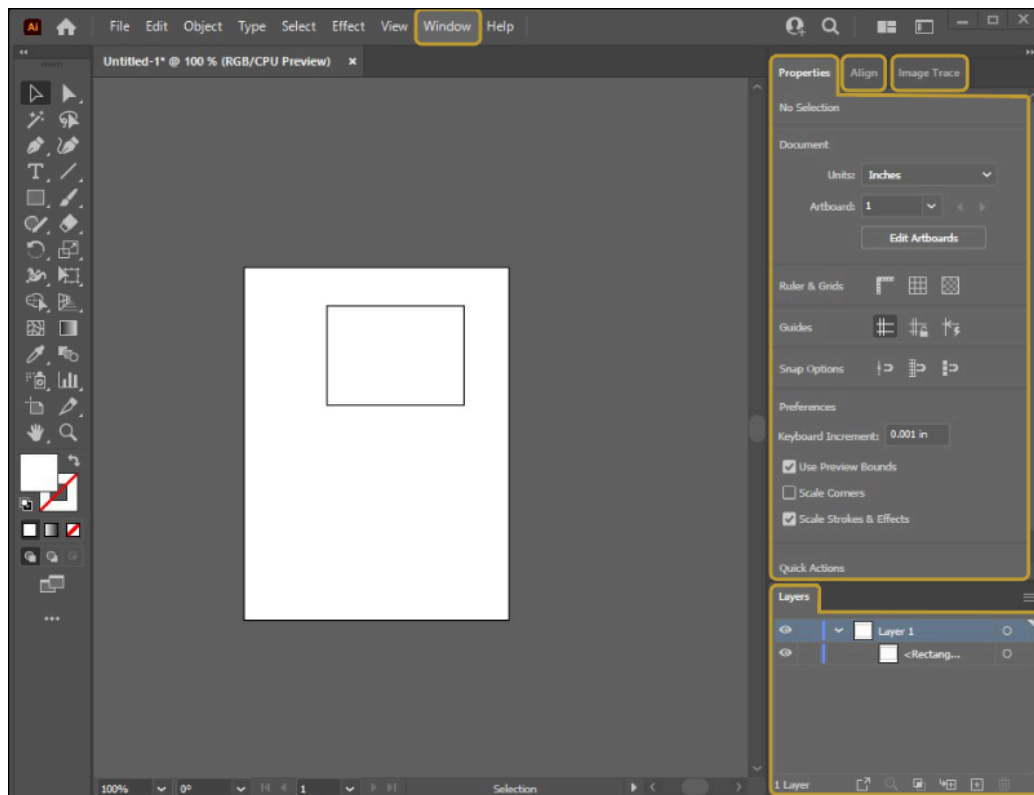
Unlike regular paper, the size of the **Artboard** can be changed to match your material size. To do this use the **Selection Tool** to click anywhere in the empty gray **Workspace** area (thus selecting it), then going to the **Properties Pane** and clicking [Edit Artboards](#).



2e. Window Panes (Properties, Layers, Align)

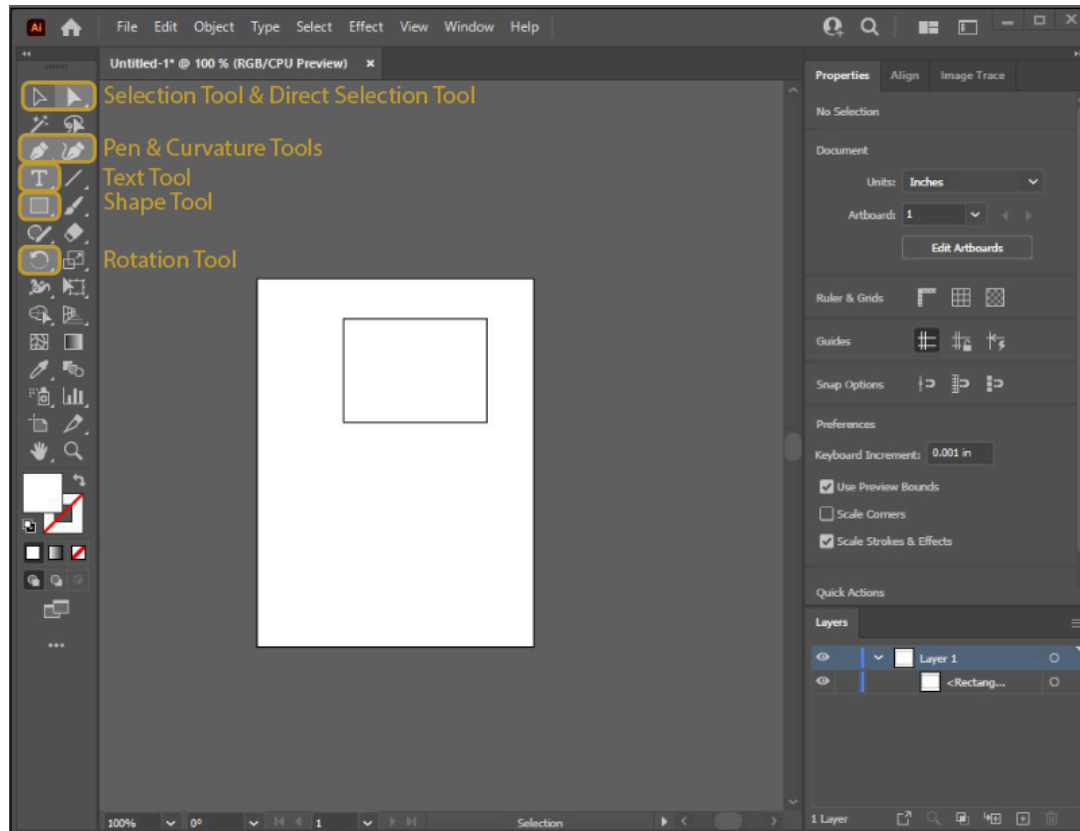
The **Window Panes** are small, special purpose boxes usually found on the right side of the program. You can add or remove these panes by opening the [Window](#) menu in the **topbar**. To get the standard set used for laser cutting, go to [Window > Workspace > Reset Laser Workspace](#). This will open the following panes on the right hand side:

- [Properties Pane](#) - shows details about whatever is currently selected
- [Layers Pane](#) - shows which layer (background, foreground, etc.) is currently selected. (*Advanced*) Also allows you to move layers in front of each other, select them, delete them, duplicate, hide, etc.
- [Align Pane](#) - (*advanced*) helps center items within the **artboard** or relative to each other
- [Image Trace Pane](#) - (*advanced*) is used to stencil images in ways that make them look better when printed. Instructions can be found in the “Advanced Laser Software Strategies” Binder.



2f. Basic Tools (Move, Shapes, Rotate, Text, etc)

Tools are the ways in which you interact with the program. Depending on which **tool** you have selected, clicking will do different things, much like having a tool in your hand. The **toolbar** is found on the left side.



- **Selection Tool** - This is **the most important tool**. This is how you *select* objects, *move* objects, and *resize* objects. If this tool is not selected, clicking will do surprising things.
 - You can also **nudge** selected objects by using the arrow keys. This is useful for getting pixel perfect results.
 - Whenever an object is selected, its details will be displayed in the **Properties Pane**.
 - Try to make a habit of always defaulting back to this tool.
- **Text Tool** - Used to create or to edit highlighted text's font and size with the **Properties Pane**.
- **Shape Tool** - Used to create squares, ellipses, lines, or other simple shapes.
 - Right click the tools icon to view shapes other than rectangles.
- **Rotation Tool** - Used to rotate an object
- **Pen & Curvature Tools and Direct Selection Tool**- (*Advanced*) Used to draw custom shapes or select individual points of an object.

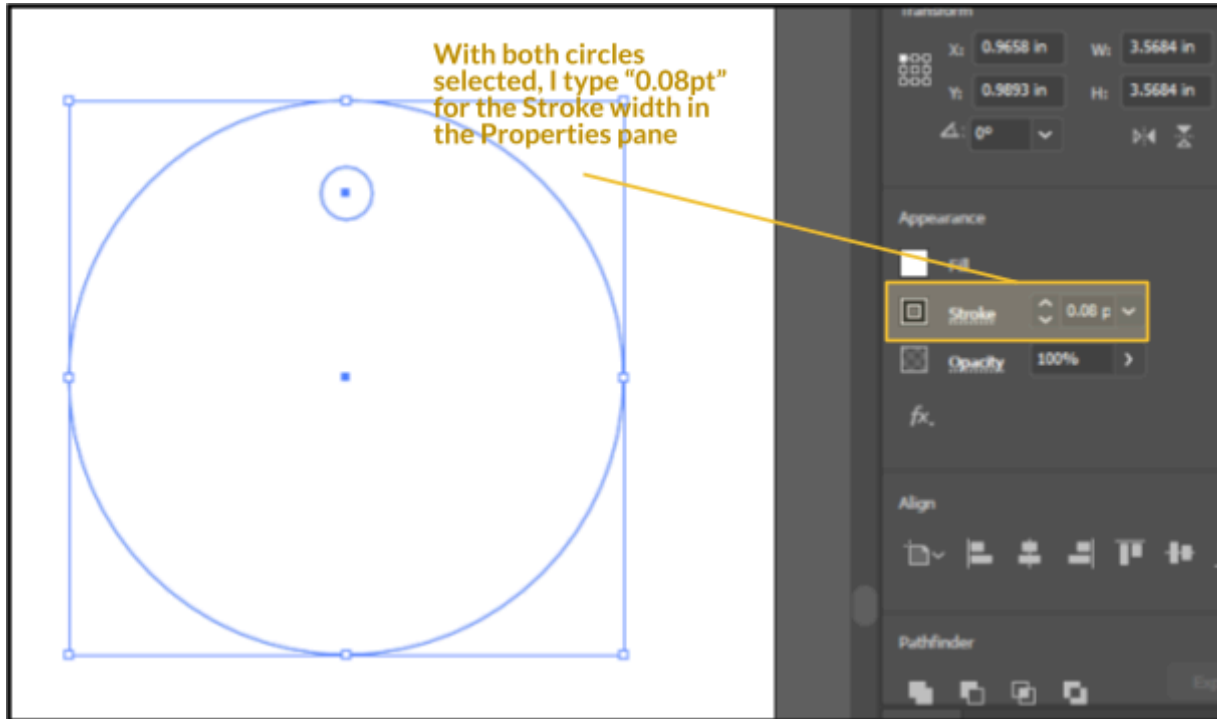
No matter what tool is selected, you can **zoom in and out** by *rotating the scroll wheel on the mouse* or **move your view around** by *clicking the scroll wheel in and then dragging*.

Remember: Undo is your friend!

If anything strange ever happens, you can just undo it

2g. Cutting Stroke Width

Vector shapes can draw any size stroke width you want, from super fine to extra thick. If you want these lines to **cut** rather than **engrave**, there is a certain lower limit which tells the laser cutter to switch from engraving to cutting. That limit is **.08 pt / .001 in**. Any stroke thinner than this will be interpreted as cutting instructions, anything bigger will be engraved. You must also **set a color**. Typically, people use colors like **black** or **red**. You may also want to set fill to none.

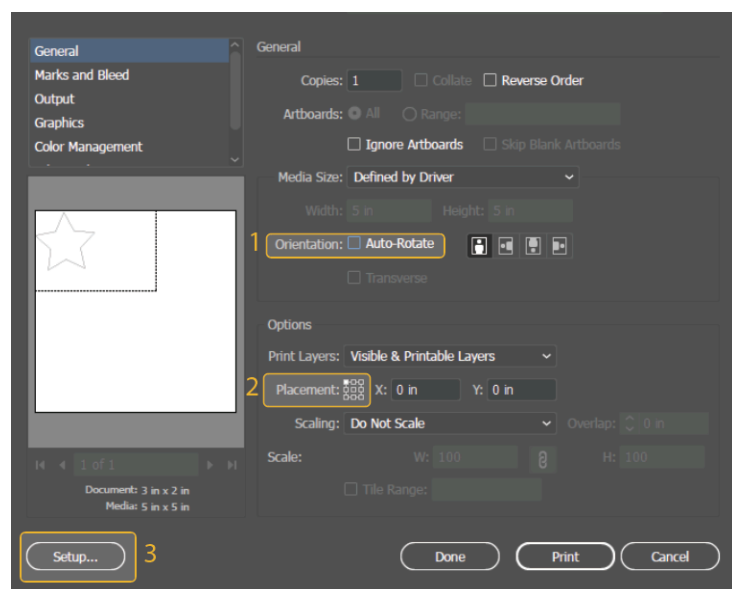


2h. Print Settings

Printing requires a bit of setup to make sure your piece has the right orientation, size, position, as well as cutting and etching powers.

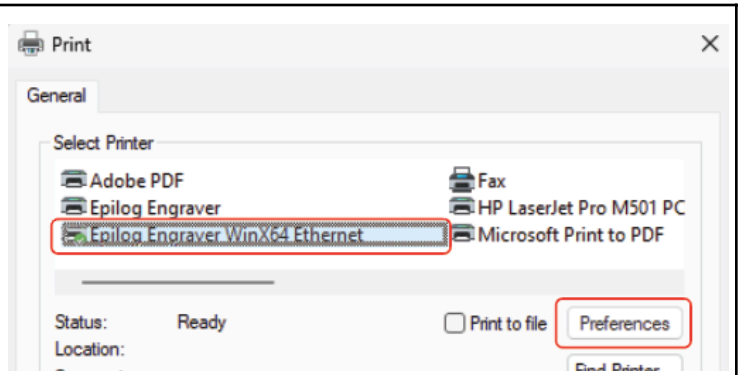
Print Menu

- Go to **File > Print** to open the **Print Menu**
- Make sure **Auto-Rotate (1)** is *disabled* by unchecking the box
- Make sure **Placement (2)** has the top left box selected
- Go to **Setup (3)**



Printer Setup Menu

- Make sure **Epilog Engraver X64 Ethernet** is selected
- Click **Preferences**



Epilog Engraver Properties

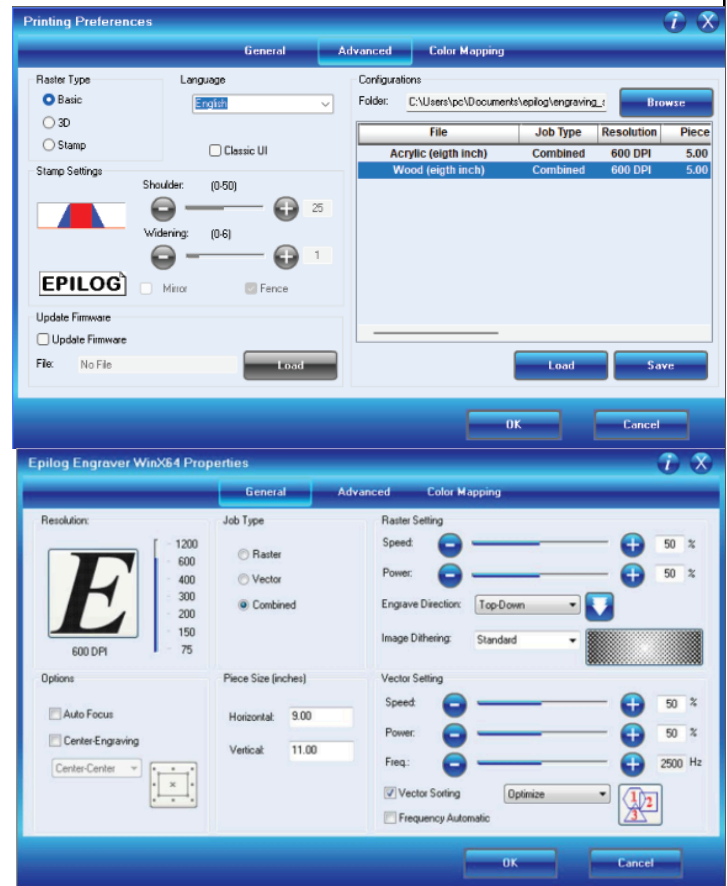
This panel is where you manage how the **Laser Cutter** will engrave and cut.

Easy Way - If you want to do things the easy way, you can click the **Advanced Tab** at the top to display a list of material presets. Select one and hit **Load**.

Advanced Way - For special materials or fine-tuning, you can specify every aspect of how your print will run in the **General Tab**. This settings pane refers to engraving as “raster” and cutting as “vector”, though vectors will be engraved if they don’t have a super thin line. Specifications for known materials and their settings can be found in “Table II: Material Settings” on *Page 27*. The settings available are:

- **Resolution (Raster)** - defines how closely packed the burn dots will be
- **Job Type** - you can choose to engrave (Raster), cut (Vector), or both (Combined)
- **Piece Size** - any size bigger than your print and smaller than the printer bed will do here
- **Speed (Raster and Vector)** - defines how quickly the laser head will move, and how long the print will take
- **Power (Raster and Vector)** - defines how hot the laser will burn
- **Freq (Vector)** - number of zaps per inch. Similar to resolution, but for vectors.
- **Image Dithering (Raster)** - changes the style of shading
- **Options**
 - **Auto Focus** - when enabled, the Laser Cutter will find its ideal focal length automatically. For some (*Advanced*) projects that aren’t flat enough, focus must be done manually. Details can be found in the “Manual Focus” section on *Page 17*
 - **Center Engraving** - when enabled, prints will center on the home position. Details can be found in the “Centering a Print at Arbitrary Locations” section on *Page 17*

For any nitty gritty details, the manufacturers manual is in the binder next to the Laser Cutter


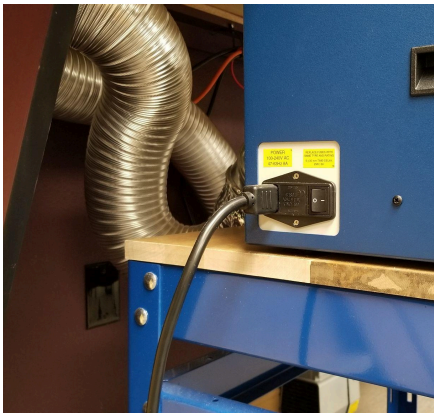



Once you have input your settings...

1. Make sure the laser is on
2. Keep clicking the **Okay** and **Print** buttons until the instructions are sent to the Laser Cutter
3. Follow the instructions in “Section 3: Running the Machine”

3. Running the Machine

3a. Power On

| | | |
|--|--|---|
|  |  |  |
| Turn on the Laser/Exhaust switch under the counter. You can also turn Air Assist on now if you like. | If the laser doesn't come on, check that the large switch near the plug on the lower rear part of the left side is flipped to (on) | The laser will boot up and you will hear the X and Y axis motors checking their home position |

3b. Choose Your Print

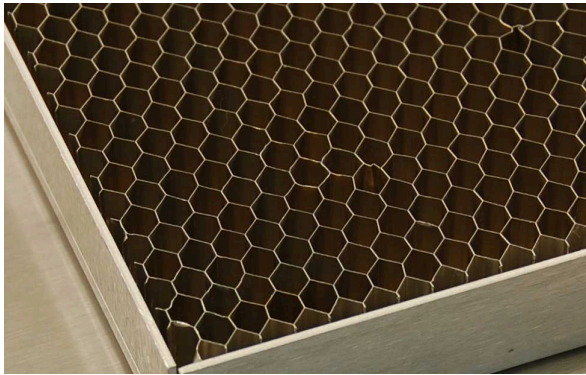
Creating your art is likely the hardest and most time consuming part of using the laser. It is a skill unto itself. There are details on how to setup a simple artwork on *Page 5*, as well as separate *Advanced* tutorials available in the “Advanced Laser Software Strategies” Binder

3c. Choose Your Material

Which material you choose can depend heavily on the type of project you're trying to make. There are many different material types, and thicknesses of each. Examples include things like wood, cloth, paper, acrylic, leather, metal, glass, cork, or stone. You can find more information in **Table I - Printing Materials** on *Page 24*

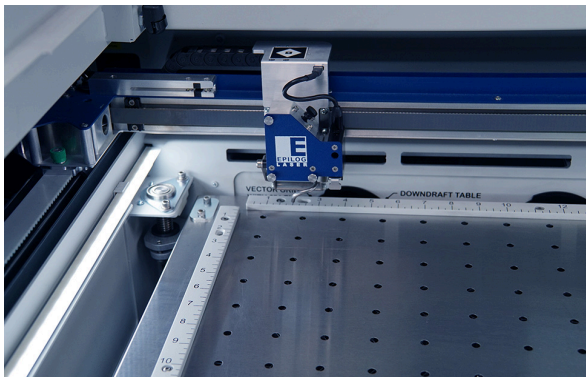
3d. Choose Your Printing Insert

For the vast majority of purposes – especially introductory ones – the **honeycomb grid** will work perfectly. But there are some projects that require a different printing insert. Details on how to change setups can be found in the *Advanced Section* on *Page 16*. The three insert types can all be found in **Cabinet 10**, and they include:



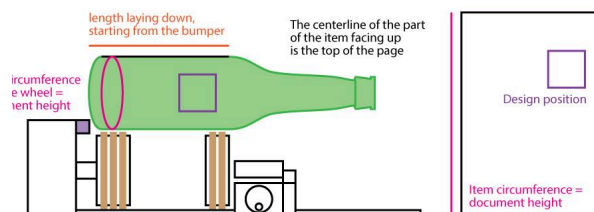
Honeycomb Grid - (default) used for the vast majority of materials which are heavy enough that they won't blow around, but light enough they won't bend the insert.

The open grid minimizes scorch marks on the back of your material caused by the laser beam bouncing off the metal.



Vacuum Table - (solid with small holes) used for engraving/cutting on light materials/objects that need suction, magnets, and/or tape to stay in place. Also used for very heavy materials that might bend the honeycomb grid.

The more holes in the table that are covered, the more light materials will be held in place. You can cover any exposed holes with scrap material or use the magnets on the whiteboard and/or painters tape to hold your light materials in place if needed



Rotary Attachment - used for round objects, typically glass or metal bottles.

Can also handle tapered (cone like) objects; see the full *Advanced Section* tutorial on *Page 18*

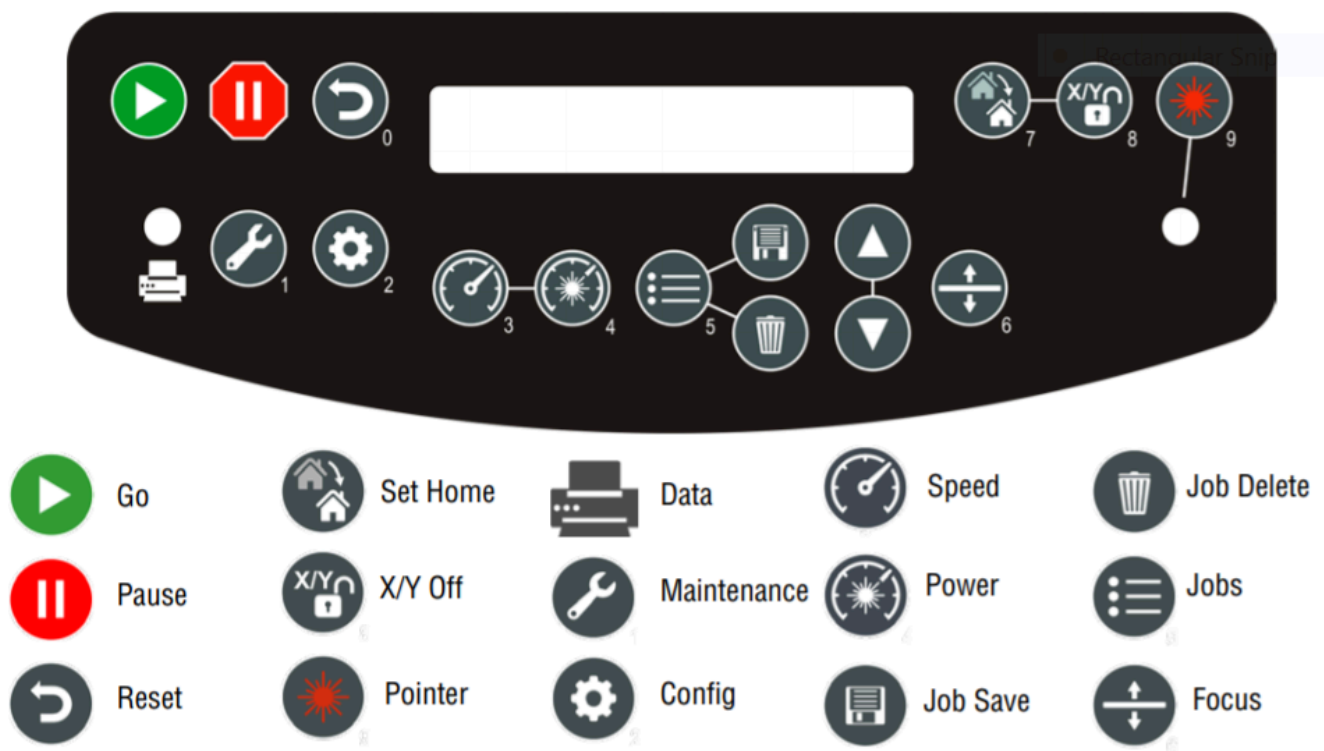
3e. Placing Your Material

The **top-left corner** is where material will be placed for the vast majority of projects. The exceptions to this will be when printing from arbitrary locations, or using the **rotary attachment**. Details of these cases can be found in the *Advanced Section* on *Page 18*

3f. Control Panel

The top row of the **Control Panel** on the laser contains 3 *basic* buttons, and 3 intermediate buttons to know about. Usage for the rest of the buttons can be found in various *Advanced Tutorials* on *Page 16*. The top-row basic and intermediate buttons include (in order):

- Basic (need to know):
 - **Go** - Starts a selected print
 - **Pause** - Pauses a running print
 - **Reset** - Ends a print entirely, and returns laser to *home position*. It is also used in navigating *Advanced* menus
- Intermediate (for non top-left aligned projects):
 - **Set Home** - Chooses a new *home position*
 - **X/Y Off** - Unlocks the laser head so it can manually be moved in order to set a new *home position*
 - **Laser Pointer** - Shines a laser pointer; helpful for seeing where the new *home location* will be



3g. Uploading and Running the Job

Jobs are uploaded through the *Adobe Illustrator* program. You can find more information in “3h. Print Settings” on *Page 11*.

Running the Job Checklist

- ☐ Exhaust fan is on
- ☐ Laser is warmed up. Use cardboard to test it.
- ☐ The LCD screen shows your project name. It will be “Untitled” if no name has been given.
- ☐ (Bonus) Cardboard test was successful

To run, hit the **Go button**

3h. While the Job Runs

- Stay within arms reach of the laser during engraving, and watch the job during cutting.
- Follow the instructions on *Page 1* if you see flames.
- To pause the job, use the red **Pause Button**. Resume with the green **Go Button**.
- To end the job, use the red **Pause Button** and then the black arrow **Reset Button**.

3i. When Done (Cleanup)

- ☐ Remove any debris from the laser bed
- ☐ Turn off the laser, the Laser/Exhaust switch and the Air Assist pump switch.
- ☐ Shut down Adobe Illustrator. If you want to save your work, use a thumb drive or email yourself the file.
- ☐ (Bonus) Pull very hard on one front access door handle to open it, then flip out the two latches on the crumb tray, slide it out, dump it in the trash, and put it back.

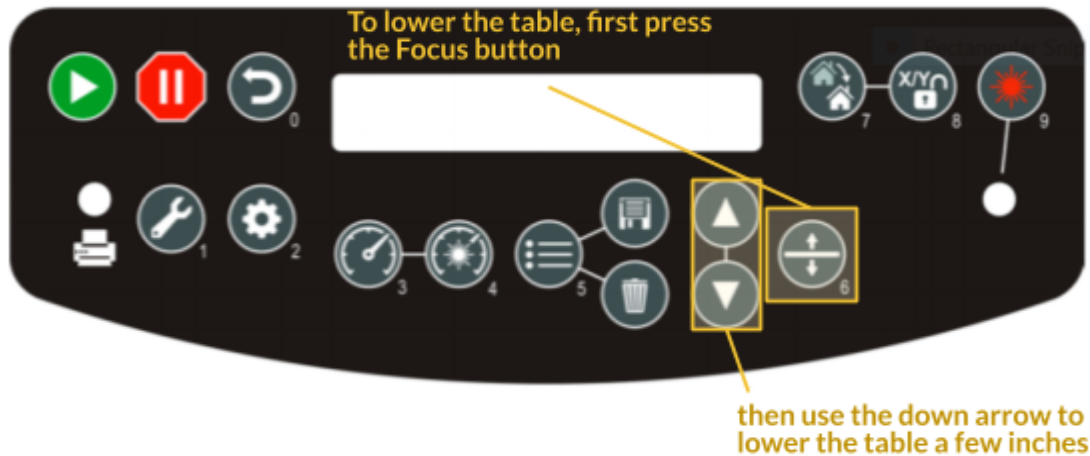
3j. Finishing Artistic Touches

- For any cuts that did not go all the way through, use a box-cutter or exacto knife to finish the cuts from the back
- For burn smudges and stains *on wood*, you can clean the surface with isopropyl-alcohol or sand paper
- Coating with stains and paints can really bring some pieces to life
- For prints that need assembly, super glue and hot-glue are available in **Cabinet 9**. The latter is easier to use but harder to hide.

4. Advanced Machine Techniques

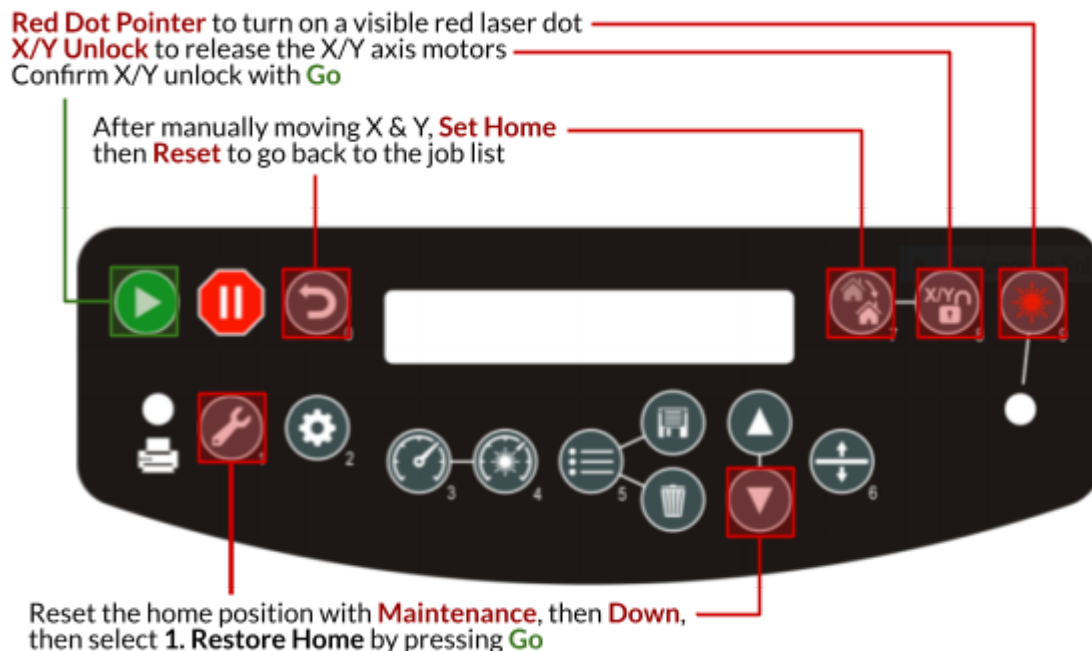
4a. Changing the Insert

- Press the **Focus button** and use the **up/down buttons** to lower the table several inches.
- Flip up the spring-loaded rulers on the left, top, and right sides of the enclosure
- Load the insert (honeycomb grid with its metal rim down, vacuum table shiny side up), and flip the rulers down



4b. Printing at Arbitrary Locations

To change the *Home Position* from which the prints will start:



4c. Resetting to Top Left Corner

To undo a previously set *Home Position*, use the **Maintenance** button as shown in the previous image.

4d. Centering a Print at Arbitrary Locations

Centering a print can be very useful for items like coasters or book covers. It allows one to point the laser at the center of their material, and the laser does the rest from there.

First follow the instruction in “Printing at Arbitrary Locations” to move your *Home Position* to the center of where you want to print. Then, in the **Epilog Engraver Properties** panel (shown in section “2d. Print Settings” on Page 11), enable the **Center-Engraving** option.

It is highly recommended that you do a test print by drawing a small dot on some cardboard and then targeting the dot. This will make it obvious if you need to offset your print.

4e. Manual focus

Good for small or unusually shaped items or soft surfaces, situations where you want a little extra certainty, or would prefer the autofocus plunger not touch your material (which could move it)

1. Grab the **focus gauge** from the top left side of the laser printer and place it onto the laser carriage. A magnet will hold it in place.
2. Press **Focus** on the control panel, then use the control panel’s **up/down arrows** to raise/lower the table until the material surface just barely touches the tip of the focus gauge. It doesn’t have to be perfect. If you lower the focus gauge into the material, it will move up without hurting anything and eventually pop off the magnet.
 - If your material is uneven, select a medium distance between the high and low points.
 - If there is more than 3mm of variation in your surface, parts of your engraving may look fuzzy and the beam might not cut all the way through during vector cutting (the more out of focus the beam is, the weaker it is)
3. You will [uncheck Auto Focus](#) in the Laser Dashboard during the printing step (see Page 11).
4. Press the **reset button** (back arrow) on the laser panel to exit focus mode.



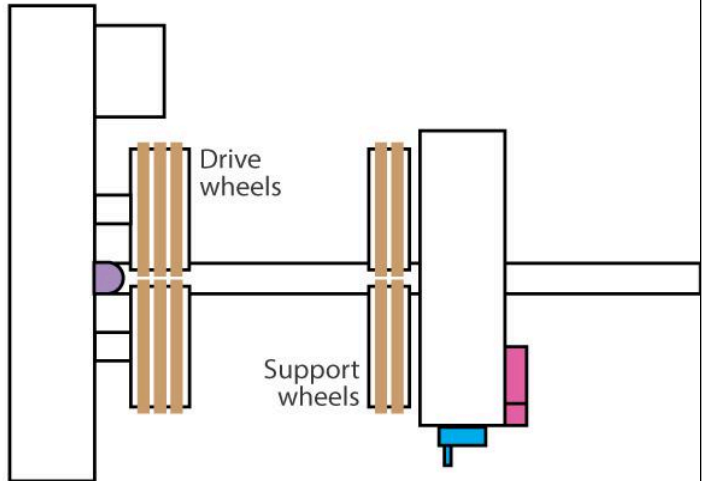
4f. Using the Rotary Attachment

This section requires knowledge of how to switch the plate, use manual focus, center-engrave, and print from arbitrary locations. The Rotary Attachment can be found in **Cabinet 10**.

The value of the rotary attachment is that it can be used to print on cylindrical objects such as bottles, dowels, or jars. It is generally only used for engraving, typically on glass or paint covered metal.

Parts of the rotary

- The **drive wheels** on the right side are motorized and spin your object
- The **support wheels** on the left side roll with the object and can be raised up and down to make the surface of your object level. If your object has a narrow side, place it on these wheels.
- Push the left side of your object against the **bumper**. The bumper is the start point of the engraving.
- Flip the **release lever** toward the front of the laser to slide the support wheels right. Flip it back to lock.
- Use this **knob** to raise and lower the support wheels to level your object. Consider using one of the small levels found on the peg board.



Step 1: Remove the vector grid and crumb tray and install the rotary

1. **Lower the table slightly.** Power the laser on. Using focus mode, lower the table a few inches so you have room to flip the rulers up.
2. **Remove the vector grid.** Flip up the spring-loaded left, top, and right rulers and remove any insert. See "5a. Changing the Insert" on *Page 16* for details.
3. **Remove the crumb tray.** Open the front door (pull very, very hard on just one of the handles). Flip the crumb tray latches outward and slide the crumb tray out. Set aside.
4. **Lower the table completely.** Using focus mode, lower the table all the way down.
5. **POWER OFF. Never plug in the rotary when the power is on.**
6. **Position the rotary.** With the wheels on the left side, align the 3 pins of the rotary with the 3 holes on the bottom of the laser (the right hand pin is out of sight under a little cutout on the frame)
 - When handling the rotary, try not to touch the rubber tires
7. **Plug the rotary in.** Leave the power off for now.

Step 2: Place your object on the wheels and level it

1. Examine your object and decide how to place it on the wheels.

- The rotary attachment has a scissor jack that can lift the right side of your object, so you'll want to place the side that needs lifting, usually the smaller side, to the right.
- You can also place both sets of wheels under a straight/flat section of your object rather than under the far end.

2. Adjust the spacing between the tires.

- Flip the silver release lever toward the front of the laser and slide the support wheels to the right until the space between the wheels is the right width for your object. Flip it back to lock.

3. Place the object on the tires.

- Push the object against the black tab/bumper on the left side of the rotary. This bumper is the start point for the engraving.

4. Level the object.

- Use a level from the pegboard on the top edge of your object, then rotate the scissor jack knob to raise/lower the right side if needed.

5. Turn the laser on.

- With the rotary plugged in, the laser will automatically set the home position to the black bumper (X 0, Y at the centerline of the rotary)

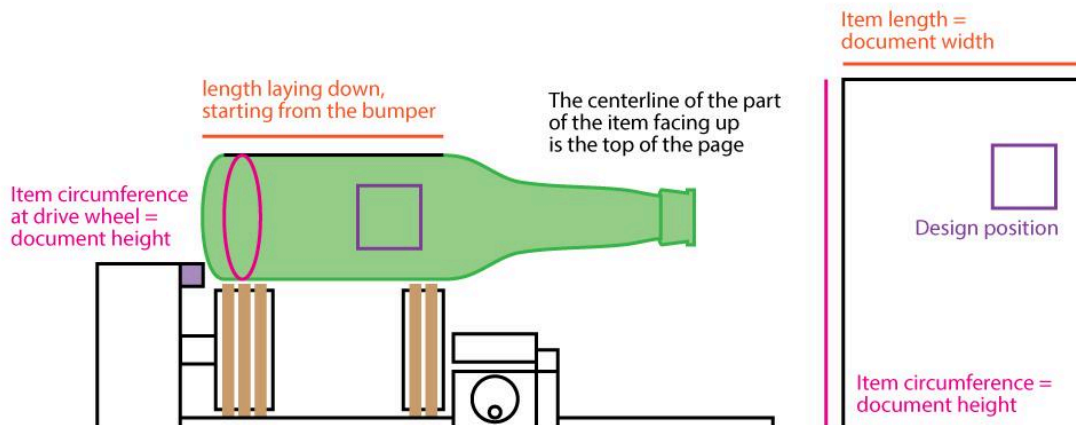
Step 3: Focus and Position Laser

Read the sections "Printing at Arbitrary Locations" and "Manual Focus"

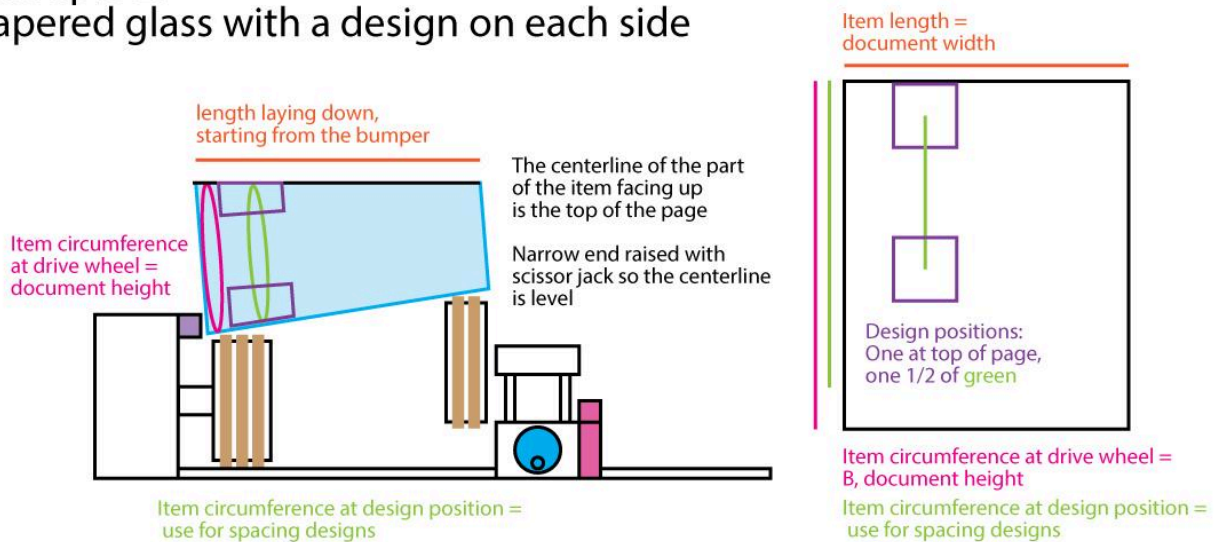
Step 4: Create a document and position your design

1. In Adobe Illustrator, use **Create New** to make a document the same size as your object.
 - **Document width:** length (right to left) of the object when it's horizontal, starting from the left side
 - **Document height:** Distance from your starting point to the end of your design
2. Refer to the examples on the next page for tips on how to position your design on the document.

Example 1: Bottle with a straight section



Example 2: Tapered glass with a design on each side



Step 5: Print

- Refer to the Laser Cutter training for full printing instructions, with these special considerations:
 - **Resolution:** Use 300 DPI for glass- higher DPI settings get flaky/melty
 - **Job Type:** Will be **Raster** in most cases
 - **Raster Setting:**
 - **Image Dithering:** **Jarvis** is recommended for glass
 - **Options:**
 - **Auto focus** should be *unchecked*
 - **Center-Engraving** should be *unchecked*
 - **Page Size:** Same as your document- width is the object length, height is the object circumference
- The laser automatically detects the rotary and knows to spin the object rather than moving the Y axis.
- **Remember to warm up the laser tube** on scrap material (use your own test object). You don't need to re-level or change focus, just look for a visible beam.
- Use the material settings from the "Table II: Material Settings" on Page 27.
- Especially when using the rotary, **run the job with the lid up** (disabling the laser) and the red dot pointer **on** to confirm that the object is stable on the wheels and that the laser is traveling to the area you want to engrave. Then run again with the lid down.

Glass Tips

- When removing glass, **do not touch the engraved area** when removing the item. Rinse the engraving under water and use a scrub pad to remove the glass powder.
- Try changing the fill color of your design to 80% gray (that's the third gray from the left in the Illustrator Swatches panel. Hover over the swatches to see the K percentage) rather than using pure black.
- Use the Jarvis rather than the Standard dither for a frosty appearance.
- Avoid engraving over already engraved areas as it may crack the glass.

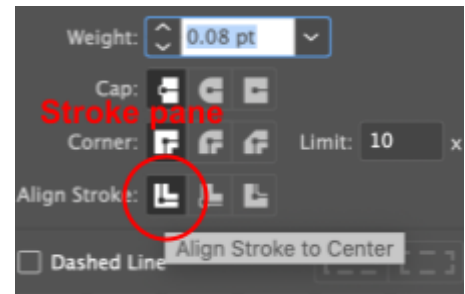
Warning! Glass powder irritates eyes and skin

Make sure to wash off your piece before handling it too much

5. Common Tech Issues

5a. Print Beeps Complete Having Done Nothing

- Check that your job type is right for your job (vector for cutting, raster for engraving, combined for both)
 - If your job is Combined, try running it first as vector only and then as engraving only to help diagnose the problem
- Check that you are using a printable layer
 - Open the Layers window, click on the 3 lines in the upper right corner of this window, and choose “Options for Layer”
 - Make sure the “Print” box is checked (this is mostly a problem with designs that have been downloaded)
- For vector cutting jobs, check that your line:
 - is a vector line (click with the white Direct Select tool and make sure you can see a path, points, and handles)
 - Is the right width (0.08 pt/0.001 in)
 - Is a color (red or black are common choices)
 - Is aligned to the center of the path. In the Properties pane, click the word Stroke and check that Align to Center is selected rather than Inside or Outside, and that Dashed Line is **unchecked**



5b. Vectors Are Being Etched Instead of Cut

- Check your stroke width
- Try bringing your cutting layers to the top
- Check your layers to make sure that cutting and engraving layers are not being combined into the same sub-layer
- Try making all engraving layers invisible (click the eye in the **Layer Pane**), then print again

5c. Laser Not Cutting All the Way Through

- Check focus
- Check line width and color
- Let makerspace@estesvalleylibrary.org know that the laser optics may need to be inspected and cleaned

5d. Plunger Folded, Machine Jammed

First, don't panic, the autofocus plunger is spring loaded and it can fold over without damage. You will need to manually lower the table so the laser can check its x and y axis during startup without getting caught:

1. Turn **off** the laser

2. Pull hard on the handles on the front door of the laser
3. Grab the first belt you see running along the bottom of the laser's case and pull it to the right to slowly lower the table. You'll probably have to pull on the belt a few times to get the bed low enough that the autofocus plunger is no longer folded over.
4. Close the front door and turn the laser on. It should be able to run through its normal setup process.

In the future, **avoid using Auto Focus with bumpy, uneven, or oddly sized materials**, or material sheets with holes in them. If the autofocus plunger touches down at an angle, it can fold over.



5e. Laser Starting in Wrong Position

Check that someone didn't accidentally set a new home location. To reset, see section "4a. Resetting to Top Left Corner" on *Page 17*

5f. Print Showing Up in Wrong Location

This is likely an issue with your Print Settings. Follow the steps in "3d. Print Settings" on *Page 11*

5g. Position Error

This means the printer is trying to move out of bounds. Check that your bounds are correct in the Epilog Settings, and that center-engraving is not accidentally checked.

5h. If All Else Fails... Ask For Help

Most days, there is a *staff member* or *makerspace guide* who can help. Alternatively, you can reach out to us at makerspace@estesvalleylibrary.org and we'll get back to you as soon as possible.

You can also try checking online (youtube, stack exchange, quora, etc), or in the machine's manuals (found in the binder).

6. Table I: Printing Materials

Bad Laser Materials

Adapted from ATXhs.org | Always positively identify your materials before cutting

| | | |
|--|---|---|
| PVC (polyvinyl chloride), including vinyl and pleather/artificial leather | Emits noxious chlorine gas when cut! | Don't ever cut materials containing chloride as they release chlorine gas that will corrode the inside of the laser, damaging the optics and motion control system. It's bad for people too! If you aren't <u>sure</u> your material <u>doesn't</u> contain chlorides, don't cut it! |
| Polycarbonate/Lexan | Cuts poorly, discolours, damages laser optics | Although it might <i>look</i> just like acrylic, polycarbonate absorbs the laser's light frequency, causing discoloration and poor cutting performance. The inefficient cutting process creates stringy soot that can coat and damage the laser optics. |
| ABS | Cuts poorly, melts, catches fire, emits fumes | ABS cuts and engraves poorly on a CO2 laser. It tends to melt rather than vaporizing, creating ugly cut edges and risking fire. It also emits noxious fumes. |
| Polystyrene Foam | Catches fire | Catches fire quickly and burns rapidly. Polystyrene foam is the #1 cause of laser fires! |
| Polypropylene Foam | Catches fire | Like polystyrene, it melts, catches fire, and the melted drops continue to burn and turn into rock-hard drips and pebbles. |
| Epoxy | Emits noxious fumes | CO2 lasers can't cut through it, and attempting to cut it releases toxic fumes. Items coated in epoxy or cast epoxy resins should not be used in the laser cutter. |
| Fiberglass | Can't be cut, emits noxious fumes | It's a mix of two materials that can't be cut. The laser can't cut the glass fibers, and the epoxy resin can't be cut AND releases fumes |
| Coated Carbon Fiber | Emits noxious fumes | Thin carbon fiber mat can be cut, but not when coated with epoxy |
| Material with "PSA" glue backing | Damages laser optics | Otherwise suitable materials like wood veneer create sticky soot that can damage the laser optics if they have a "PSA" glue backing. Please do not cut sheets of material that have a PSA backing. |
| Polyethylene (HDPE & LDPE) | Cuts poorly, melts | Plastics commonly found in packaging materials (milk bottles, butter tubs, etc). It melts and becomes gooey and waxy, with messy edges |

Good & OK Laser Materials

- Always positively identify your materials before cutting
- Bring extra materials and plan to test your settings before working on your project
- Check the laser binder for recommended settings
- **Our laser cannot cut metal, no matter how thin!** See the next page for ways to engrave on metal

Cut & Engrave

| | |
|---|--|
| Acrylic/Plexiglass | Cuts beautifully! One of the best materials for laser cutting. We buy our acrylic from estreetplastics.com . Cast acrylic engraves better than <i>extruded</i> acrylic, so look for “cast” in the product description if you’re buying for an engraving project. |
| Specialty laser plastics & sheet materials | Check the “Laser” section of online engraving suppliers like jpplus.com for plastics and other sheet materials specially selected for laser use, including two-layer plastics for high-contrast engraving |
| Wood | Baltic birch plywood, alder, and cherry give especially nice results and white pine, oak, and balsa are also recommended. Woods with a tighter grain make for clearer engravings, but wood with a bold grain can give an interesting artistic result. Plywood is more difficult to cut than solid wood and our low-power tube will struggle with plywood sheets thicker than about 5/8”. Test on different woods before pursuing a large project to make sure you like the results. Wood specially selected for laser cutting can be purchased from engraving suppliers like jpplus.com . |
| Eucaboard brand hardboard | Eucaboard by Eucatex is a common brand of high-density fiberboard that cuts and engraves beautifully in the laser and contains no glues. It’s made entirely of eucalyptus fiber, so no worries about releasing fumes. Check the back of HDF sheets at Home Depot, Lowes, etc, for this brand to guarantee an excellent laser experience. |
| Paper & Cardboard | Cardboard is a great material for the beginner laser cutter enthusiast since it’s cheap or free! It cuts better than it engraves. The laser cuts even delicate paper beautifully at low power levels- use the solid vacuum table and magnets or tape to hold the paper down. |
| Fabric | The laser can cut both synthetic and natural fabrics on low power levels. Use the solid vacuum table with magnets or tape to hold it down. |
| Taskboard | Taskboard is a dense, solid paper product about halfway between cardstock and balsa wood. It engraves and cuts beautifully. Highly recommended for craft projects. Commonly used for architectural models. Available from taskboard.com |

| | |
|----------------|---|
| Leather | Leather engraves and cuts nicely, but it doesn't smell very good. |
| Cork | Cork cuts easily and is also very rewarding to engrave, creating a clear and crisp black mark even on low power settings. Avoid cork with a PSA (pressure sensitive adhesive) backing which can create sticky smoke that is hard on the laser optics. |

Engraving Only

| | |
|--|---|
| <u>Painted & coated metal</u> | <u>The laser cannot cut or mark metal (not even foil!)</u> , but it CAN mark or remove surface coatings from painted or coated metal. Painted steel water bottles and other drinkware give nice results, especially on the rotary, as does anodized aluminum. Several passes may be required to remove the coating completely- bring a spare item to test on! Metal sheets pretreated with a "Ceramark" coating work great for engraving- check engraving suppliers like jpplus.com for Alumamark/Ceramark or "laserable metal". |
| Promotional items | Promotional items like keychains, coasters, wallets, jewelry boxes, etc are sometimes engraveable. Browse an engraving supplier like jpplus.com and follow their recommendations for best results. Never engrave unknown materials, especially plastics! You <i>must</i> be able to positively identify the specific material before engraving it (for example, alder, acrylic, anodized aluminum, painted steel- not just "wood" or "plastic"!) |
| Glass | Glass can be engraved with good results. Colored glass tiles are a great place to start. Rounded objects (bottles, wine glasses, Christmas ornaments) can be engraved either by propping them on the flat table, or on the optional rotary attachment. The rotary is best for intermediate to advanced laser users who are ready for a challenge. |
| Ceramic Tile | Works great, especially darker tiles with a lighter center. The laser will remove the top layer and expose the interior ceramic color. |
| Stone | Stone can be marked with high power settings and several passes. Slate gives especially good results and smooth river stones can be interesting, yet unpredictable. |

7. Table II: Material Settings

These are initial power settings for common materials. Bring extra materials for testing and plan to adjust your settings further.

| | | Key: | Engrave/Raster | Cut/Vector |
|--|---------|-------|----------------|------------|
| Material | Speed | Power | DPI | Frequency |
| Wood | | | | |
| Engrave photos* | 40 | 100 | 600 DPI | |
| *Note: Plan to experiment with the <u>dither</u> settings to get the most appealing results on your material | | | | |
| Engrave text/clipart (high resolution) | 30 | 100 | 600 DPI | |
| Engrave text/clipart | 25 | 100 | 300 DPI | |
| Cut veneer | 30 | 22 | | Freq. 500 |
| Cut ⅛" (3mm) | 20 - 25 | 100 | | Freq. 500 |
| Cut ¼" (6mm) | 7 - 8 | 100 | | Freq. 500 |
| Acrylic | | | | |
| Engrave photos | 90 | 60 | 300 DPI | |
| Engrave text/clipart* | 90 | 70 | 300/600 DPI | |
| *On transparent acrylic, try engraving at 300 DPI with image dithering set to <i>Jarvis</i> for the most opaque "frosted glass" look | | | | |
| Cut ⅛" (3mm) | 9 | 100 | | Freq. 5000 |
| Cut ¼" (6mm) | 5 | 100 | | Freq. 5000 |
| Other plastic | | | | |
| Engrave general plastic | 90 | 40 | 300 DPI | |
| Engrave two-layer plastic (high resolution) | 90 | 70 | 600 DPI | |
| Engrave two-layer plastic | 90 | 80 | 300 DPI | |
| Cardboard | | | | |
| Cut single layer | 50 | 50 | | Freq. 500 |
| Cut double layer | 30 | 70 | | Freq. 500 |

| | | | | |
|---|---------|-----|---------|------------|
| Engrave (light mark) | 100 | 15 | 300 DPI | |
| Copy paper | | | | |
| Cut | 100 | 15 | | Freq. 1000 |
| Eucaboard brand hardboard | | | | |
| Cut | 12 | 100 | | Freq. 500 |
| Engrave | 30 | 100 | 600 DPI | |
| JPPlus Laserable Alderwood | | | | |
| Cut (1/8") | 20 - 25 | 100 | | Freq. 500 |
| Engrave | 30 | 100 | 600 DPI | |
| Taskboard | | | | |
| Cut (1/16") | 50 | 50 | | Freq. 500 |
| Engrave | 100 | 60 | 300 DPI | |
| Glass (engrave only) | | | | |
| Text/photos (Use 80% gray instead of black with Jarvis dither) *Glass may be hot when finished | 20 | 100 | 300 DPI | |
| Slate Coasters (engrave only) | | | | |
| text | 90 | 65 | 600 DPI | |
| photo | 90 | 55 | 300 DPI | |
| Cork coaster | | | | |
| Engrave | 90 | 50 | 600 DPI | |
| Painted Steel Water Bottle (engrave only) | | | | |
| Engrave *Bottles had thin paint. Bottles with a Yeti-like textured coating may need more power | 60 | 50 | 600 DPI | |
| Leather 1/8" | | | | |
| Engrave text | 70 | 60 | 600 DPI | |
| Cut (1/8") | 20 | 80 | | Freq. 600 |

