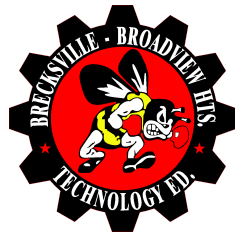


# BBHHS Fab Lab

## Laser Cutter (Laguna Smart Shop EX)

### Tutorial: Using the Laser Cutter



#### Introduction

The Laguna Smartshop Ex is used to cut and etch wood and certain types of plastic.



#### Types of Finish

**Cutting**, also known as Vectoring, means moving a high-power laser beam slowly through a material, so as to entirely separate the part being cut from the original stock material.



**Vector Etching** means the head of the laser cutter will follow the path of the vectors you create in your design, but the laser will not cut all the way through the material. This allows you to score or mark materials much faster than using raster engraving.



**Etching**, also known as rastering, means moving a low-power laser beam very quickly over a material, so as to remove just a light amount of material from the surface of the original stock material. Unlike vector etching, rastering can create detailed images.



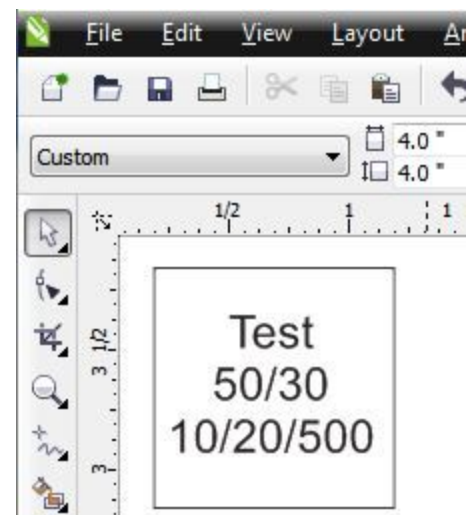
Parts may also be cut, vector etched, and etched in the same job. The laser cutter will complete all raster etching, then all vector etching, and finally finish with vector cutting.



## Before You Start

Laser cutters do **not cut consistently**. Depending on recent usage, time since cleaning, and many other factors, the actual power of the machines will vary.

Prepare small tests to make sure you have the right settings before running your actual job. Refer back to what we have learned about speed and power settings. Taking five minutes to run tests will save you time, money, and frustration.



Use Time Wisely

2. Do not start a job that you won't have time to finish before closing. Jobs can take anywhere from 5 minutes to 5 hours. **If your job is still running when think[box] closes, your job will be cancelled and your workpiece likely ruined.** Fortunately, The Fusion 48's

For example, if you have a combined etching and cutting job that's 10 inches by 12 inches, and you are etching at 80% speed and 600 dpi, and cutting at 60% speed, calculate the time as follows:

Etching Time = 10" x 12" x 38 sec/in²= 4560 seconds  
Cutting Time = 10" x 12" x 12 sec/in² = 1440 seconds  
Total Time = 1 hour, 40 minutes

Too long? Consider lowering the resolution or coming back another day when you have more time.

If your job will take longer than the lab will be open, email the file to yourself and come back another day (see [open hours](#)) when there is more time.

Average Cutting Time (seconds / in²)

Speed	Time
100%	12
80%	12
60%	12
40%	15
20%	21
10%	24
5%	27

Average Etching Time (seconds / in²)

DPI → Speed ↓	150 dpi	300 dpi	600 dpi	1200 dpi
100%	9	19	37	74
80%	10	19	38	76
60%	10	20	40	79
40%	12	24	47	92
20%	17	35	62	123
10%	19	45	76	149
5%	25	51	84	164

## Select and Check Your Material

3. You will need something to cut or etch. You may buy stock materials from our supply, or bring in your own.

**EXTREMELY IMPORTANT:** Some materials produce poisonous gases when lasered. These are often everyday materials like PVC plastic (produces chlorine gas). This is just an example, and an exhaustive list is not available. Continue reading this document to learn how to distinguish safe and appropriate materials.

**Please note: other materials are allowed for laser cutting but still release toxic gases such as Delrin, Fiberglass, and polyurethane. Please provide a couple minutes between the end of your laser cut job and opening the hood to prevent fumes from leaking out of the exhaust system.**

If this is your first time using the laser cutter, look in the scrap bins to find a free piece of material you can use to learn this process.



4. Check with Mr. G or Mr. K on the materials we stock.



5. If you are bringing in your own materials, check the [Laser Cutter Speed/Power Document](#). Is your material listed? If your material is not listed, you **must** find a Material Safety Data Sheet (MSDS) for your material and show it to a teacher to see if you may use it in the laser cutter.

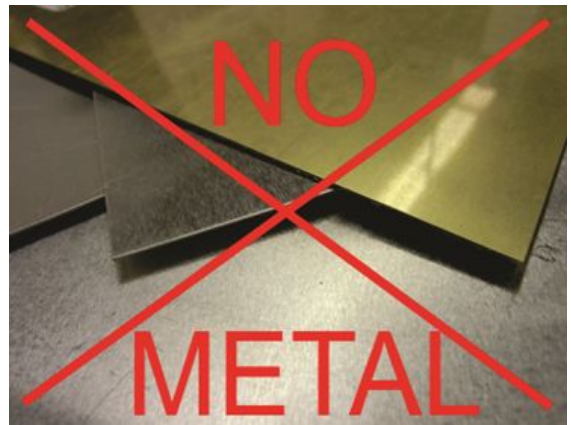


## 6. Do not cut unapproved materials

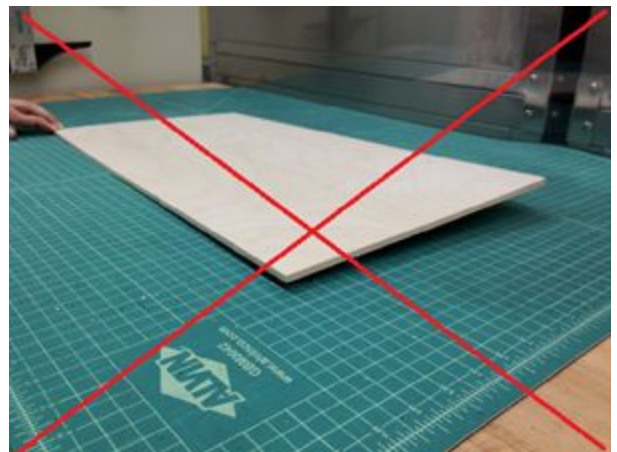
This laser cutter **cannot** cut or etch any metal. That includes thin metal, aluminum, and so on. To be very clear, it **cannot** cut or etch any metal. If you try to cut or etch metal, you may severely damage the laser cutter. What the machine can do is etch anodization, ink, or paint off of the surface of a metal object.

Certain types of material such as PVC and FR4 Fiberglass produce **poisonous gasses** and may not be cut or etched under any circumstances. This is very serious.

Other types of material such as Polycarbonate, Polypropylene, or Polyethylene do not absorb the wavelength of light produced by a CO2 laser and will not cut well. If your material is not listed in the Speed/Power document, see a full-time staff member before using it in the laser cutter.



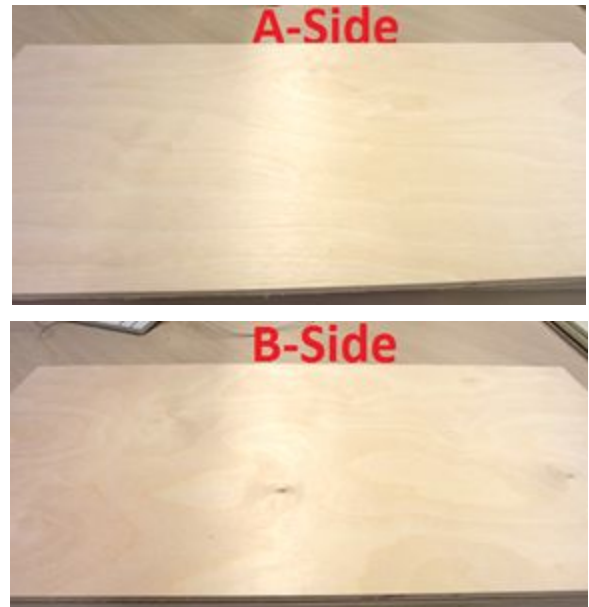
7. If your workpiece is cupped, warped, or twisted, more than 1/4 (0.25) inch, stop! Do not put significantly warped workpieces in the laser cutter or you can break the very expensive machine. Don't risk it. Find a flat workpiece.



8. If your workpiece is slightly cupped (1/4 inch or less) flip it so that the material is **concave** (like a mountain, not like a valley), so the highest point in your material is somewhere towards the center of the bed. This is important so that you can focus on the highpoint, and so that your workpiece doesn't rock back and forth.



9. If your workpiece has one side that looks nicer than the other (for example, our stocked laserable wood has one "B" grade side and one slightly more attractive "A" grade side), consider putting the **nice side facing up**. When you are cutting, burn marks will be most visible on the bottom of the workpiece. You can sand or wash off some of the burn marks, but in general it's a good idea to place the nice side facing up.



10. If your workpiece is plastic, look to see if there is a thin protective film on it. If you are etching at all, even for a combined etching/cutting job, you want to take that film off now. Otherwise the film will be etched but not your material. If you are **ONLY** cutting, it is wise to leave the film on until your part is finished, as that will prevent some of the burn marks. In case you are curious, this film is typically made of low-density polyethylene.



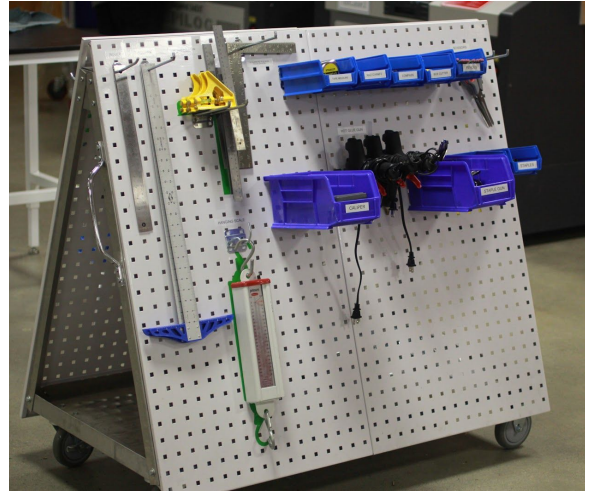
11. If you were etching a large workpiece, especially **plastic**, you may find that your piece has warped significantly. As you may imagine, this is because the heat of the laser left thermal stresses in the material, which results in strain in the form of warping. You can lessen this effect in the future by trying more passes (re-running your job a second or third time) at less power, decreasing the resolution of your job (which leaves less thermal stress).





## **Measure the Dimensions of your Material**

**12.** Get a measuring tape and calipers from one of the white tool carts.



**13.** Measure the width, height, and thickness of your material.

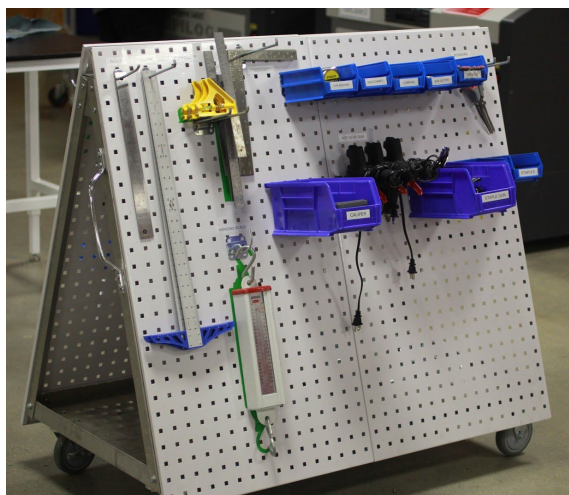




14. Write these numbers down, you will need them soon.

Height - 12"  
width - 24"  
Thickness - 0.2665"

15. Return the measuring tape and calipers to the tool cart you took them from.



16. This laser cutter can accept materials that are a **maximum of 51 inches by 36 inches**. Is your workpiece larger than this?

If your workpiece is larger than this, even just slightly larger, it needs to be cut to fit inside the laser cutter. Decide if your material needs to be cut.

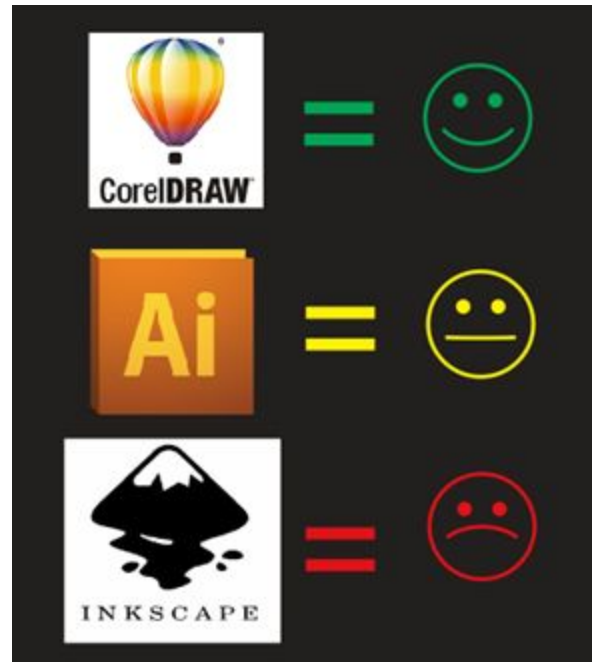
17. If your material needs to be cut, ask Mr. G or Mr. K to assist you with this in the Woodworking area.



Create a new CorelDraw File



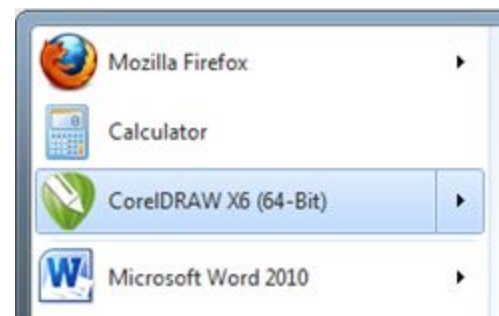
**18.** The Laser Cutter works best with CorelDraw. It will not work at all with some programs, such as Inkscape. Other programs such as Illustrator will work, but you will run into dozens of quirky bugs and ruin many workpieces before you learn them all. The best and most reliable software for this laser cutter is CorelDraw.



**19.** CorelDraw is available on the PCs. Find an available computer anywhere in think[box].



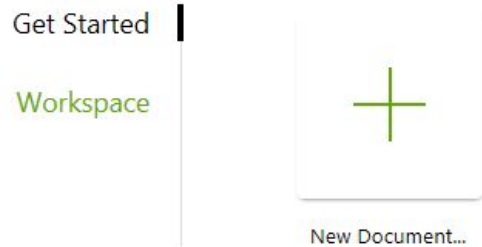
**20.** Open CorelDRAW from the program menu.



21. If a product registration dialog box or some other advertisement opens up, simply click the red X at the top right hand corner. There is no need to register your product.



22. The start dialog will appear. Click on “New Document”



23. The "Create a New Document" dialog will appear.

A. Type a name for your design, this will be the filename used to save your design. Choose a unique file name that you will recognize later and that will distinguish your file from others.

B. Set the color mode to **RGB**. Though this model of laser cutter is capable of processing CMYK jobs, RGB color coding is best for color grouping and visual clarity.

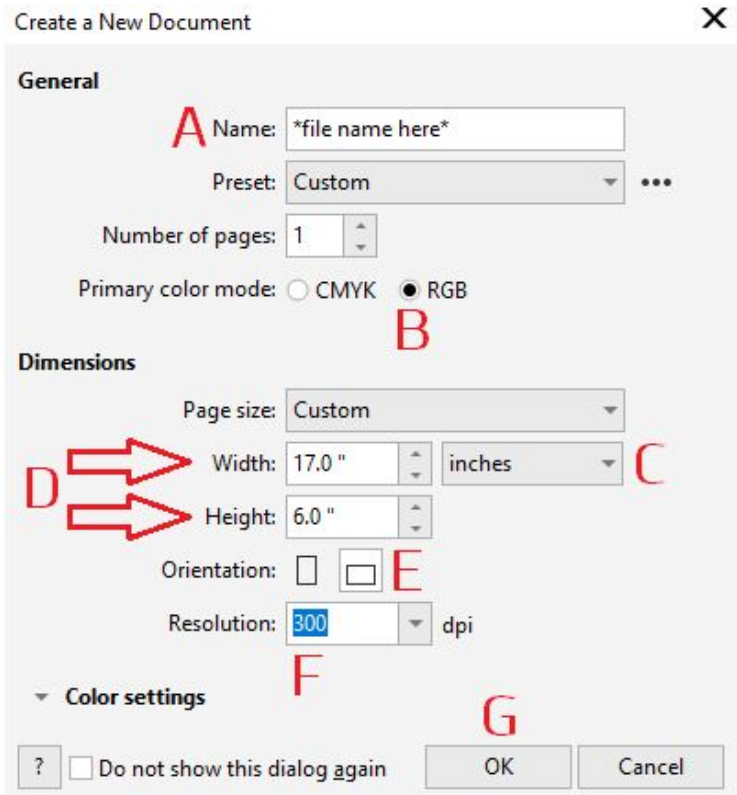
C. Select the units you want to work in. This document assumes you are working in inches.

D. Enter the **length** and **width** of your workpiece. It is very important that you always create a document that is the same size as your workpiece. This makes everything easier and prevents certain software bugs that you would otherwise run into. Ignore the thickness of your material for now; you will take that into account later on.

E. Click on the **landscape** format icon. It is absolutely important to choose landscape mode, otherwise the laser cutter will not process your file properly.

F. Set the “Rendering Resolution” to **300dpi**.

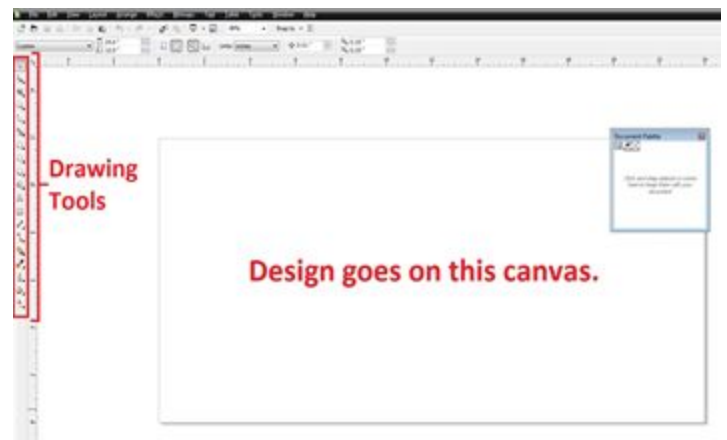
G. Click “**OK**” to continue



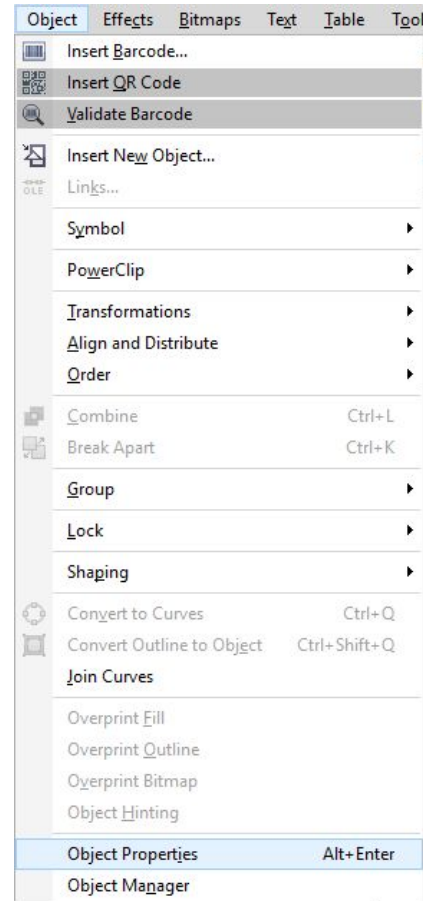
## 24. You are now at the main CorelDRAW Screen

Notice the toolbar on the left that contains the drawing tools, and the blank canvas in the center of the screen.

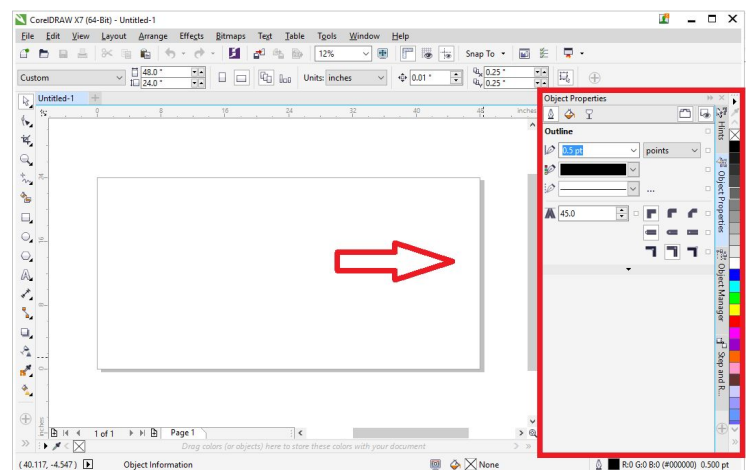
You do not need to click anything right now. Just look at the drawing tools, and look at the canvas. Now you know the names of these things, and you can communicate more effectively if you need to talk to a student technician later.



## 25. It's always a good idea to open the Object Properties panel. To do that, **press Alt+Enter**, or you can open it from the menu by clicking *Object >> Object Properties*.



Upon default setting, the Object Properties panel should be on the right side of the workspace



Option 1: Draw Vector Objects ---- Continue to Step 26

Option 2: Import a DXF file (a 2D Vector File) ---- Continue to Step 27

Option 3: Import an image file (jpg, gif, bmp, png, eps and more) ---- Continue to Step 33

## Draw Vector Objects

**26.** Use the drawing tools to draw the vector shapes you would like the laser cutter to CUT or VECTOR ETCH.

If you have finished importing all the files, please proceed to **Define shapes**

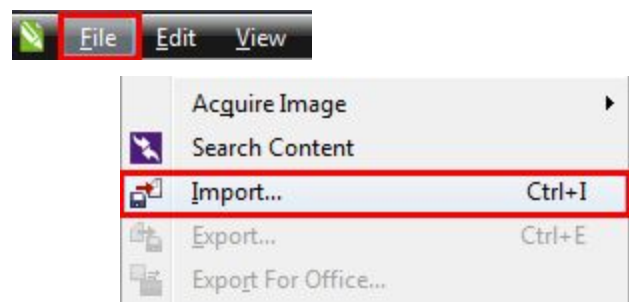
If you are not familiar with Coreldraw, please refer to [this tutorial](#) about this software.



## Import a DXF file (a 2D Vector File)

**27.** If you have a DXF file you would like to import, such as a DXF file from SolidWorks, CREO, AutoCAD, or Illustrator, you may import it now.

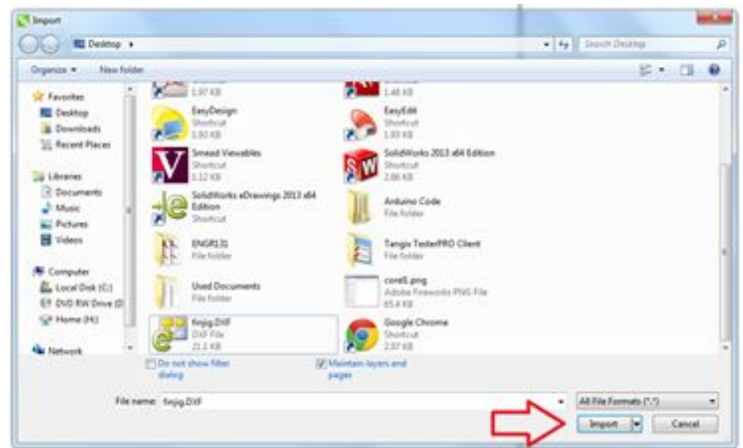
If you would like to import a file, start by clicking File → Import.





**28.** The Import File dialog will appear.

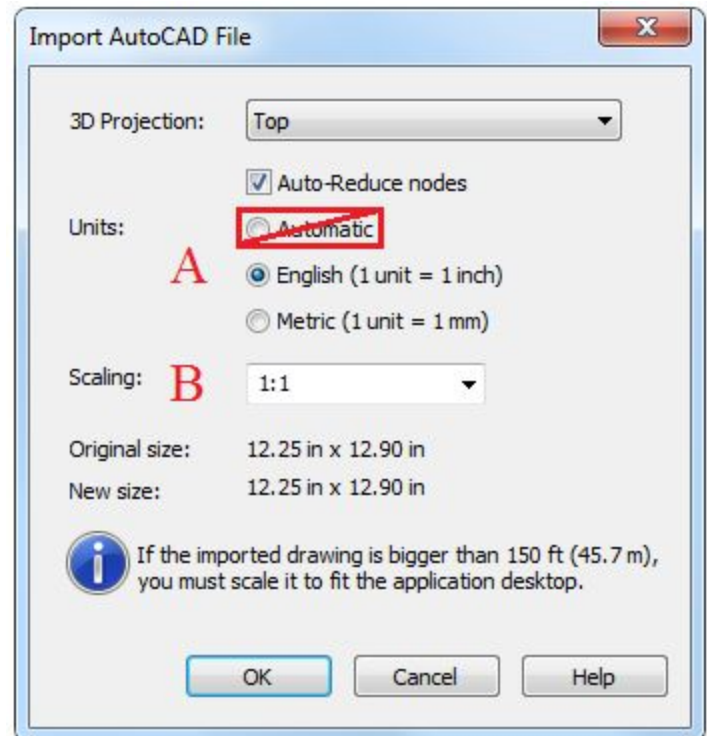
Select the DXF file you would like to import and click Import.



**29.** The Import AutoCAD File dialog will appear. Do not be concerned that the title of this dialog includes the word AutoCAD. It does not matter what software you used to produce your DXF file.

A. Choose the appropriate units system for your design. Do not use Automatic Units!

B. Set the scaling to 1:1



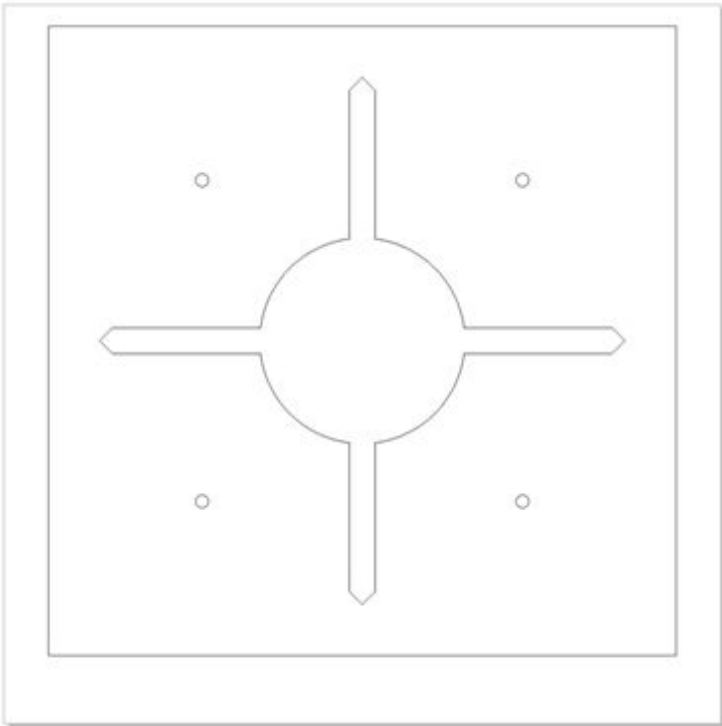
30. The cursor now indicates where the upper left corner of your DXF sketch will go and displays some text. If you want the sketch centered, simply press enter, or continue for manual placement.



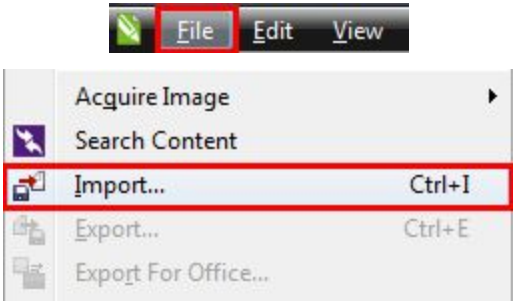
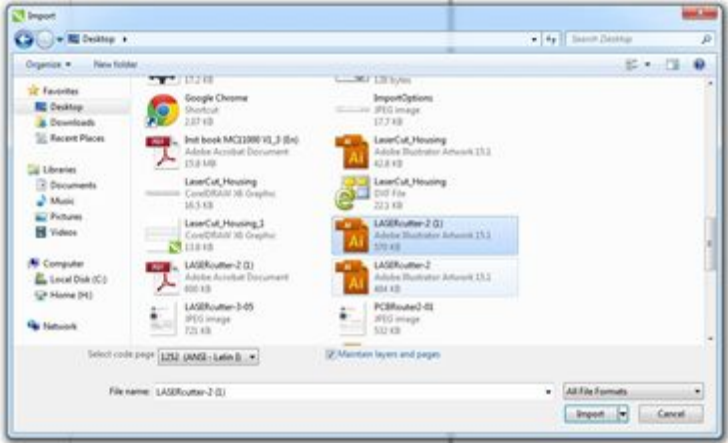
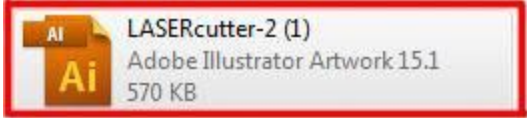
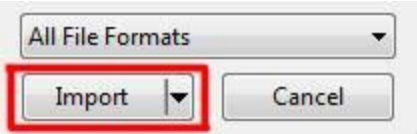
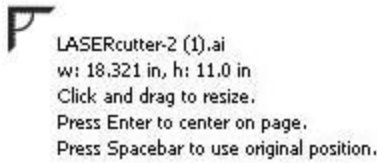

31. Move your mouse to the location you want to place the DXF sketch. Click the left mouse button once to place your sketch.



32. If you have finished importing all the files, please proceed to **Define shapes**

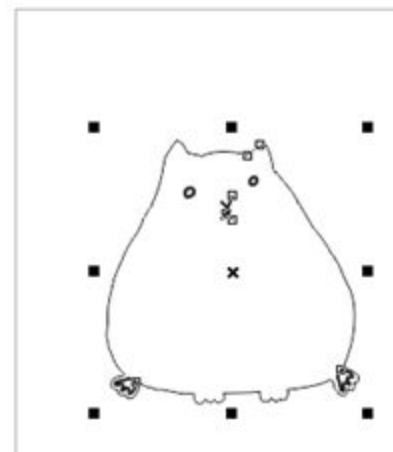


Import an image or a file from another program

<p><b>33.</b> If you have an image you would like to include in your design, you may import it now. You can import most any file format, including jpg, gif, bmp, png, eps, even files from Adobe Illustrator.</p> <p>If you would like to import an image, start by clicking File → Import.</p>	 <p>A screenshot of the 'File' menu in a software application. The 'File' menu bar is at the top with 'File', 'Edit', and 'View' options. The 'Import...' option is highlighted with a red rectangle, and its keyboard shortcut 'Ctrl+I' is shown to the right. Other options visible include 'Acquire Image', 'Search Content', 'Export...', and 'Export For Office...'.</p>
<p><b>34.</b> The Import File dialog will appear.</p> <p>Select the image file you would like to import and click Import.</p>	   <p>A screenshot of the 'Import' dialog box. The dialog shows a file explorer view of the desktop with various files listed. The file 'LASERCutter-2 (1)' is selected. Below the file list, there is a 'File name' field and a 'File format' dropdown menu set to 'All File Formats'. The 'Import' button is highlighted with a red rectangle.</p>
<p><b>35.</b> The cursor now indicates where the upper left corner of your image will go and displays some text.</p>	 <p>A screenshot showing the import cursor, which is a large 'P' with a red arrow pointing to the upper left corner. To the right of the cursor, the following text is displayed: 'LASERCutter-2 (1).ai', 'w: 18.321 in, h: 11.0 in', 'Click and drag to resize.', 'Press Enter to center on page.', and 'Press Spacebar to use original position.'</p>
<p><b>36.</b> Move your mouse to the location you want to place your image.</p>	 <p>A screenshot showing the import cursor, which is a large 'P' with a red arrow pointing to the upper left corner. To the right of the cursor, the following text is displayed: 'LASERCutter-2 (1).ai', 'w: 18.321 in, h: 11.0 in', 'Click and drag to resize.', 'Press Enter to center on page.', and 'Press Spacebar to use original position.'</p>

37. Click the left mouse button once to place your image.

If you have finished importing all the files, please proceed to **Define shapes**



## Color coding lines you would like CUT (through cut)/VECTOR ETCHED (engraved)

**Cutting**, also known as Vectoring, means moving a high-power laser beam slowly through a material, so as to entirely separate the part being cut from the original stock material.

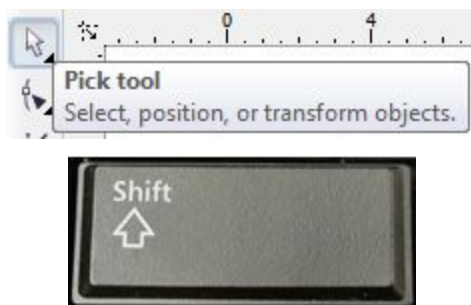
**Vector Etching** means the head of the laser cutter will follow the path of the vectors you create in your design, but the laser will not cut all the way through the material. This allows you to score or mark materials much faster than using raster engraving.

While the Epilog Fusion Pro 48 is able to do these tasks very well, **it won't automatically know the difference between cutting and etching vectors**. It will assume all vectors are being processed in the same way and group them all into one cutting or etching job unless you tell it not to. If you are only doing cuts with no vector etching, or vice versa, this is no problem, and you can proceed to step 45. However, if you are doing both in one run, then pay close attention to the following steps!



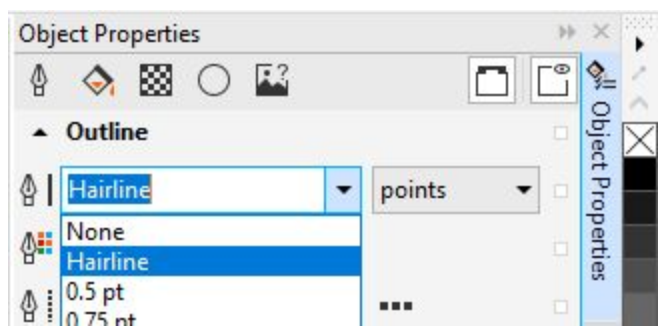
38. Use the Pick tool to select vector shapes you want to **cut** through.

**Hold the shift key** down while selecting objects to select multiple objects.



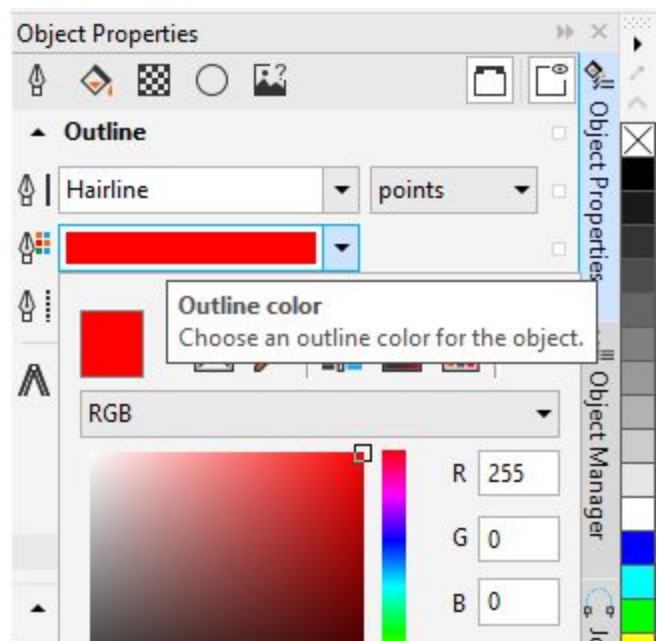


**39.** With your cut lines selected, go to the Object Properties, and select Hairline under the drop down menu. If you are using Adobe Illustrator, you will set the line width as 0.001”.



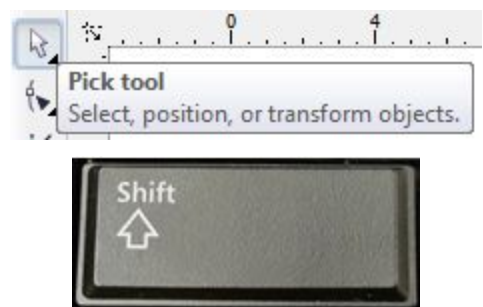
**40.** Go to the dropdown menu right below to change the outline color. Use the RGB fields to increase the Red, Green, or Blue levels.

A good practice is to make the R value for all cutting lines 255, while leaving G & B at 0. This will make the cut lines a vibrant red, which we can single out in the Epilog software later.

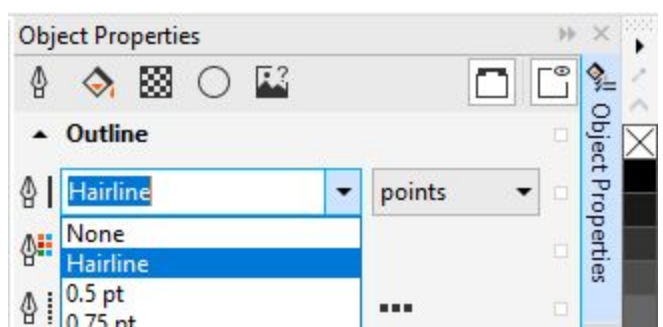


**41.** Now use the Pick tool to select vector shapes you want to **etch**.

**Hold the shift key** down while selecting objects to select multiple objects.

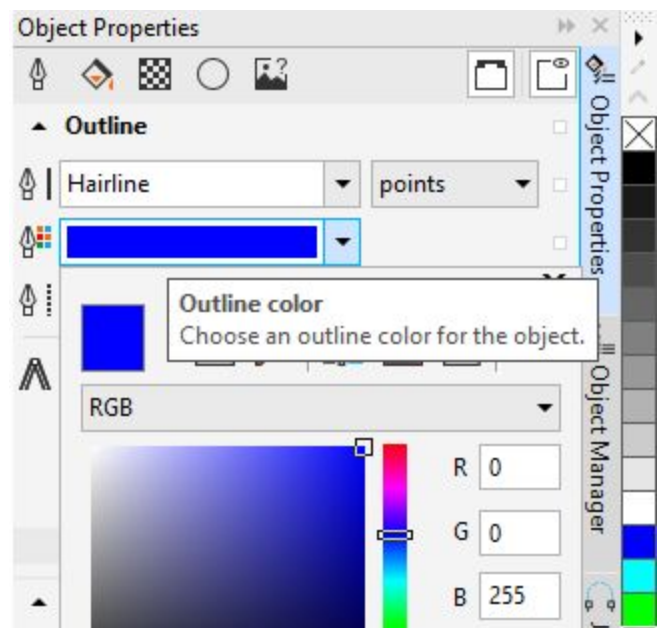


**42.** With your etch lines selected, go to the Object Properties, and select Hairline under the drop down menu. If you are using Adobe Illustrator, you will set the line width as 0.001”.



**43.** Go to the dropdown menu right below and use the RGB fields to again increase the Red, Green, and/or Blue levels.

A good practice is to make the B value for all etching lines 255, while leaving R & G at 0. This will make the etching lines a bright blue, which will stand out against the red cut lines and differentiate the two in the Epilog software.



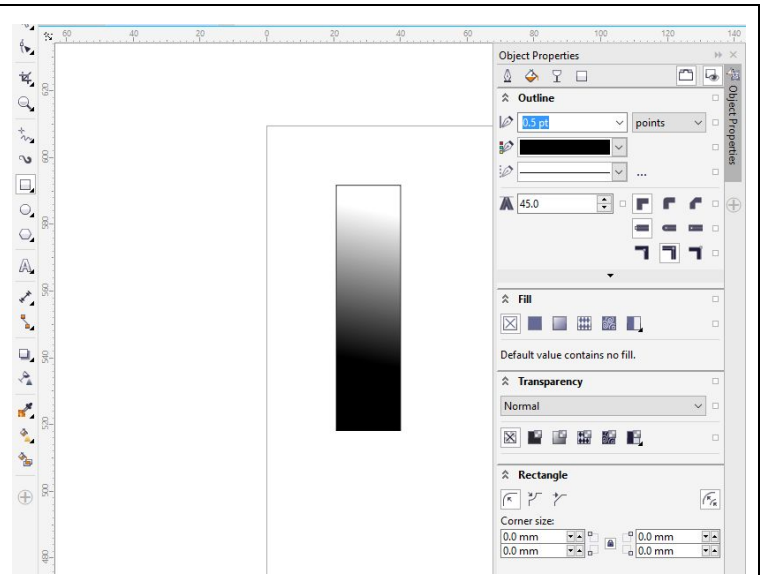
## Define shapes you would like to ETCH (surface pattern)

**Etching**, also known as Rastering, means moving a low-power laser beam very quickly over a material, so as to remove just a light amount of material from the surface of the original stock material. Unlike vector marking, raster etching can create detailed images.



**44.** Use the drawing tools to draw the vector shapes you would like the laser cutter to ETCH, or simply import an image you have.

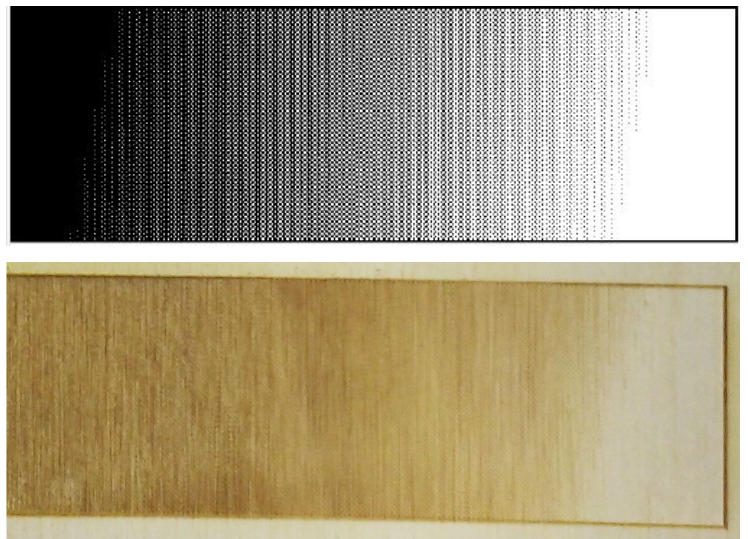
All objects in your design that are **not hairline thickness** will be interpreted as raster objects and will be ETCHED.



**45.** A note about etching from the Universal Laser User Guide: “All elements of the graphic interpreted as raster objects will be converted to **grayscale** and printed using the raster job settings with a grayscale dither pattern applied. A dither pattern is a method of mimicking shades of gray using patterns of dots with varying spacing. Dots further apart will appear lighter gray and dots closer together will appear darker gray. This is how the laser system is able to print shaded images and photographs. If you desire a solid background removal for certain elements of your graphic instead of a dither pattern, you must make those elements solid black in color.”

Basically, if you want tighter control over the way your image will look after being etched, make everything in your design **grayscale** and don't use colors.

You might want to directly convert the pattern/picture into grayscale. Please refer to [this tutorial](#) to learn how to do that in Coreldraw



## Before You Move On...

### Check your design for common mistakes

**46.** If you want a shape to be CUT or VECTOR ETCHED into your material, it must have a “hairline” width.

If you want a shape to be ETCHED, it **must be anything other than a “hairline” width line.**



**47.** Check your design for unexpected “Hairline Width” lines. If you have imported a DXF, CorelDraw, Illustrator, or other file, it may have contained Hairline Width vector lines that you are unaware of. Rest assured, the laser cutter will be aware of it!

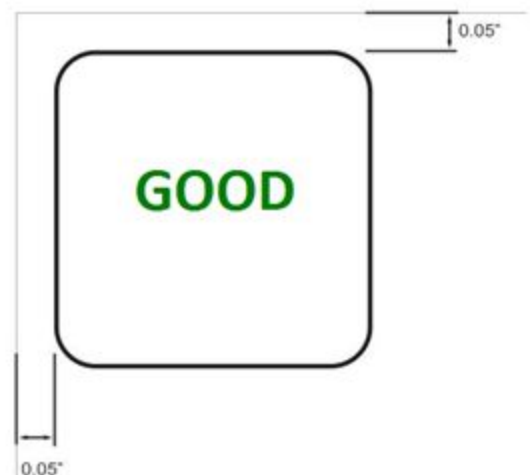
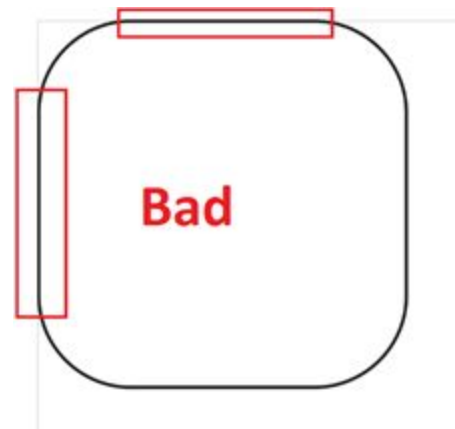
In order to prevent unexpected cuts into your material, look closely at all imported designs and if you find unwanted Hairline Width vector lines, either remove them or make the lines thicker so they are etched instead of cut.

Also remove any unwanted text that was in the DXF unless you want it to be etched.



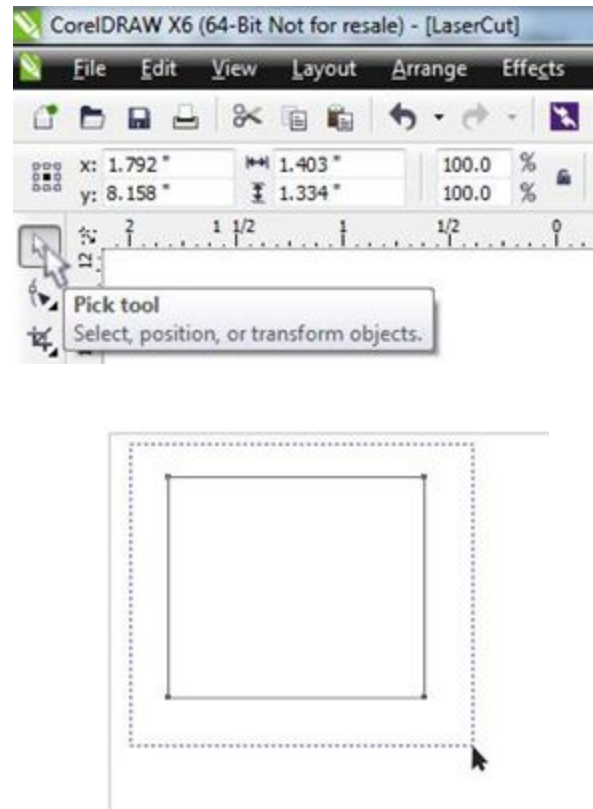
**48.** Your design must be within the bounds of the machine by at least 0.050 inches (1.27 mm). Otherwise, the laser could hit the rulers in the bed of the machine.

Look at the image on the right to understand what this means more clearly.

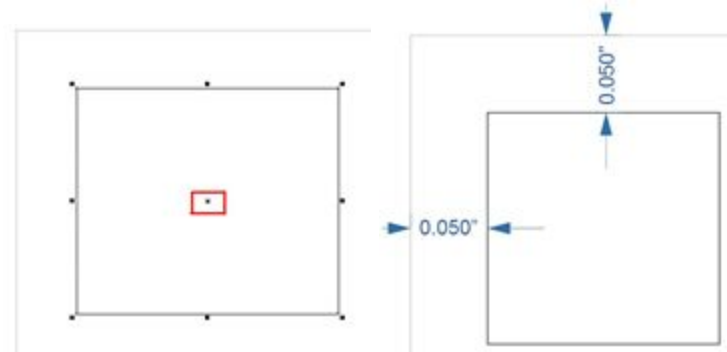




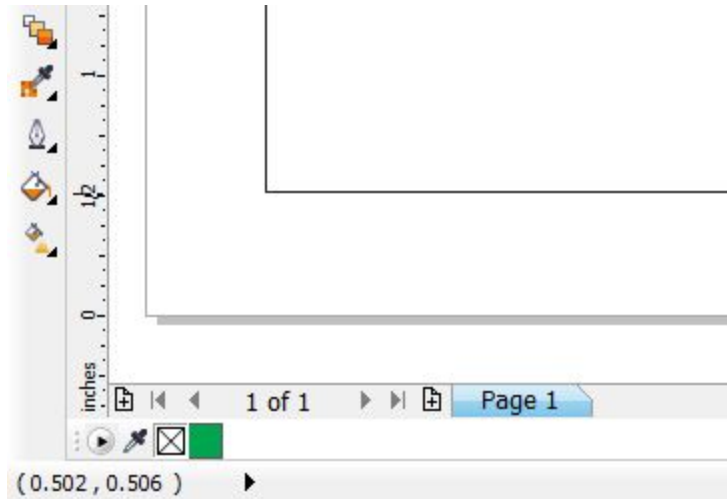
49. Use the Pick tool to draw a selection box around any shapes you need to move.



50. A small “X” will appear in the center of your selection. Click and drag this to drag your shapes so they are at least 0.050 inches (1.27 mm) from the edges of the machine.



51. Double check that you have a safe margin by moving your mouse around the edges of your canvas, and observing the Mouse X and Mouse Y positions down below in the status bar. Again, make sure there is at least 0.050 inches (1.27mm) between the edges of your canvas and the edges of your shapes.



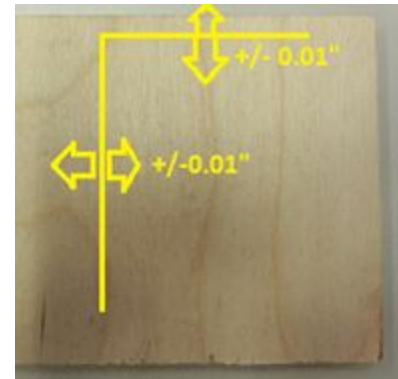
**52.** When cutting, the laser beam will remove a slice of material (called a “kerf”) approximately 0.063 inches (1/16”) wide. This results in parts slightly smaller than you designed. For example, if you want to end up with a 1” diameter disc of material, your drawing may need to be of a 1.063” diameter circle in order to account for the cutting kerf.

If you do not care about the exact final size of your shapes, you can safely ignore this step.

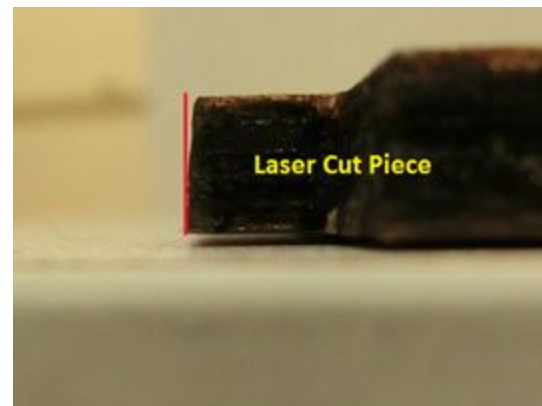
If you care about the exact final size of your shapes, change them to account for the kerf. The kerf will vary depending on the type of material, the material thickness, how well focused the laser is, and other variables. The only way to know what the kerf will be is to run a sample cut and measure the kerf with a ruler or a pair of calipers.



**53.** Accuracy along the length and width of the bed is only guaranteed to be within +/- 0.010 inches. If your design requires a tighter tolerance, do not use the laser cutter, use another machine.



**54.** The edges cut by the laser will not be completely vertical. They will be angled by a few degrees due to the physics of the laser beam focusing on your material. If you need perfectly vertical cuts, do not use the laser cutter, use another machine.



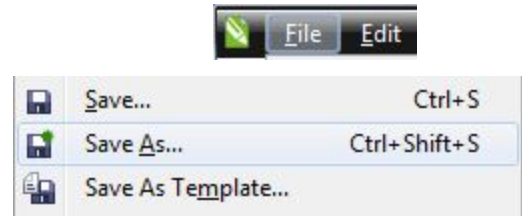
## Get a student technician to check your design now

**55.** There are common mistakes that can damage the laser cutter or ruin your material. Until you have used the laser cutter several times and are comfortable with the process, see a student technician to check your work.



## Save your work

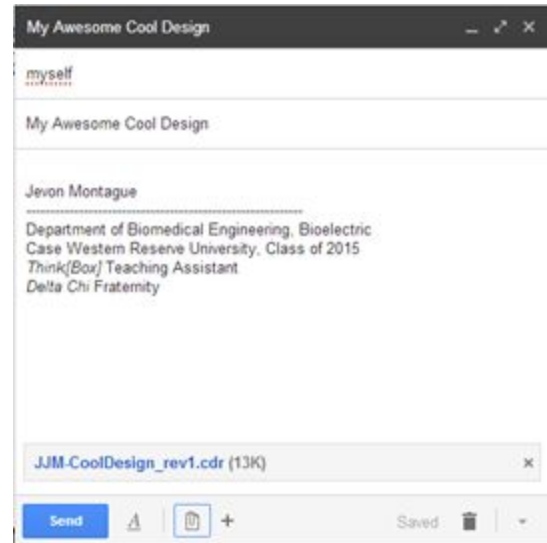
56. Now is a good time to save your work. You might want to email it to yourself or save it on a thumb drive.



57. If you are signed in to the computer using the think[box] guest account, please note that the files saved on the computer may be deleted at any point, by any user.

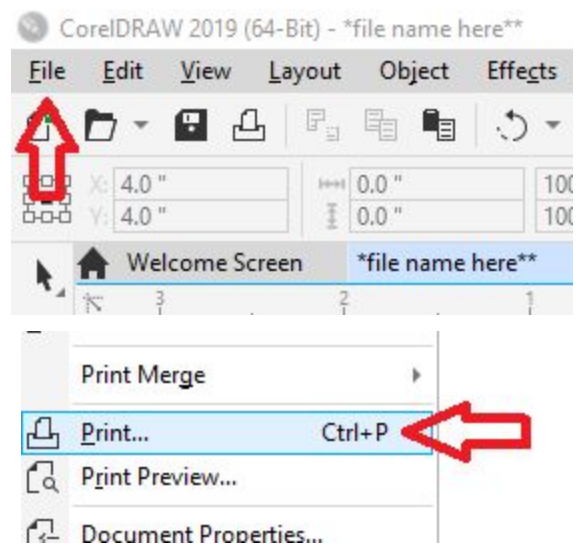
Email the file to yourself.

Keep in mind that **we are not responsible** for any lost user files if they weren't copied or emailed from think[box] computer.



## Prepare your job to be sent to a laser cutter

58. In CorelDraw, Click File → Print to bring up the printer dialogue.

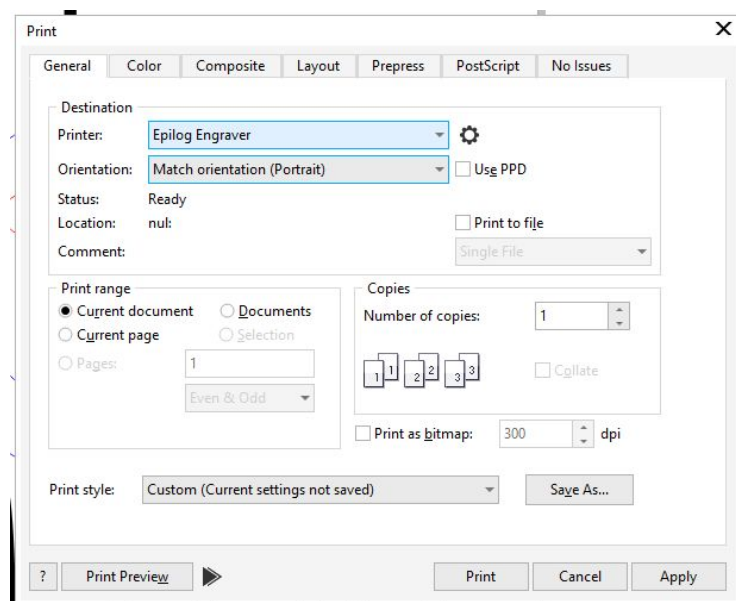


**59.** The printer dialog will appear.

A. Select “epilog engraver.” Each laser is connected to this name, so you’ll specify which device you’re using later in the job manager once the file is ready.

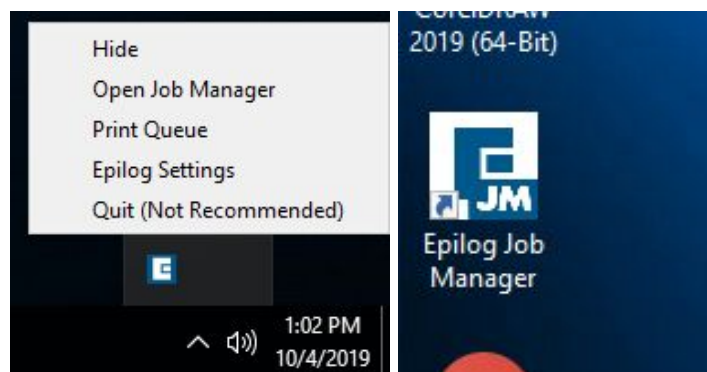
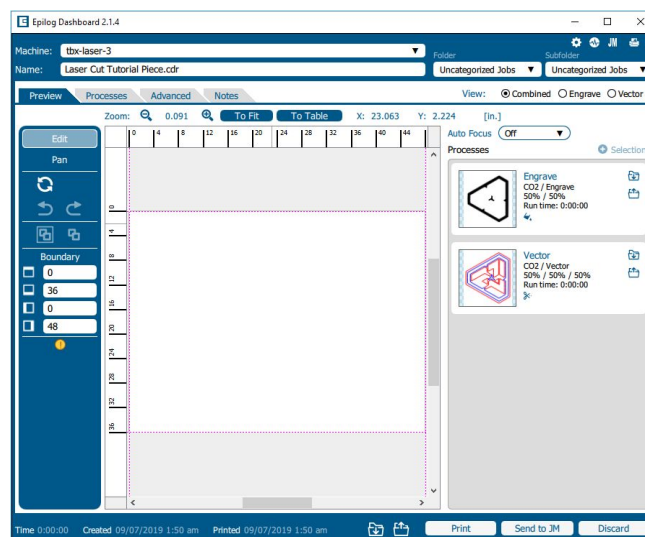
B. In the “Page” drop-down immediately under, select “Match orientation and size” if the option is there. If it is not, don’t worry, and proceed using the standard “Match orientation” setting.

C. Click Apply, then Print. This will save your settings, at least until you restart CorelDraw.



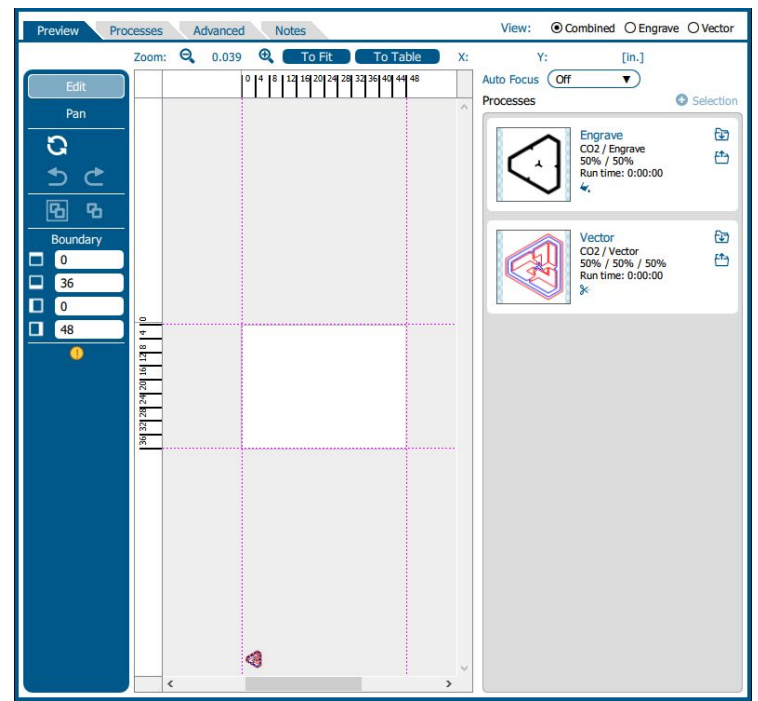
**60.** The Epilog Dashboard should now open. If it does not pop up, check if it is already open but buried under another window.

If it is not open whatsoever, click on the up arrow near the bottom right of the screen and right click on the blue and white Epilog logo, then select “Quit (not recommended)”. From there, you should be able to restart the Job Manager by clicking on the desktop shortcut.



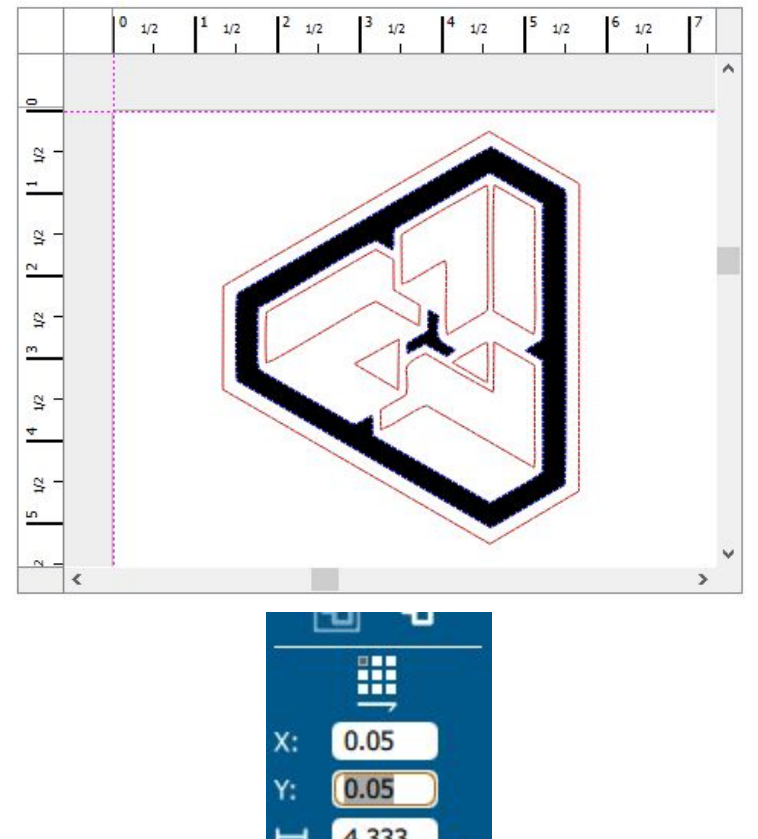


**61.** Find your design in the software. The different print dialogue settings can place it in very different positions, so it may be centered on the bed, or it might be very far away in the background. If you do not see your design at first, you'll likely need to zoom out quite a bit.

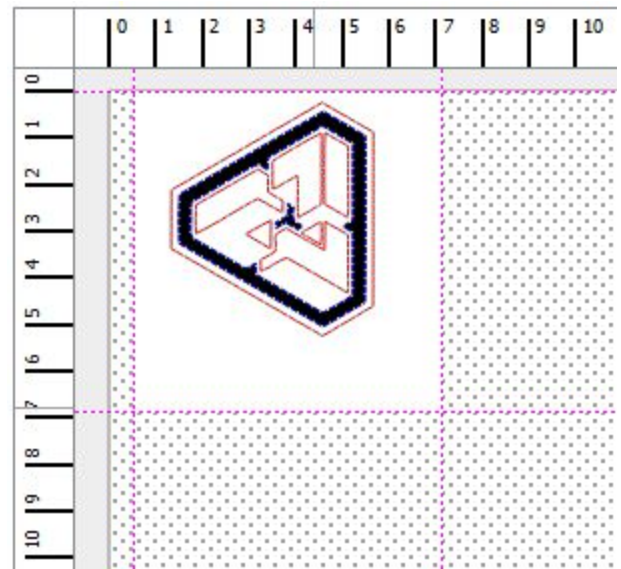


**62.** Select your design and drag it to the top left of the bed, or wherever you would like it to be on your piece. Make sure not to put it too close to the edge.

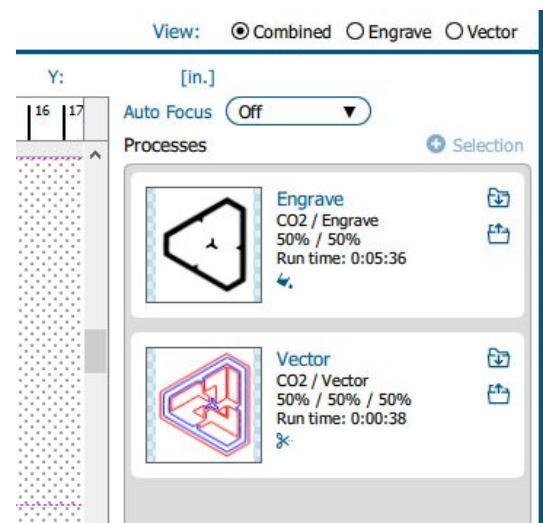
An easy way to ensure you're a proper distance away from the rulers is to click on the top left dot in the 3x3 grid pictured here and then input "0.05" into the X and Y fields.



**63.** The pink lines surrounding the bed are the boundary lines. Move them in to surround your piece, but take care not to have them overlap your design. The laser will not cut anything outside the boundary lines.

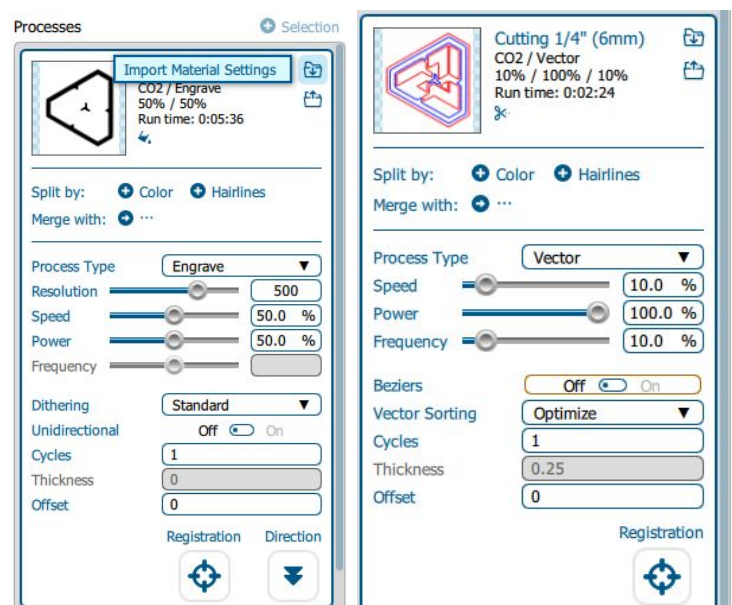


**64.** Job settings will vary according to the material you are cutting and its thickness. You'll need to set them for each step by clicking the different process sections in the column on the right.



**65.** You can find these settings from [the spreadsheet on our website](#) and input them manually, or import them directly from the laser's internal setting database by clicking the file icon with a downward pointing arrow.

If your material isn't listed on our online spreadsheet or the machine database, or if you just want someone to double-check your settings, see a student technician.



**66.** This is also where jobs can be split by color, especially useful for combined vector engraving and cutting jobs.

Make sure your vector cutting jobs come after your vector engraving jobs. This can be done by clicking and dragging to reorder the processes.



**67. Make sure your vectoring jobs do NOT have the “Beziers” setting on.** This causes some weird behavior with cutting corners and can ruin jobs.

Also, using the setting “inside out” will give cutting jobs a more logical cutting priority system, where internal cuts are made before outer ones.

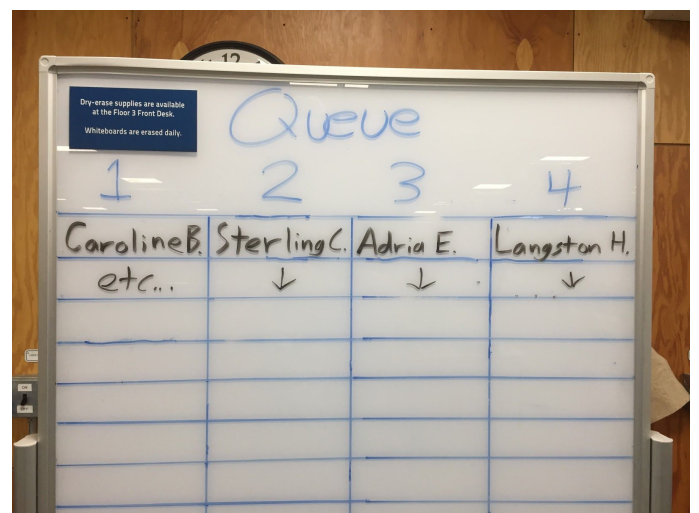


## Machine Setup

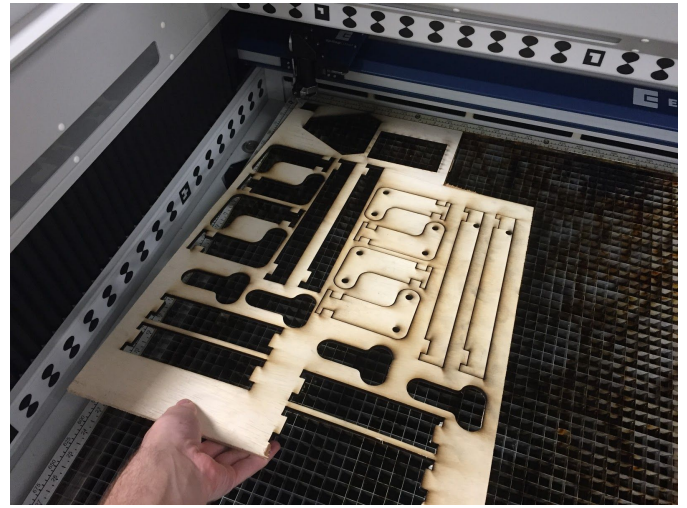
**68.** Walk over to the laser cutters and see if one is available. You will know it's available if the laser cutter bed is empty (does not have a workpiece on it) and if the queue is empty.



**69.** If none of the laser cutters are available right now, add your name to the queue and wait until it is your turn. When it is your turn you may run one job, and then add your name to the queue again. This is how we keep things fair and make sure one person cannot monopolize the machine. If someone is not following the rules, talk with them - they may just be unaware. If there is any trouble, see a student technician or a full-time staff member.



**70.** Once you've located an available laser cutter, and your name is in the proper place in the queue, open the lid and place your piece so that it will line up with your design. This will most likely be the top left of the bed, against the vertical and horizontal rulers. While placing your material, be careful not to hit the delicate laser head with your workpiece.



**71. AGAIN,** if your workpiece is slightly cupped (1/4 inch or less) flip it so that the material is **concave** (like a mountain, not like a valley), so the highest point in your material is somewhere towards the center of the bed. This is important so that you can **focus on the high point**, and so that your workpiece doesn't rock back and forth.



**72. WARNING.** The next step is very delicate. You will be moving the laser bed closer towards the laser head. If you do not follow the instructions carefully, or if you are not paying very close attention to what you are doing, you can crash the laser bed into the head, and permanently damage the machine. If you do not have much experience using machines, or if you are not confident in your eye-hand coordination, now would be a good time to ask a student technician to show you how to focus the laser. They are very friendly and would be very happy to help you with this.



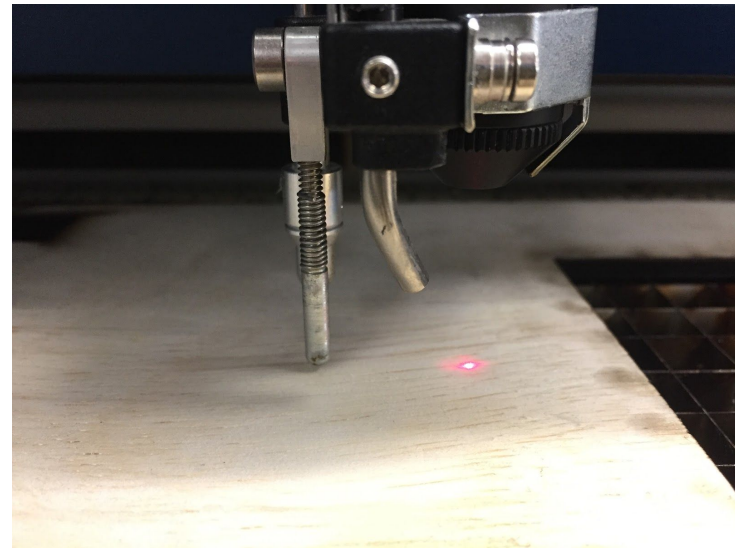


**73.** On the laser cutter touchscreen, tap the fourth button to open the jogging menu. Use the joystick to maneuver the head of the laser over the center of your piece. Make sure the head is positioned over the highest point of your material.

The third button, colored red in this photo, will activate a pinpointer that will show you exactly where the laser's position is on the bed and/or your piece. While nonessential, it's a nifty feature for alignment.



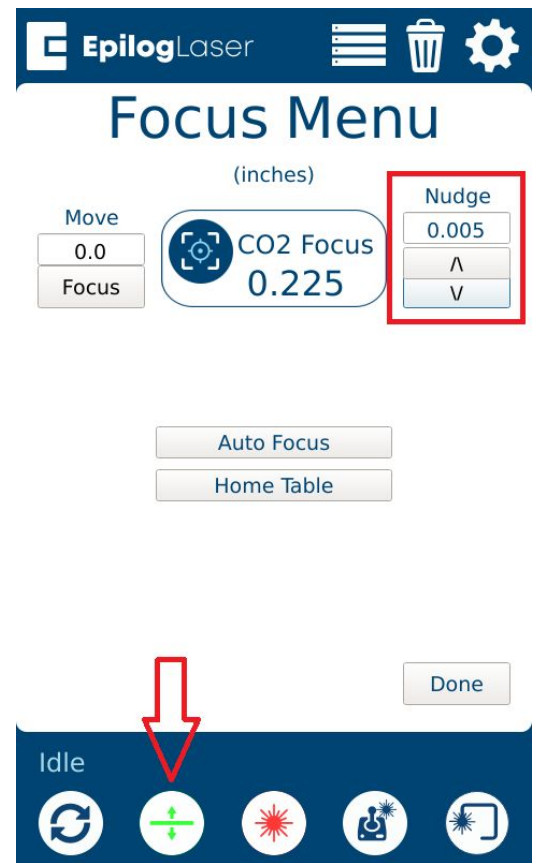
**74.** On the laser head, there is a metal rod attached to a spring and hinge on the left of the laser tube. Pull the top of the rod and it will drop down over your piece.



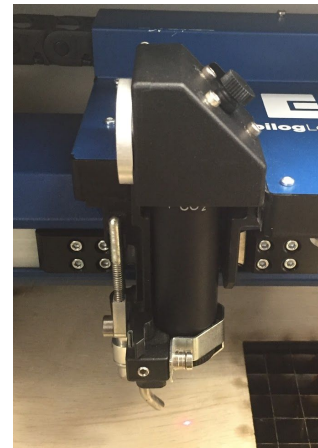


**75.** Tap the second button to open the bed height adjustment menu, and use the joystick to carefully move the bed to the height where the focus rod is just barely touching your piece. This might mean raising or lowering the bed, depending on its initial height from the job before yours.

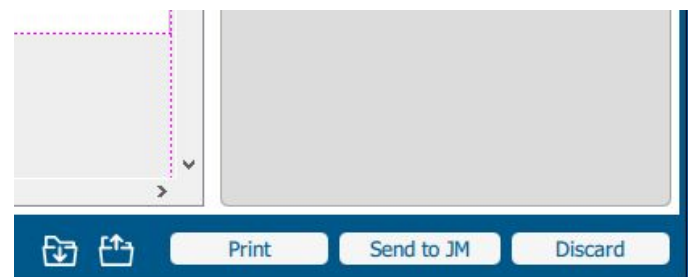
Use the “nudge” buttons to make finer adjustments for best results.



**76.** Flip the focus rod back up so that it is held by the magnet and remains upright. You do not want it to be down during your job, as it has the potential to disturb your piece(s) mid-job.



**77.** Return to your computer station and select the correct laser from the drop-down menu at the top of the job manager. It should give you a list of our four laser cutters. Select the one your piece is in, with laser 1 being on the far left, and laser 4 on the far right. Then click on “Print” near the bottom right and your job will be sent to that machine.



**78.** Open the job menu by tapping on the bulleted list icon at the top of the screen. If you tap and hold on your job name, it will display the settings you input earlier.

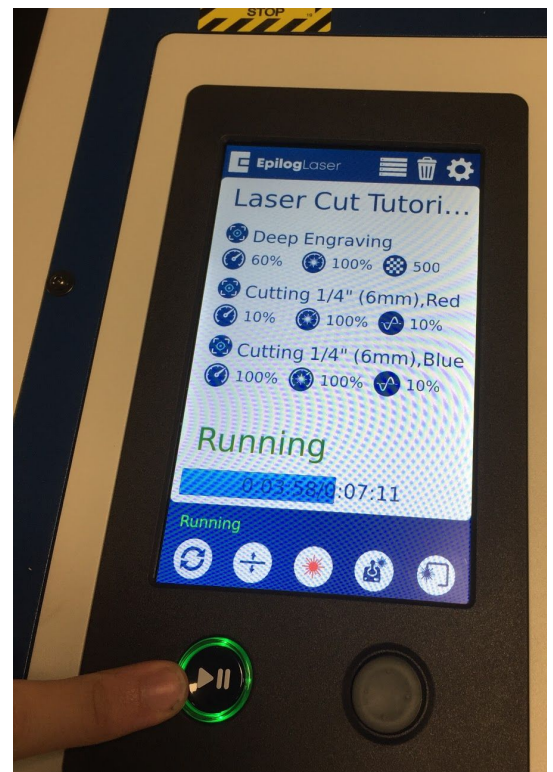
If these are not correct, check the job list again and ensure you have the right job. If the settings of your job are all set at zero, or otherwise incorrect, see a student technician to request troubleshooting assistance.



**79.** Before you start your job, check the green lights on the side of the machine. The two leftmost with the R and L lock icons indicate the door latch sensors. Both should be lit when the laser's lid is closed. If one of them is not lit, then the lid is not fully closed and **the laser will not activate**. Press gently on both sides of the lid until it settles fully, usually punctuated with a click of the responsible lid latch.



**80.** With correct focusing, positioning, and settings, your job is good to go! Press the large play button and your job will start. You can see the time remaining in your job at any time on the touch screen. You can also press the pause/play button to stop/resume your job if needed.



Running

0:01:31/0:01:35

Running



## Stay at the machine and watch for issues

**81.** Stay near the machine until your job is completely finished.





**82.** Workpieces sometimes catch fire, so it's important to know the location of the E-Stop, fire blankets, and fire extinguisher.

It is normal for small, localized fires to pop up sporadically when cutting some materials, especially thicker wood. However, if you see a larger, sustained fire in the bed of a laser, immediately hit the E-Stop above the touch screen.

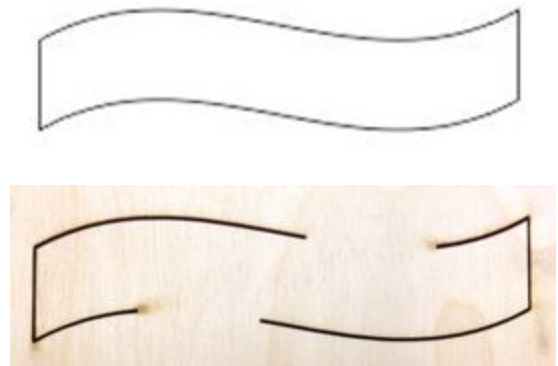
There are multiple fire blankets located on the back wall in the gaps between the laser cutters. You can use these fireproof blankets to smother any bed fire. This is preferable to using the fire extinguisher because they are closer and do not need to be refilled after use.

Take note of the fire extinguisher mounted on the wall between Laser Cutter 2 and Laser Cutter 3. This is a special kind of fire extinguisher that's safe to use in the Laser Cutter. It's called Halotron and it doesn't leave the powdery mess that ABC type extinguishers leave, which would be difficult to clean off the laser cutter's optics and mechanics. Feel free to use this extinguisher anytime. There is no penalty or cost. Go for it! Better safe than sorry.



**83.** If the laser seems to be skipping part of the vector cut operation, what's probably happening is the laser tube is overheating and experiencing automatic thermal shutdown. If this is the case, the solution is to lower the power and slow the speed. Lowering the power will help prevent the laser tube from overheating.

Did you use more power than you saw in the Speed & Power document? Overdoing this can hurt the machine and lower the life of the laser optics. It's always better to use lower power and either slower speed or multiple passes, depending on what seems to be giving the best quality cuts.



**84.** If the laser beam starts to etch the metal rulers on the edges of the bed, or if the shapes being cut or etched are distorted or stretched, stop the job and alert a student technician.



**Inspect your workpiece before removing it from the machine**

**85. Please provide a couple minutes between the end of your laser cut job and opening the hood to prevent fumes from leaking out of the exhaust system.**

**86.** Look at your workpiece. Did everything etch that you were expecting? If not, see a student technician to check your CorelDraw file and job settings.

**87.** If you were cutting, be aware that the machine may not have cut all the way through your workpiece. There are many sources of variability, from the density and uniformity and moisture content of your material to how clean the laser optics are.

Open the lid and firmly press down on your workpiece. With your other hand, try gently moving the pieces you wanted to cut. If they are not moving, chances are the cut did not go all the way through your material.

**88.** If you were cutting and the material did not cut all the way through, go back to the job manager on the computer and calibrate the settings in order to run your job again. Delete anything that has already been cut or etched, and depending on how close the rest of the cuts were, you could make the speed a bit higher. You can always run your job several times to try to cut all the way through your material.

In the future, you can try changing the Speed and Power settings so that it cuts all the way through on the first pass. However, the quality of the cut will suffer, and the edges of your material will probably be a bit more toasty. It is not recommended to raise power by more than 15% or 20% without running it by a student technician first.



## 1. Clean Up



**89.** Promptly remove your material from the laser cutter.



**90.** Remove any scraps from the laser-cutter bed, and dispose of them in the large blue scrap bin next to the laser cutter.



**91. DO NOT** put any scraps in the regular trash receptacles. The trash bags are very thin, and laser-cut wood and plastic scraps have sharp edges that tear the bags, causing the contents to spill out and create a big mess for the custodial staff. Be considerate to them, their job is not easy. Put your scraps in the designated bin.



**92.** Absolutely do not leave your scraps in the laser cutter or on a workbench for someone else to clean. That is rude.



**93.** If there are other people waiting to use the laser cutter, let them know you are finished.

**94.** To clean the burn marks off wooden workpieces head over to the dirty rooms. Use either fine grit sandpaper to sand the marks off or use denatured alcohol from the yellow flammables cabinet and blue shop towels to wipe away the marks.



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