

Universal Laser Systems

VLS 3.50 Laser Cutter/Engraver Tutorial

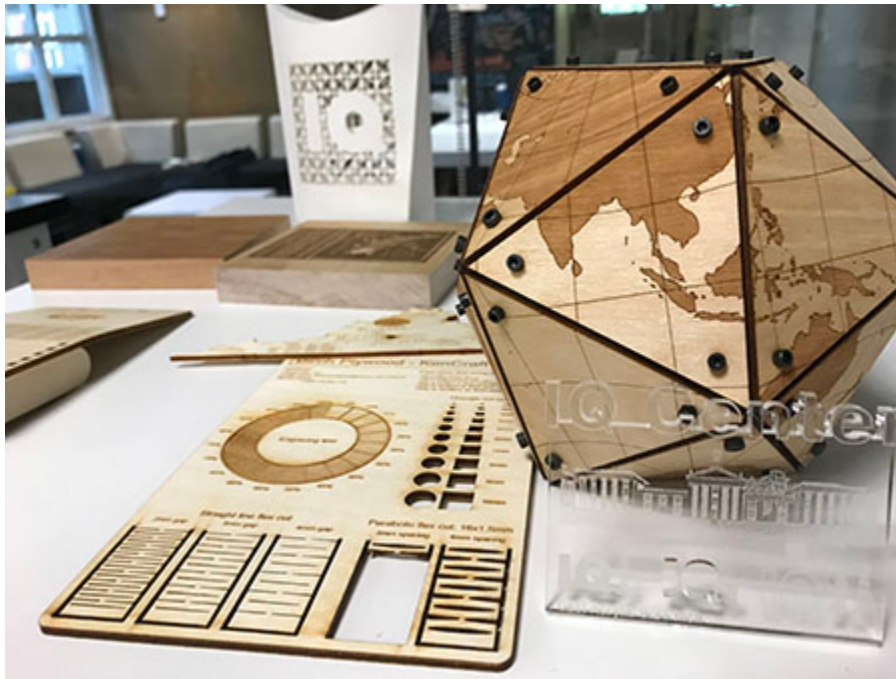
Introduction

The IQ Center is home to our very own laser cutter/engraver, located in the [Physical/Mechanical Lab \(Science Addition 202D\)](#). The VLS 3.50 has the ability to cut or engrave pieces of wood, glass, or acrylic to meet your unique design.

Students can come to the [IQ Center](#) with their design, made in Adobe Illustrator, and upload it onto a special interface that sends the design to the laser cutter/engraver.

With a single 50 watt laser, the laser cutter/engraver can cut or engrave [almost any material](#) within the span of seconds. The speed and accuracy of the laser cutter/engraver makes it one of the most popular machines in the IQ Center.

Many different projects have been made using the laser cutter/engraver, including a wooden globe, robotics projects, and sculpture projects.



PLEASE READ ON TO LEARN WHAT YOU NEED TO KNOW TO USE THE LASER CUTTER/ENGRAVER!



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What Can I Make with the VLS 3.5 Laser Cutter/Engraver?

Vector and raster images

Raster and vector are two digital graphics file types which require different modes of laser processing. The main difference between vector and raster graphics is that raster images are composed of thousands (or millions) of pixels, arranged in rows and columns, and vector images, which are made of thin lines and curves known as paths, are rooted in mathematical theory.

You can identify a raster (sometimes called bitmap) image by looking at it very closely. If you zoom in enough, you will be able to see the square outlines of each pixel (especially around edges where there are dramatic color contrasts). Some common formats for raster files are: BMP, JPG, PNG, GIF.

You can also identify a vector image by looking at its edge. A vector image will always appear smooth no matter how much you enlarge it or how close you zoom in. Photographs are not vector graphics. Vector files can be saved, accessed, and exported in four main formats – AI, EPS, SVG, and PDF.



Raster engraving and vector engraving

Raster engraving is the standard process for engraving. This process is similar to how an inkjet printer applies ink—printed line by line, point by point—but instead of ink being applied, material is removed pixel by pixel by the laser.

The raster method is used to fill areas, and the vector method is used to follow outlines.



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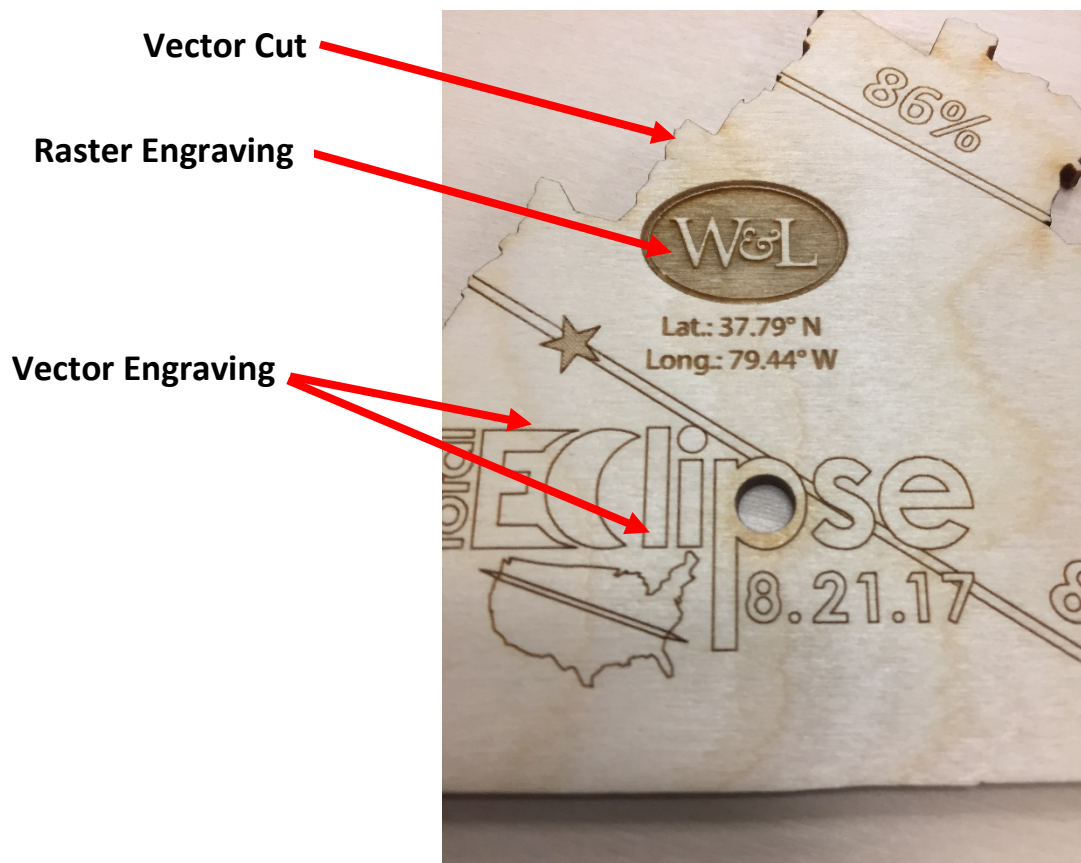
Vector engraving and vector cutting

Vector engraving is essentially the same as in vector cutting. The difference is the power setting. If a low power setting is chosen, the line is “scored” as engraving. A higher power produces a complete cut.

When to raster engrave and when to vector engrave?

For filled letters or shapes and photographs, raster engraving is the most appropriate method. If only thin lines are to be engraved, vector engraving is advantageous and may also be faster. In the cutting process, solely this method is used.

As a general rule of thumb, if your surface details consist of large, relatively simple shapes, opt for vector engraving, as this is the quicker and thus more economic laser engraving method. However, if the design covers a large area that contains many intricate details, choose raster engraving.



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Safety & Rules

The VLS 3.5 Laser Cutter/Engraver is a potentially dangerous machine. The most common safety risk while using the laser cutter comes from fire. The laser cutter can also produce dangerous fumes.

IT IS REQUIRED THAT YOU RECEIVE TRAINING PRIOR TO USE OF THE LASER CUTTER/ENGRAVER!

W&L faculty, staff, and students must meet with Dave Pfaff (dpfaff@wlu.edu) to learn how to properly operate the laser cutter/engraver.

IT IS REQUIRED THAT YOU STAY WITH THE LASER CUTTER/ENGRAVER AT ALL TIMES DURING OPERATION!

It is your responsibility to sit in front of the machine and watch the entire job until it is finished. If you walk away, an IQ Center staff member will stop the machine due to the potential fire hazard. Cell phones/texting, and laptop or desktop computer use are not permitted while monitoring a job.

If at any time you notice anything unusual, shut off the laser cutter/engraver immediately! This includes fire, loose parts, warped materials, or anything that looks or sounds strange. WHEN IN DOUBT, SHUT IT OFF!

- Lift the lid. This will often stop small flames.
- Turn off the exhaust system.
- Remove the material if it is safe to grab a corner. Move the material to the sink.
- If your job begins to produce large flames and/or excessive smoke, use the fire extinguisher that is next to the entrance and immediately notify the nearest IQ Center staff member.

IT IS REQUIRED THAT YOU REMOVE ALL MATERIALS, INCLUDING SCRAP MATERIAL, AFTER USE!

You must remove the cutting table and clean out the interior. Scrap material left in the laser system, including materials that collect in the removable cutting table, can be a fire hazard. *Failure to do so may result in damage to the machine and possible bodily harm to you and other users.*



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Laser Cutter/Engraver Materials

All materials to be used must be approved prior to use of the Laser Cutter/Engraver.

Approved Materials

Note: MATERIALS CAN BE NO MORE THAN 1/4" THICK.

Material	Raster Engraving	Vector Engraving	Vector Cut
Corrugated Cardboard	OK	OK	OK
Uncoated Paper	OK	OK	OK
Chipboard/Matboard/Museum board	OK	OK	OK
Resale Acrylic	OK	OK	OK
Interior Plywood	OK	OK	OK
Balsa Wood/Basswood	OK	OK	OK
Hardwoods (Domestic only)	OK	OK	OK
MDF (medium density fiber board)	OK	OK	OK
Marble	OK	OK	NO!
Masonite	OK	OK	OK
Resale Natural Cork	OK	OK	OK
Resale Vegetable tanned leather	OK	OK	OK
Resale Muslin	OK	OK	OK
Unmounted Linoleum	OK	OK	OK
Glass	OK	OK	NO!

Banned Materials

Some materials can be extremely toxic and/or damaging to the machine. Reflective materials should never be cut, as they can cause the laser beam to reflect and bounce out of the enclosure. ***The materials listed below are banned:***

- Any painted materials
- Plastics of unknown origin
- PVC, ABS, PLA
- HDPE (Milk bottle), PET, PETG, Delrin, etc.
- Bending Plywood, Tropical Hardwoods
- Foam, Styrene, Polystyrene, PolyPropylene, Depron, Gator
- Fiberglass
- Nylon, Polyester, Vinyl
- Corian



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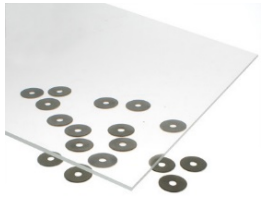
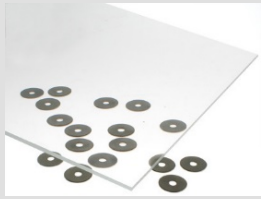
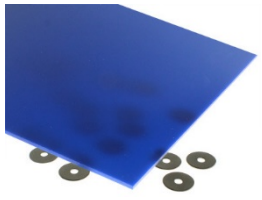
Approved Vendors

The following vendors are recommended for purchasing approved materials (see list of approved materials above):

- Inventables: <https://www.inventables.com/categories/materials>
- ACME Plastics: <https://www.acmeplastics.com/>
- Amazon: <https://www.amazon.com/>
- Rowmark products (available from various vendors)

Approved Materials Available for Purchase

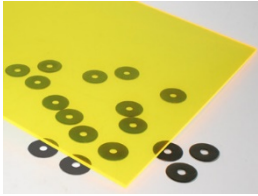

The IQ Center has some approved materials (subject to availability) that are available for purchase. Payment (through your student account) will be accepted online at <http://iq.wlu.edu/pay>.

Image	Material	Thickness	Price Per 12 in x 24 in Sheet
	Clear Acrylic	1/8"	\$10.00
	Clear Acrylic	1/4"	\$20.00
	Colored Acrylic	1/8"	\$12.00



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Image	Material	Thickness	Price Per 12 in x 24 in Sheet
	Fluorescent Acrylic	1/8"	\$15.00
	Plywood	1/8"	\$9.00

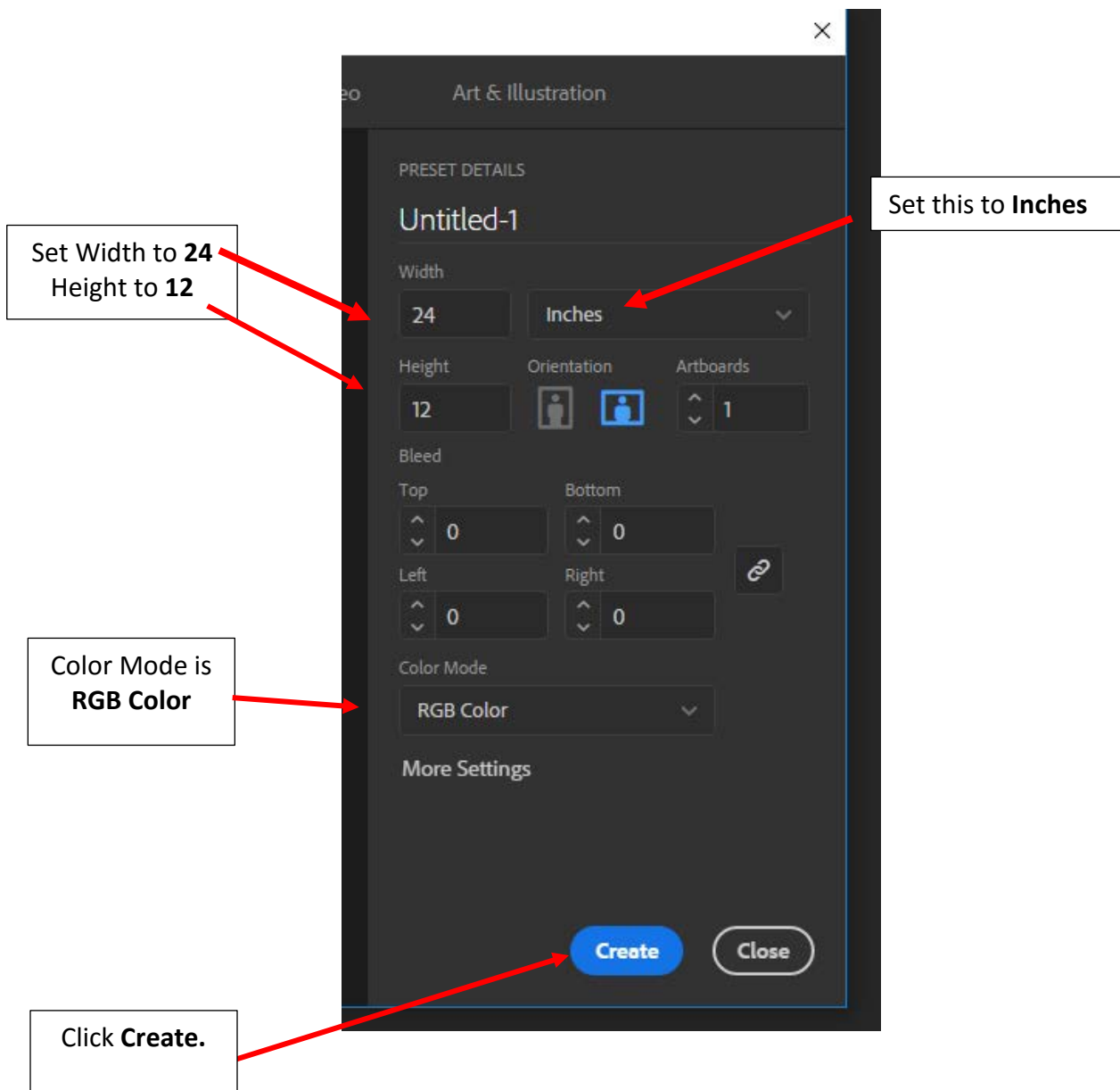
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Working with Illustrator

Open Adobe Illustrator:

File->New, On the right side of the screen select Art and Illustration. Change the settings as shown below:



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Preparing Your Graphics in Illustrator

The laser cutter/engraver can make three different types of cuts. All cuts can be sent from the same Illustrator file. Graphics in the file are grouped into different colors which allow the laser cutter to distinguish different cuts from one another. Colors are also used to determine the order in which vector cuts and engravings take place.

Cut Type	Graphics Requirements	Single/Multi-pass	Order	End Result
Raster Engraving	<ul style="list-style-type: none"> • Filled shapes or text • Images (jpg, bitmap, etc.) • Lines with heavy stroke weights (+0.072 pt) • Gradations 	Multi-pass (like an inkjet printer)	Before vector lines, following color table	Engraved area (power of the laser is limited to prevent cutting through)
Vector Engraving	Lines with these properties: <ul style="list-style-type: none"> • 0.072 pt. stroke weight • Aligned to center • No brushstrokes • No dashed lines 	Single pass (following vector path)	Dependent on color	Engraved line (power of the laser is limited to prevent cutting through)
Vector Cut				

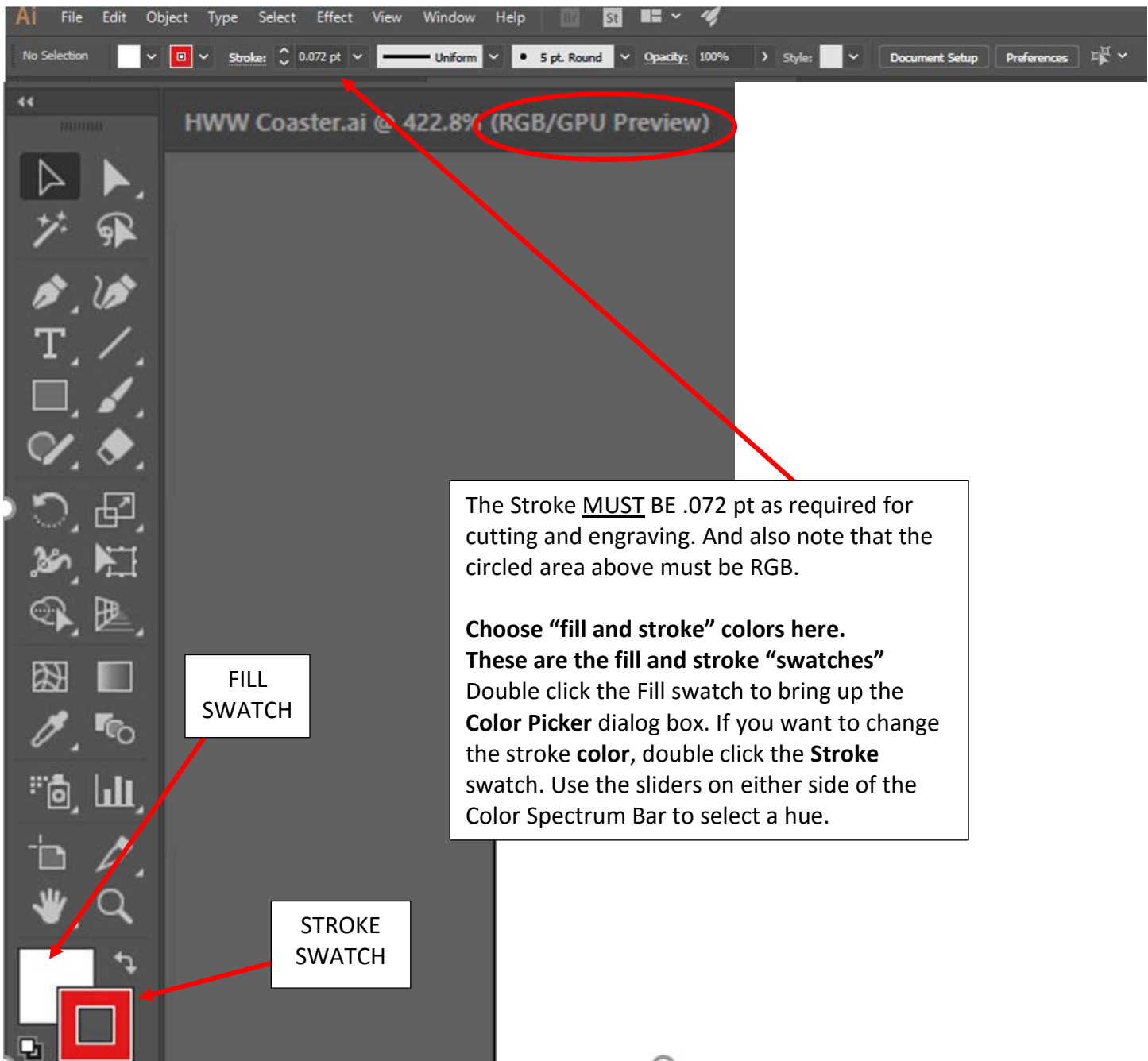
Color	Order	Red Value	Green Value	Blue Value
Black	1st	0	0	0
Red	2nd	255	0	0
Blue	5th	0	0	255

IMPORTANT: You MUST use the exact RGB color values listed in the table above and confirm your Illustrator document is in RGB color mode (NOT CMYK), otherwise the laser cutter/engraver will not read your file and it will not be able to engrave/cut!



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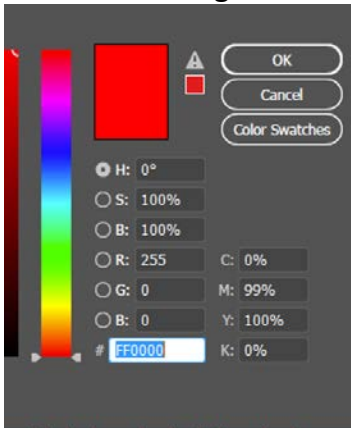
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Red is for cutting. Choose these settings in the color selector:



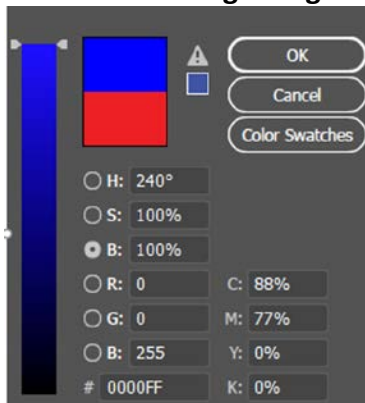
Vector Cut: RED

R: 255

G: 0

B: 0

Blue is vector engraving. Choose these settings in the color selector:



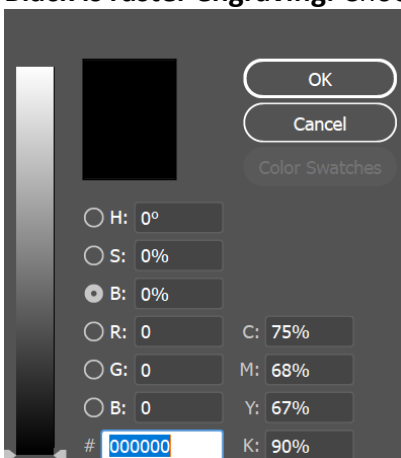
Vector Engrave: BLUE

R: 0

G: 0

B: 255

Black is raster engraving. Choose these settings in the color selector:



Raster Engrave: Black

R: 0

G: 0

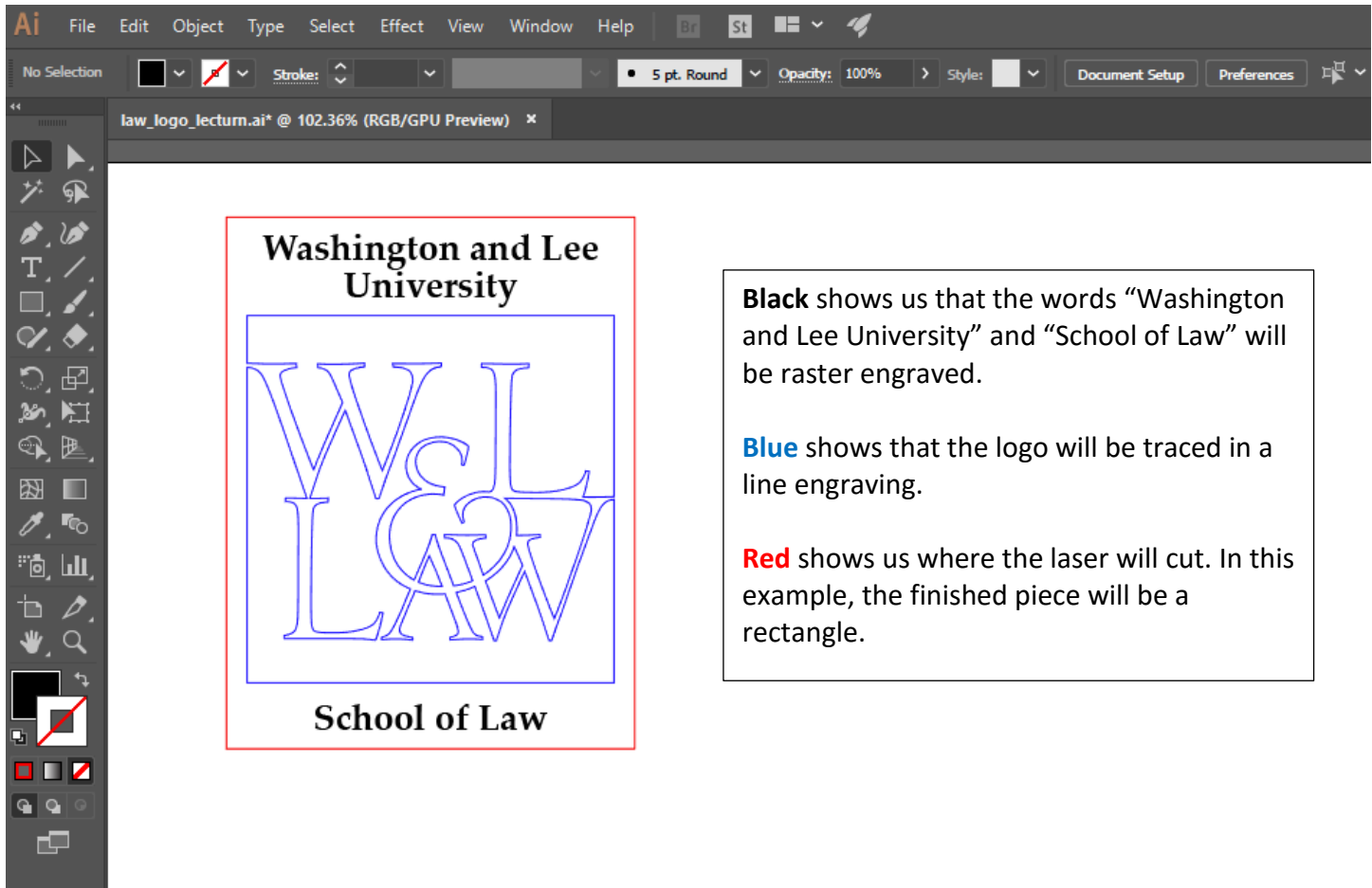
B: 0



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The finished .ai file in Illustrator:



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Print Settings

From Illustrator menu, Select File>Print (or Ctrl+P or Command+P)

Select “VLS 3.50” from the printer dropdown.

To select material settings, click the “Setup” button on the print dialog.

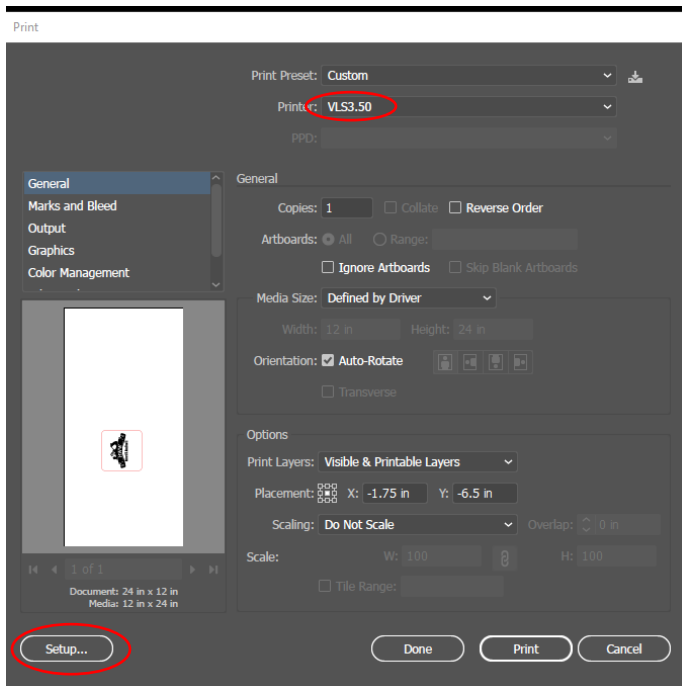


Figure 1

Select “Continue” from the dialog box.

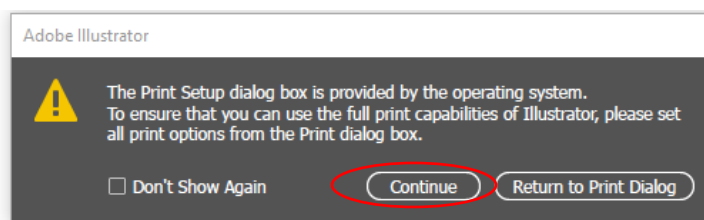


Figure 2



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Select the “Preferences” button on this dialog box.

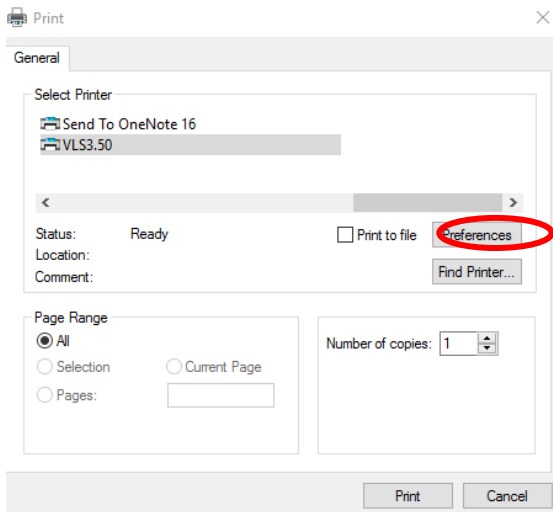


Figure 3

This launches the laser setting dialog box. Select the Materials Database tab.

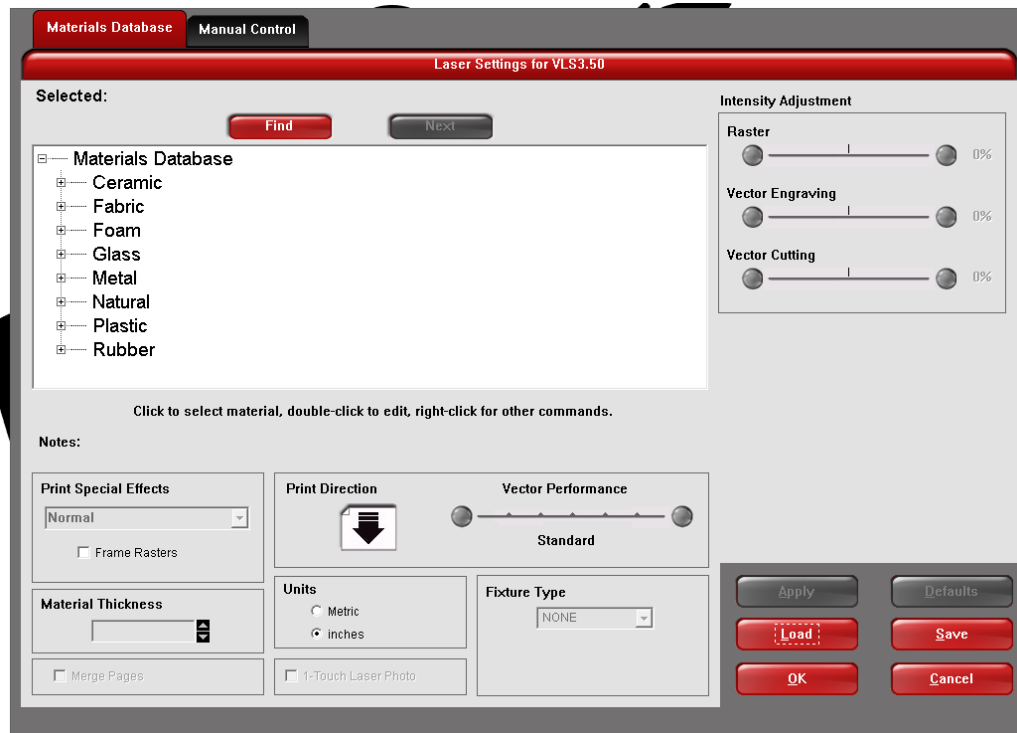


Figure 4



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In this dialog box select the material that you are using from the list. For example, if you are cutting 1/8-inch plywood, select Natural>Wood>Medium Wood>Birch.

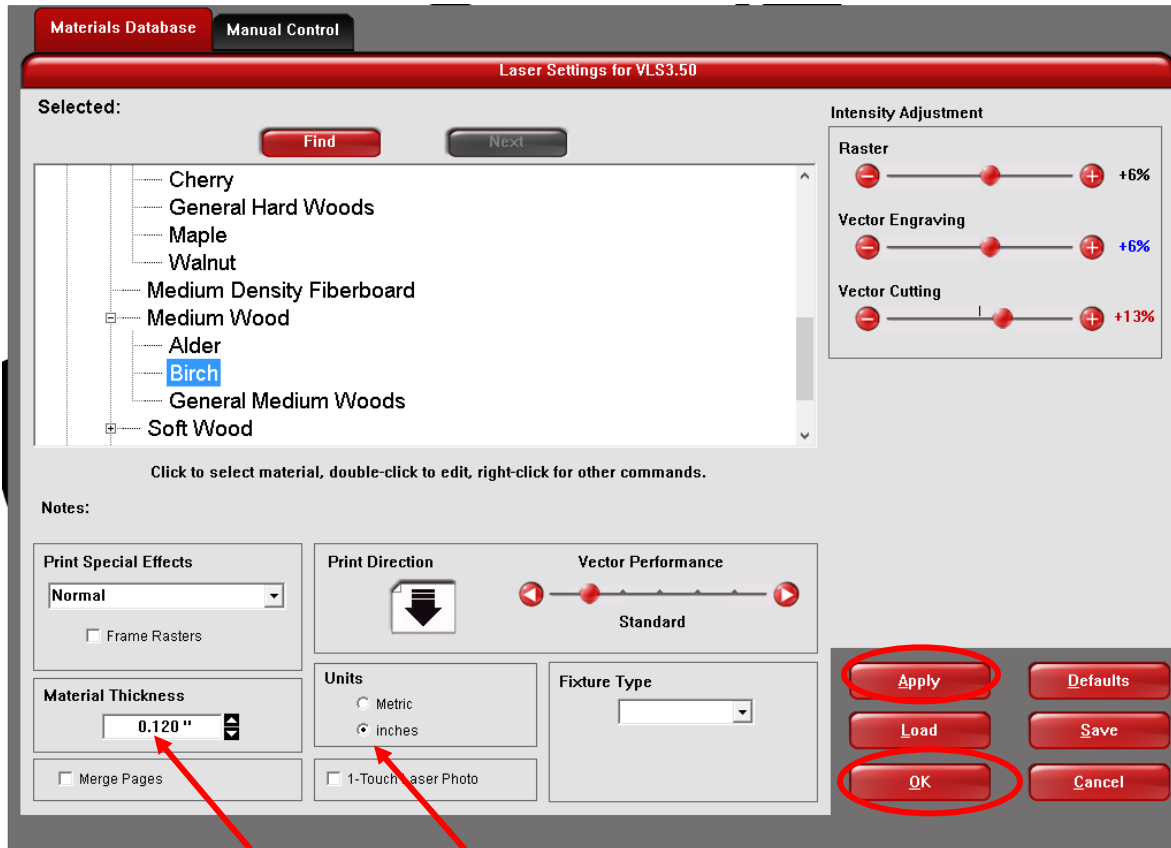


Figure 5

Then enter the material thickness in inches (decimal). If you don't know the thickness of your material use a caliper to measure it. (See **Measuring Material** section below)



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When settings are complete, press the “Apply” button followed by the “OK” button. The dialog box will close and return you to the system print setting dialog box – Press “Print”.

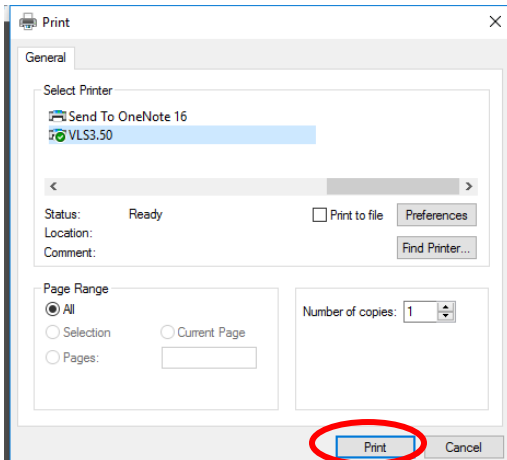


Figure 6

This will return you to the “Illustrator Print” dialog box – Press “Print” again. This sends the job to the **Laser Control Panel Application**.

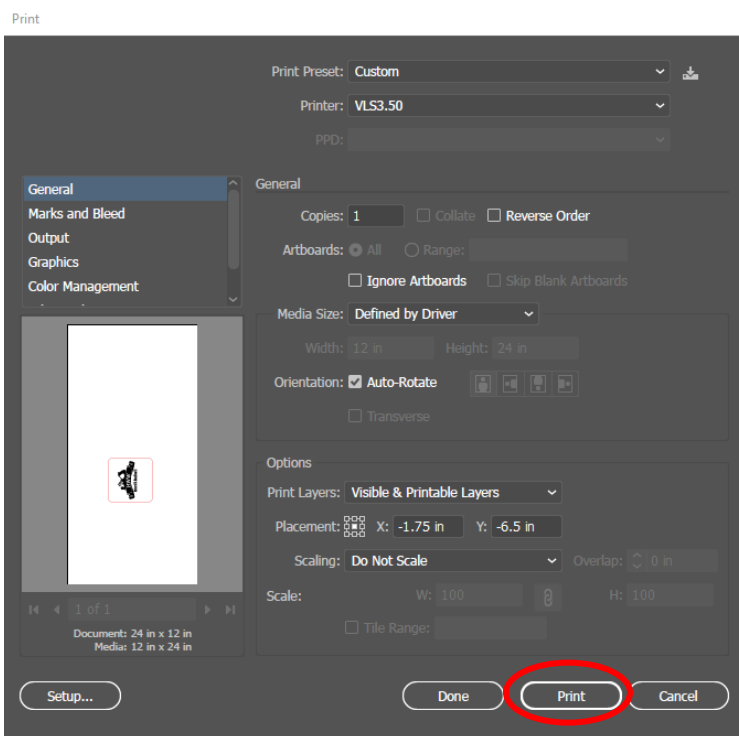


Figure 7



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To access the **Laser Control Panel**, select the Control Panel icon in the system tray. This will launch the Laser Control Panel application.

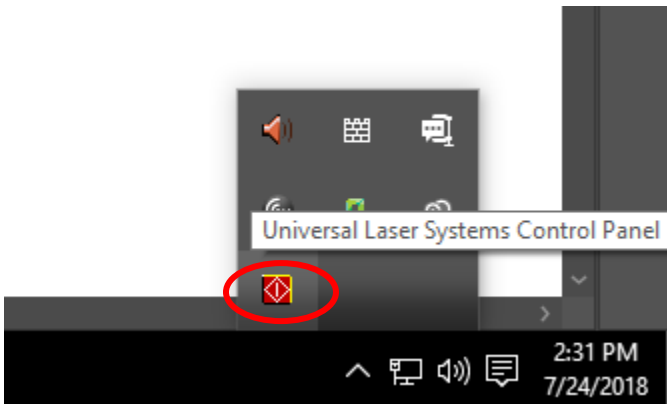


Figure 8

Laser Control Panel Application

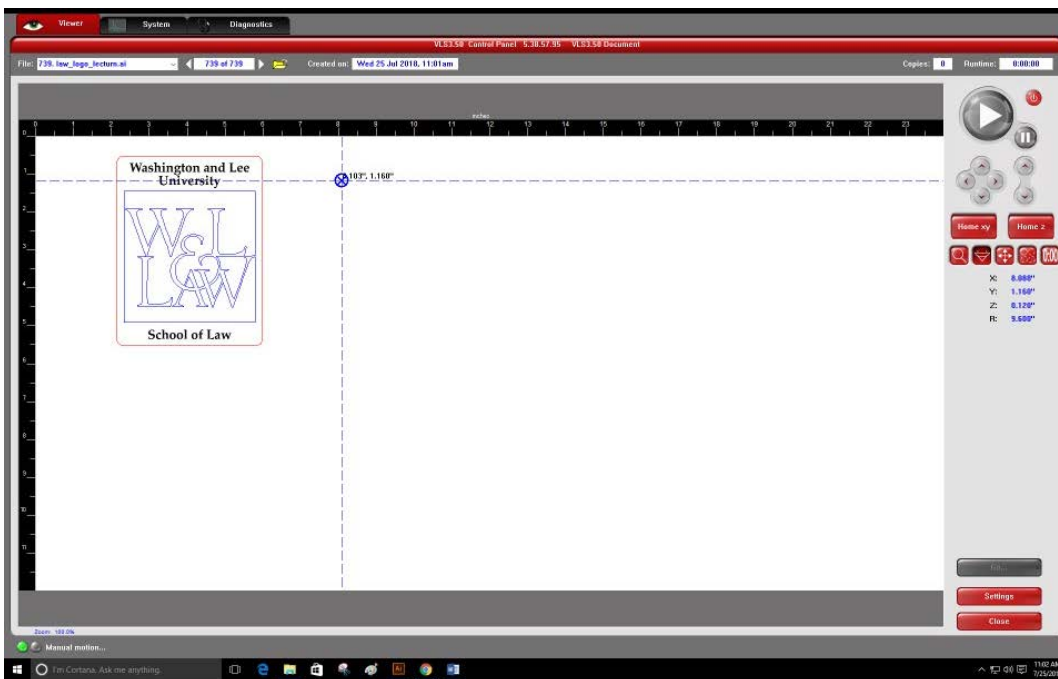


Figure 9



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Check to make sure that cut lines and engrave lines show the appropriate color: RGB red, RGB black, and RGB blue.

If you used the wrong color or line weight, your vectors will display black or gray.

If this happens, go back to Illustrator and make sure your document is RGB and your lines have the correct color and weight (see **“Working with Illustrator”** section above).

Positioning Artwork

Turn on the laser cutter using the “Power” button.



Figure 10

Open the lid and place your material on the cutting table. With the lid open, you will notice that there is a red spotting laser that shows the location of the lens assembly.

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The **Focus View** button in the **Control Panel Application** will allow you to move the lens anywhere in the cutting area. Find an available space on your material and move the laser there by double clicking in the work area of the **Control Panel**.

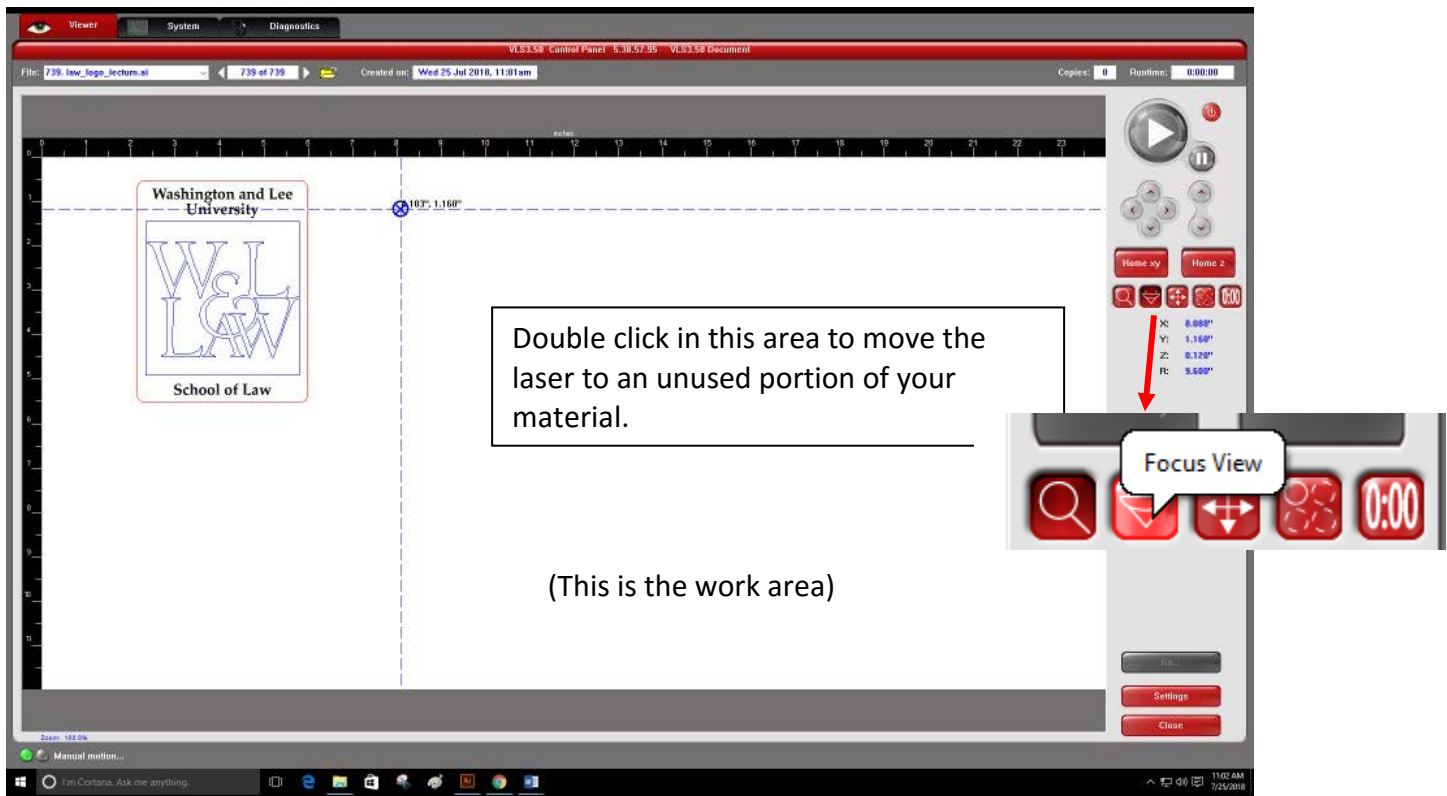


Figure 11

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Figure 12

Now that we have moved the laser to the open space on the material, we need to move the artwork to that spot. We do that with the **Relocate View tool**.

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With the **Relocate View** tool selected the artwork can be moved by clicking and dragging, or select one of the “handles” of your design and use the “**To Pointer**” button to move the artwork to the position of the Laser. You can zoom in on the workspace using the zoom tool or by rolling the middle mouse wheel.

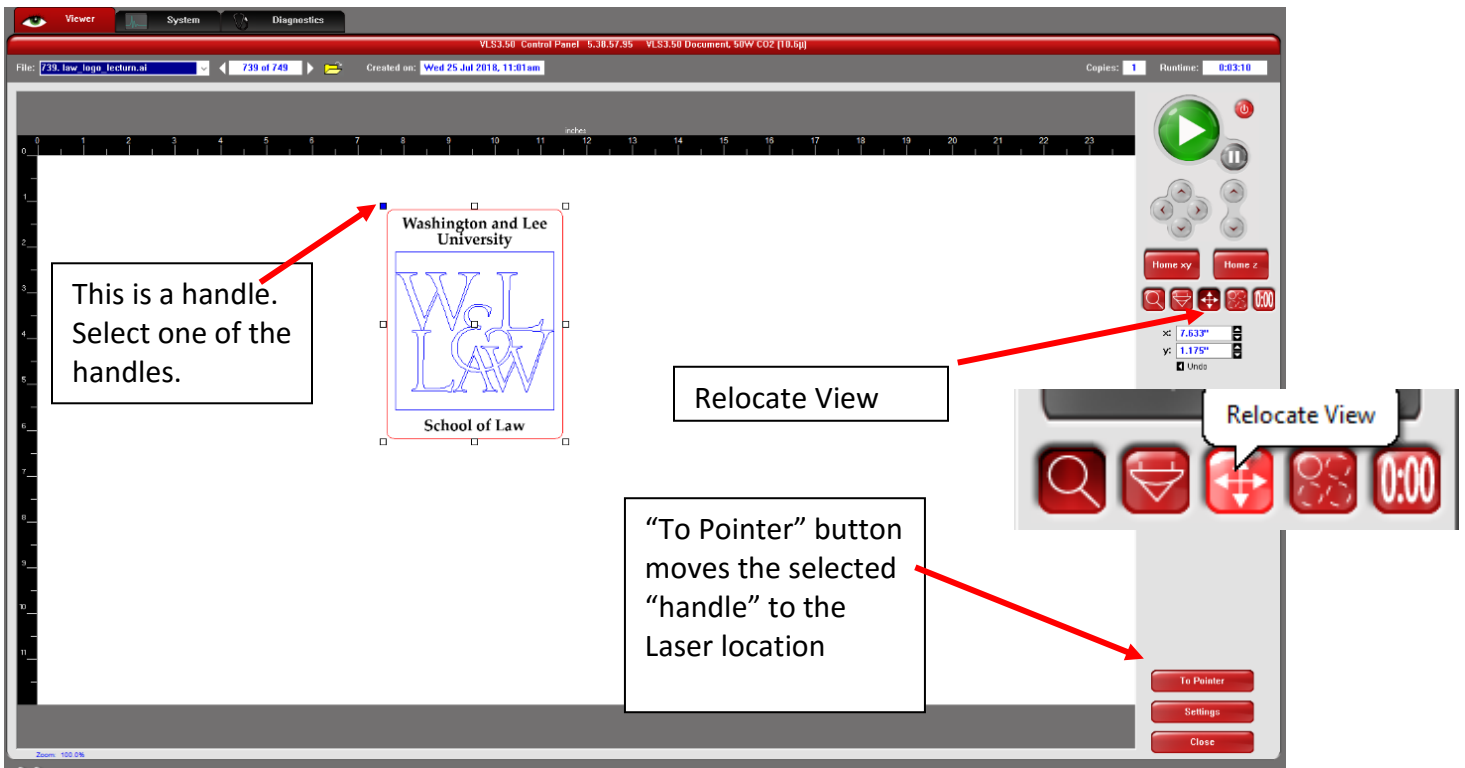
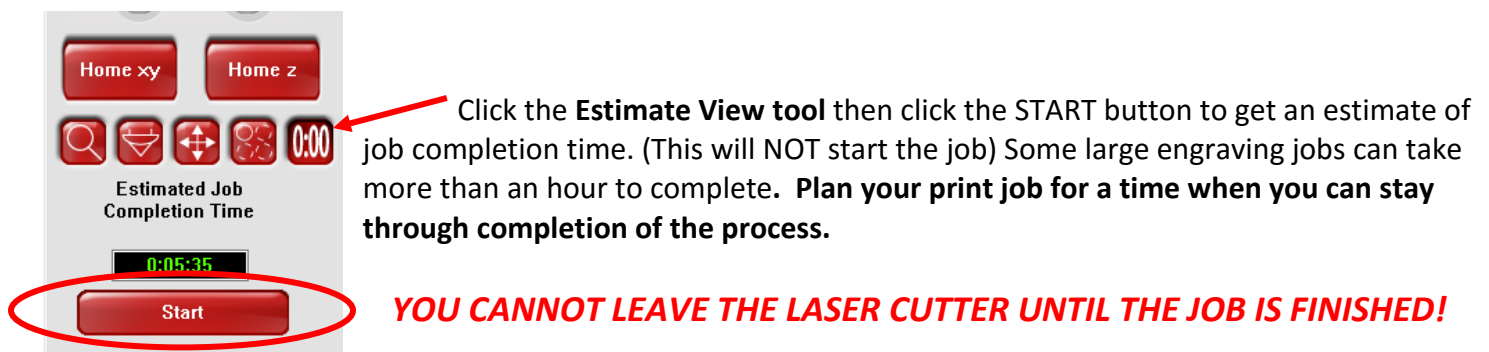


Figure 13

Once the artwork is placed use the **Focus View** tool again (figure 11) to move the laser to the edges of your artwork to make sure that it fits the available space on your material.



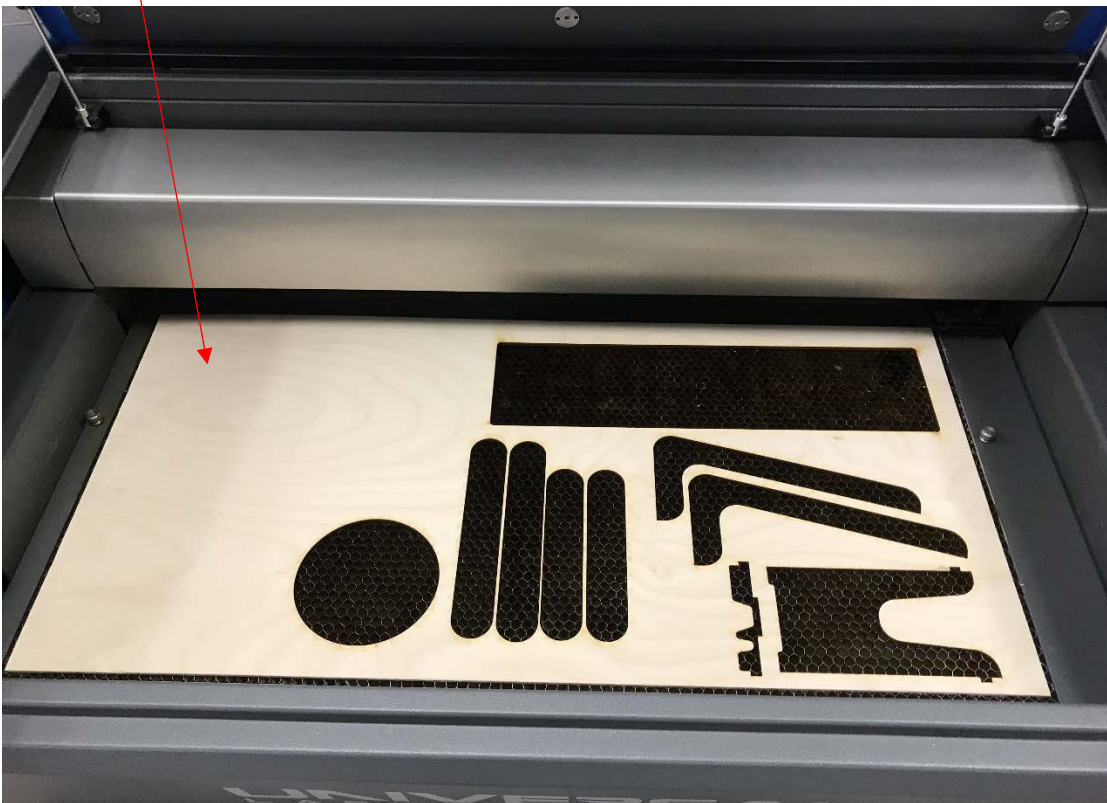
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IMPORTANT: Be thoughtful in your use of the material. Proper placement of a job will allow for more print jobs per sheet. See **Proper Placement of Job on Material** section below for example of proper and wasteful placement.

Placement of Job on Material on Cutting Table

Proper job placement on material. The open space left can contain more jobs if work is placed carefully in open space.



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Poor use of material. This cutting job could have used less than half this sheet of material.



TURN ON THE FUME COLLECTOR AT THE BASE OF THE LASER CUTTER/ENGRAVER!!!!



Figure 14: Fume Collector

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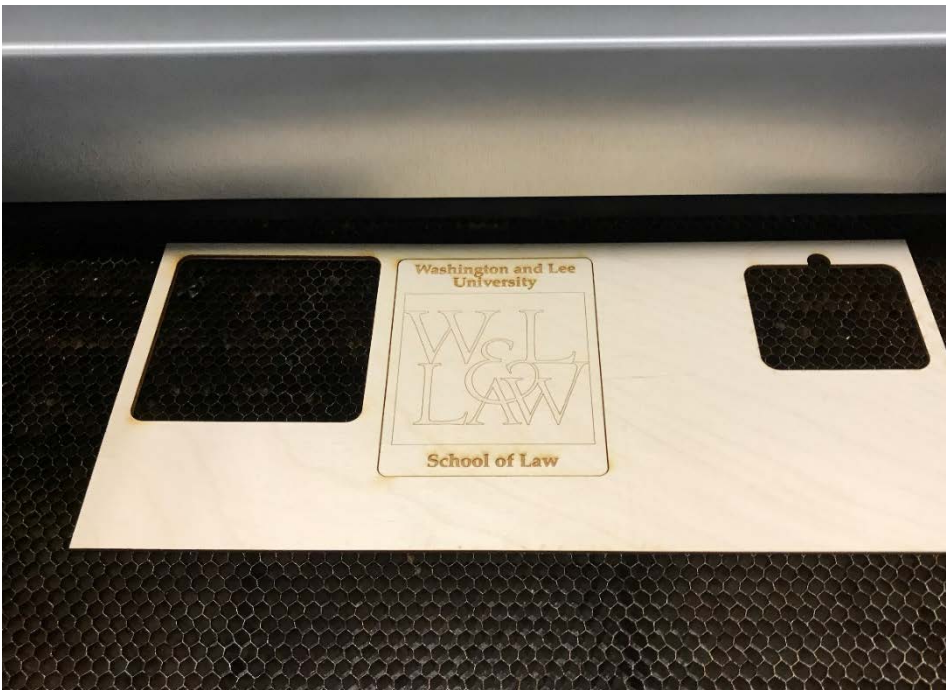
PRESS THE LARGE GREEN BUTTON ON THE CONTROL PANEL SOFTWARE TO BEGIN THE JOB – NOT the “Start” button on the laser cutter.

Watch the progress of your printing job on the laser cutter.

DO NOT LEAVE THE LASER CUTTER WHILE A JOB IS IN PROGRESS!!



Material can be removed as soon as the job is completed.



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Jobs cut from wood may need some sanding to remove burned areas:



The finished product:



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Measuring Material Thickness

You will want to use the caliper to measure the thickness of your material. It is important to make sure that the material thickness is correct. This will ensure that the laser is focused on the surface of the material. **The maximum material thickness that you can cut is 1/4 of an inch.**

Using the Caliper

1. Press the “On/Off” button on the Caliper. The Caliper should be reading in inches. If this is not the case press the mm/inch button (circled) until the units appear as inches.



2. Next you need to make sure that the Caliper is zeroed so that you get the most accurate reading. Make sure that the Caliper is closed all the way. Once it is closed press the zero button so that the screen shows all zeros. Set the units to inches (decimal).

3. Close the caliper on your material using the thumb wheel to keep it closed and note the measurement on the screen.