

**space™**

# **Laser Cutter / Engraver Reference**





# Universal Laser Systems VLS 2.30 laser cutter

**NEVER LEAVE THE LASER WHILE IT IS RUNNING.  
THE VENTILATION FAN MUST BE ON WHENEVER THE LASER IS RUNNING.  
DO NOT WATCH THE SHINY LASER WHILE IT ETCHES OR CUTS YOUR MATERIAL.**

This is a 30 watt CO<sup>2</sup> laser. Maximum cut depth will vary depending on material and settings.

In order to fit inside the ULS, your materials must not exceed 12" x 16" x 4".

Maximum cut depth on most materials that can be cut is 1/4".

Exceptions: **Cork** does not exist in a state thin enough to cut with a laser. Cork will turn into a molten black glob if you try to cut it with the laser, so please don't! It cuts quite nicely with a craft knife. **Glass and stone** etch by creating microfractures in the surface, but cannot be cut. **Metal** cannot be cut nor etched (unless you purchase a metal-etching spray, such as Ceramark), however, powder-coated metal mugs are a fun project, as the laser will remove the powder coating, leaving behind the shiny metal undercoat. **Leather** has trouble cutting through when thicker, and only certain types of leather should be used.

A 2.0 lens means you have 2" of focal depth.

## IN CASE OF FIRE:

### Let's PREVENT THAT FIRE!

- You are using mostly flammable materials, so there is always a danger of a flare-up.
- Never leave the laser while it is running.
  - If you need to step away, hit the PAUSE button, then hit PAUSE again when you return—if you hit START when you return, it will start over at the beginning).
- Make sure your materials are approved for laser safety.
- Make sure you are using the correct settings for the material.
- See more smoke than you should swirling inside the machine, or coming out the side vents? Did you remember to turn on the outside VENT switch? The switch is on the west wall next to the light switch.

### SOMETIMES FLARE-UPS HAPPEN, but let's keep them contained (quickly!):

- Are you cutting something extremely intricate, or cork (don't cut cork!), or plywood that has layers of glue? It may be on fire! Here's how to tell for sure: when the ULS cuts, a large birthday candle flame will follow the laser around. As long as the birthday flame is following the laser, you are fine. If the flame is spreading out, your material is on fire.
  - ◊ STEP ONE: **Lift the lid!** (This automatically turns off the laser, as there is a safety feature that prevents the laser from running while the lid is raised. This removes your HEAT SOURCE from the fire.)
  - ◊ STEP TWO: If the fire did not go out at Step One, **grab a smothering board** and smother the fire to remove the OXYGEN from the fire.
  - ◊ STEP THREE: If the fire is still smoldering and/or growing, **use the WATER BOTTLE** next to the machine to douse your material at the base of the flames. Do not spritz the laser lens.
  - ◊ STEP FOUR: If your fire did not go out by removing the heat and oxygen, and dousing it, this is BAD. You will need to use the **fire extinguisher**. Please be alerting staff and/or yelling at this point. As soon as you use the fire extinguisher on the laser cutter, we have to send it away for repair, where it will be disassembled so that every single nut and bolt can be cleaned, and it will be gone at least a month, which means a lot of people will be very sad. Do not get to Step Four!
    - ⇒ If you have to use the Fire Extinguisher, don't forget PASS:
      - PULL the pin
      - AIM for the base of the flames
      - SQUEEZE the trigger
      - SWEEP back and forth across the base of the flames.

*\*\*Do not dispose of smoldering or burning materials in the plastic waste containers!*



# Materials

Visit <https://www.ulsinc.com/material/materials-library> to search your specific material for safety and specifications. The following are a short list of materials to get you started, and there may be exceptions or special settings for these materials:

## Approved materials (probably):

Corrugated cardboard	Soda-Lime Glass
Chipboard/Matboard	Anodized Aluminum
Plywood	Markable Aluminum
Balsa Wood/Basswood	Painted Metal
Domestic hardwoods (exotic woods can contain toxins)	Powder Coated Metal Masonite
Cork (etching only)	Mother of Pearl
Uncoated Paper (construction, copy, etc)	Granite
Acrylic	Marble
Fabric (cotton, muslin, etc)	Leather*
Denim	Vellum
Felt	Natural Woods
Glazed Tile	MDF
LaserTile	Mylar
Salttilo Tile	Polypropylene
Film with Heat Activated Backing	Select Rowmark Plastics (See Print Dialog for details)
Tackle Twill	Laser Rubber
Select Stahls' Fabric (See Print Dialog for details)	Silicone Rubber
Tool Foam	Stone
Lead Crystal Glass	Unmounted linoleum

**PLYWOOD NOTE:** Plywood contains glue between the layers. Plywood will cut and etch differently depending on the core, type of veneer, and layers used. 5-layer plywood has more glue than 3-layer. The thickness of the veneer can affect your cut settings, as well as if the core is hard or soft. Trial and error is suggested! The glue in the plywood can catch fire, especially if your cuts are intricate (ie: scrollwork lettering).

**LEATHER NOTE:** Many processed leathers contain chromium, which you do NOT want to release while lasering. Use either vegetable-tanned leather or untanned.

**MIRROR NOTE:** When etching a mirror, make sure the reflective part of the mirror is upside down (toward the engraving or cutting tray), with the opaque matte side toward the laser. If you try to laser with the reflective surface up, best case scenario is that you will destroy the \$200 lens; worst-case scenario is that the laser beam will bounce out and hit you, another person, or flammable materials outside the laser. Be careful!

**SOFT WOOD NOTE:** Some soft woods, like pine, have growth lines running through them which are harder than the rest of the wood. When etching, these growth lines will not etch as deeply. This can be a cool effect! It can also not be what you want to use for photo etching.

## Banned Materials:

Vinyl  
 Fiberglass  
 Fr4 Boards  
 Materials containing Chlorine (PVC, Moleskin)  
 Polycarbonate  
 Lexan  
 ABS plastic  
 Artificial leather and pleather

WOOD ALLERGEN NOTE: For those with allergies, here is a great link to a list of woods that can contain toxins or are known to create sensitivities in some users, from the Woodworkers Source: <https://www.woodworkerssource.com/blog/wood-conversations/wood-toxicity-and-how-to-protect-yourself/>

LEXAN/ACRYLIC NOTE: Lexan and Acrylic look exactly alike, and the only way to tell the difference is through chemical analysis. If you do not have the original packaging or receipt that states that your material is indeed acrylic, play it safe and do not use it. Lexan releases poisonous gasses.

Here are more banned materials, although the list is not exhaustive.

Material	Banned Reason
PETG, PET	Along with other emissions, is known to emit Benzene which is known to cause cancer.
Polystyrene	Known to emit styrene fumes.
ABS	Emits cyanide gas and tends to melt.
PVC	Emits chlorine gas during a cut.
Bending Plywood	Bends into the path of the laser carriage during operation.
Tropical Hardwoods	A lot of tropical hardwoods have toxins in the wood.
Corian	Creates a fine grit inside the laser bed and will grind down equipment
Casting Wax	Melts a lot.
Nylon	Emits toxic fumes.
Vinyl	Emits chlorine gas during a cut
Delrin	Along with other emissions, is known to emit Benzene which is known to cause cancer.
Foamcore	Foamcore is an expanded polystyrene and is known to emit styrene fumes when cut.

<https://www.saic.edu/sites/default/files/Universal%20Laser%20Cutters%20Guide.pdf>

*\*\*If you have allergies or wood sensitivities, you may want to wear a dust mask designed for woodworkers.*

## Polyurethane, paint, and stain:

So you want to take your laser etching one step further? Awesome! Here is what we have learned so far (please share your experiences with us, too!):

**Acrylic paint:** should be applied before etching (and let dry for 2-3 days, at least) if you want the unetched portion to be a specific color. However, you can very carefully take paint pens to your project after the fact. Keep in mind that lasering changes the porosity of your material, so the newly-lasered part will suck up more of the color and may be difficult to control for clean lines.

**Stain:** Use a water-based stain before lasering and let dry for 2-3 days (or more). If you stain after the lasering, the lasered portion will be more porous and will suck up so much stain you won't see much contrast between the lasered and unlasered parts of your project.

We recommend water-based stain because it should have fewer chemicals, and is less prone to flash-point mini-fires than oil-based. Oil stains may contain more chemicals unsuited to lasering. Also, the waxiness of oil may create a waxy-build-up look at the edges of your etching, which is difficult to remove because it is now next to untreated wood.

Don't use a stain the same color as etched wood. Etched wood is darker than the top layer. You may not have high contrast and your image will blend in.

**Polyurethane:** can be added after lasering for a sealant. Some polyurethanes are too thick to spread evenly into all the nooks and crannies, so you may want to try a wipe-on poly that is more liquidy. Keep in mind that some polyurethanes can change the color of your wood and the etching when dry. You can also play with polyurethane before lasering, in order to wipe a paint color into the etched part, and wipe clean the poly'ed part immediately.

*\*\*All of these things add chemicals which may be released during the lasering process. Use care when experimenting!*



# Cut—Etch—Rotary

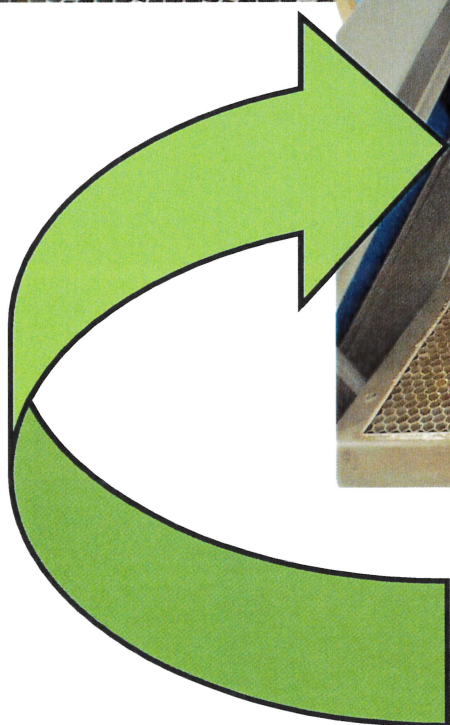
## Choosing and changing the accessory bed



Choose the cutting bed when you are cutting wood, fabric, cardboard, paper, etc, or when etching on light materials like flat glass from picture frames.

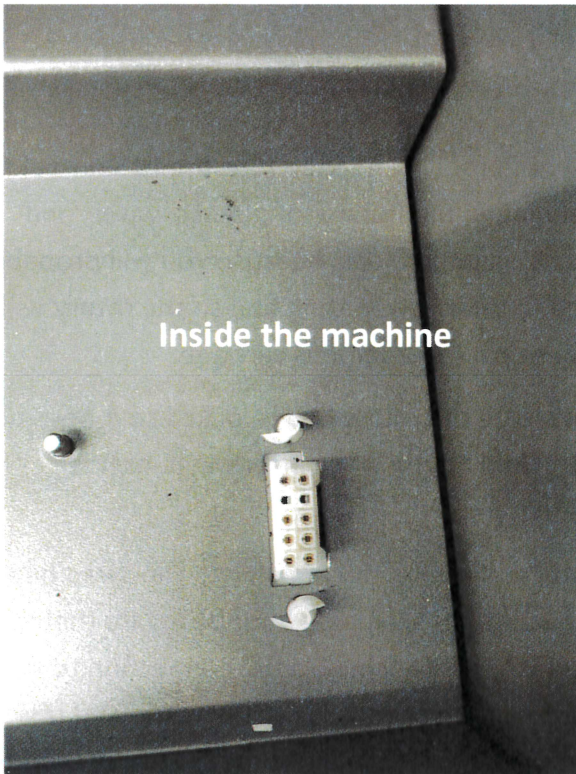
The downdraft honeycombing is pretty fragile, so do not put heavy things on this bed.

Lift it by the two screws on the side of the bed to change to the engraving or rotary.

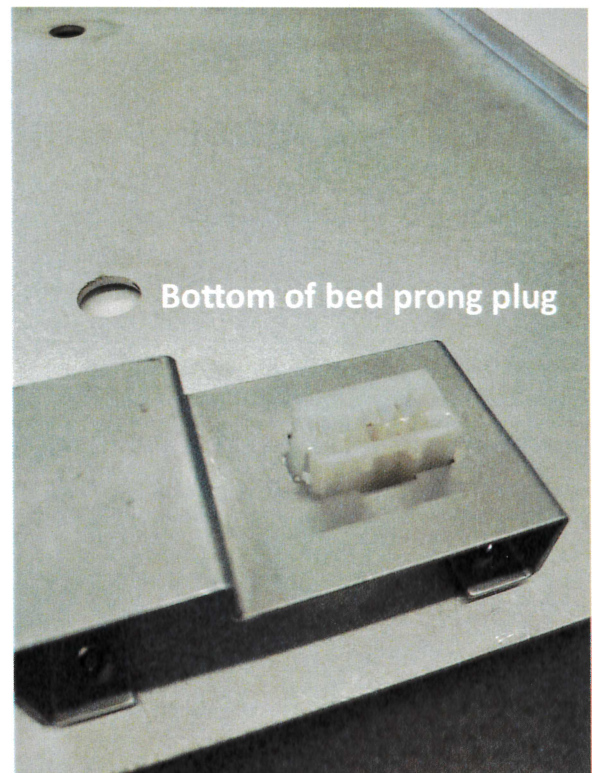


Be careful when removing the cutting bed, as it has a very high lip at the back. The laser lens is housed in the carriage right above it, and you don't want to break or dislodge it!





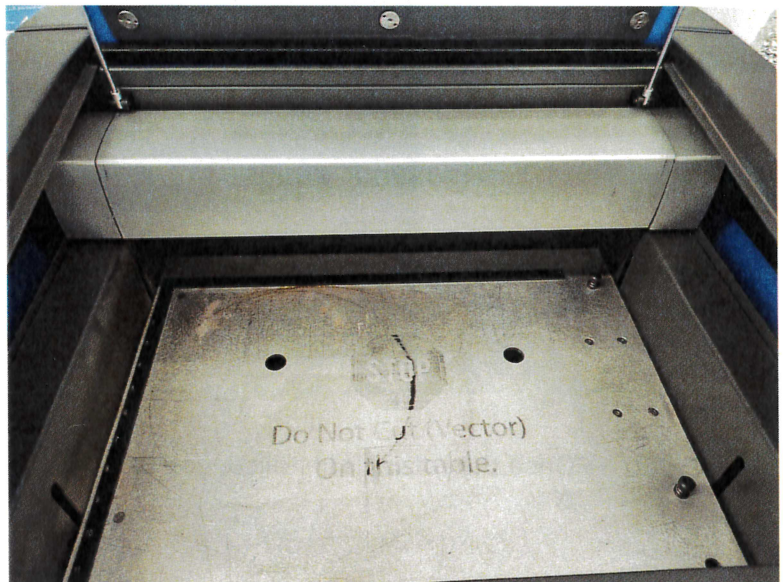
When changing any of the beds, you will find an 8-prong plug inside the Laser, and a corresponding plug on the bottom of the bed. These must connect securely for the software to allow you to print.



Use the vector engraving bed (below) for heavy or extra-tall items like slabs of marble or pie plates. There are two finger-holds to aid in getting the bed seated.

NEVER CUT (Vector, full-red—see Illustrator Settings section) on this bed, as the heat can warp the aluminum.

Don't forget that your clearance is 4" total. For taller items, the engraving bed will give you the max height possible.



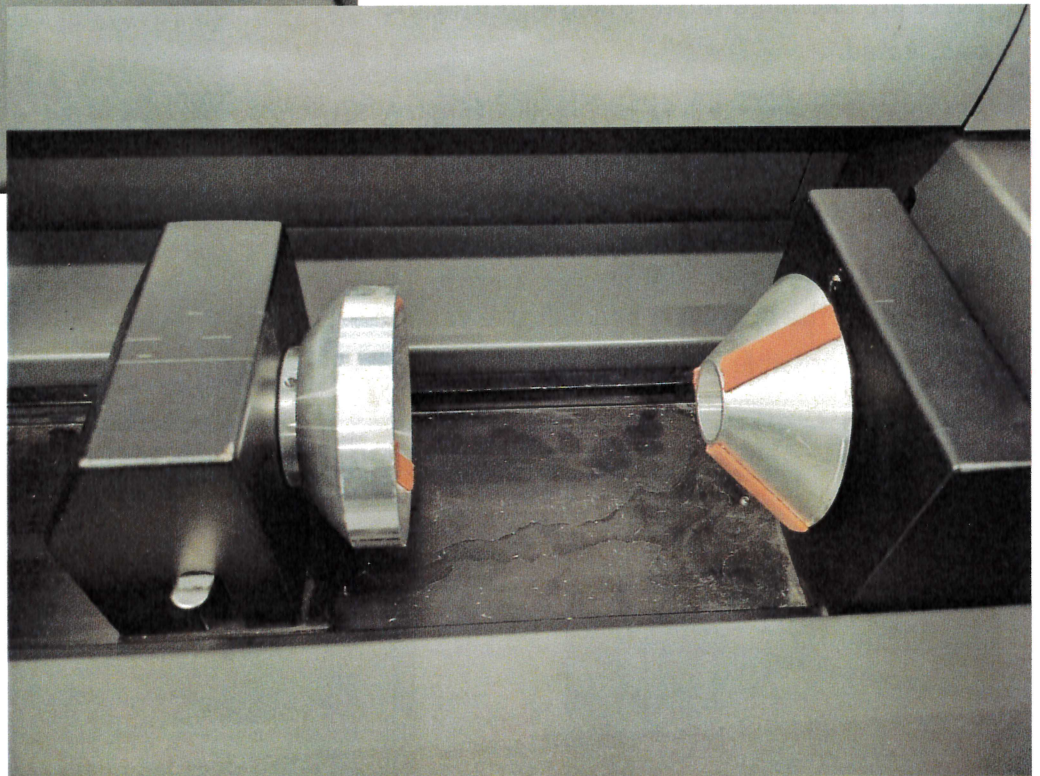




You will probably need to turn the ULS on before changing to the Rotary for glasses, vases, and powder-coated mugs, because you will probably need to lower the cutting bed so the rotary will fit beneath the laser lens carriage.

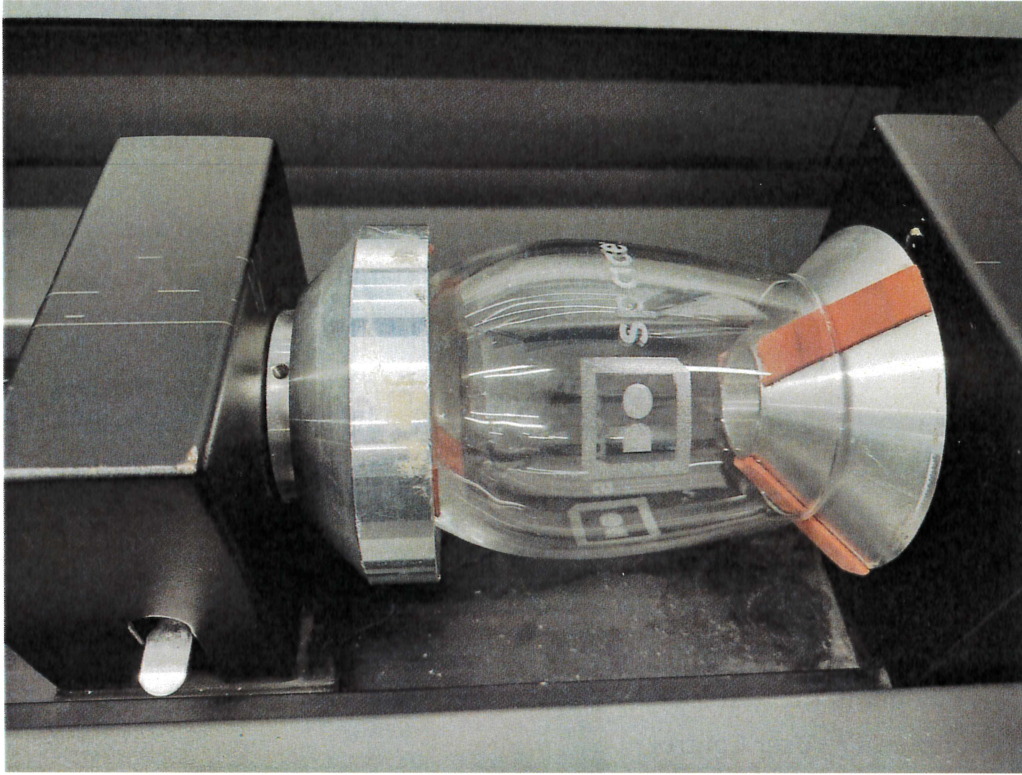
Make sure the rotary bed is locked so it does not slide. Hold tightly while inserting it, as it is **HEAVY**.

When the laser cutter is ON, you can swap beds (known as hot swapping), but be aware that as soon as the rotary makes the connection to the machine, the rotary will **MOVE** a little and this startles some people. It's okay to swap it, and to be startled. The rotary does not move enough to hurt you.



Once the rotary is installed, you can unlock the left side and slide it open.

The open end of the cup or vase or mug goes over the cone. The bottom of the cup must fit snugly so that it does not move or shift after you lock it. It may take 2-3 times to get it locked tightly.



A warning about HANDLES: You can engrave things with handles, but keep in mind that the rotary turns your mug while it etches. It may hit either the carriage housing or the bottom while turning if your image that is being etched is wide. It happens. This can squish pictures and words, or knock the entire cup out of alignment during the engraving.



# Using the Calipers

## Measuring the thickness of your material



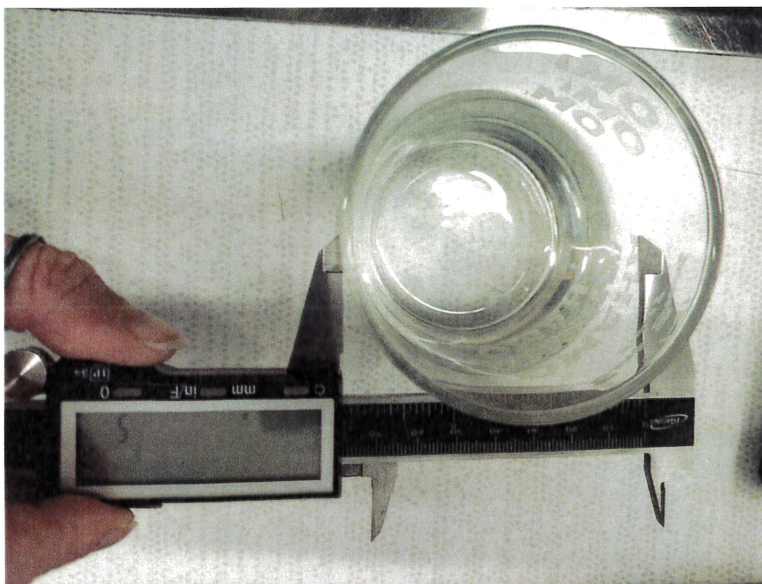
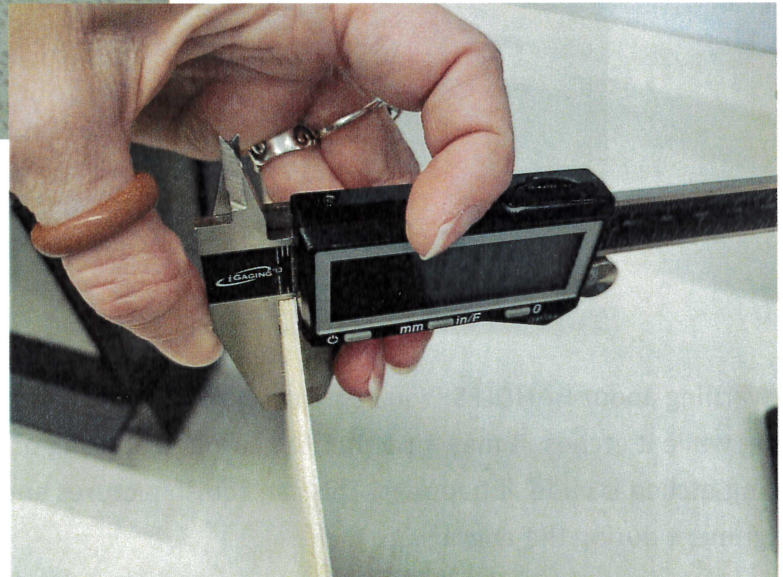
Turn the calipers on and make sure it is on inches if your design is in inches, and that it starts at 0". (If it is not at zero, use the zero-out button while it is closed to reset.)

Seat the open end over your material and clamp tightly to get an accurate measurement.

*Don't forget to turn the calipers off!*

You will input this number in the Material Thickness section of the UCP (User Control Panel) of the ULS.

Remember that the ULS can only cut through up to .25" of wood, acrylic, and other materials that can be cut.



When measuring for the rotary, measure the diameter of your glass or mug, as the ULS wants to know how high above your material it needs to be, not how thick the glass is .

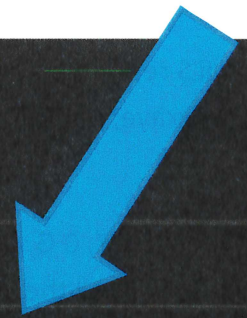
If your glass tapers slightly, measure the center of where your image will be.

NOTE: The laser cannot cut glass; it will leave a series of microfractures in the surface of the glass. The laser cannot cut metal; it will remove the powder-coating or paint from the surface.

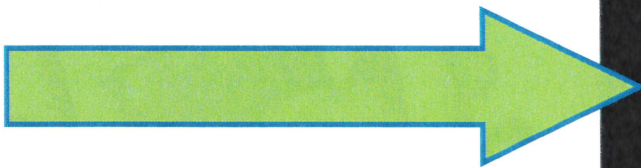


# Set Up Your Illustrator File

Your full bed size is 16" x 12", so you it's easiest to change the Illustrator pre-sets to Inches, and input the full bed size here.



This is the most important thing to remember when working with files for a laser cutter—work in RGB Color (not CMYK).



PRESET DETAILS

Untitled-2

Width: 16 in    Inches

Height: 12 in    Orientation:    Artboards: 1

Bleed

Top: 0 in    Bottom: 0 in

Left: 0 in    Right: 0 in

Advanced Options

Color Mode: RGB Color

Raster Effects: High (300 ppi)

Preview Mode: Default

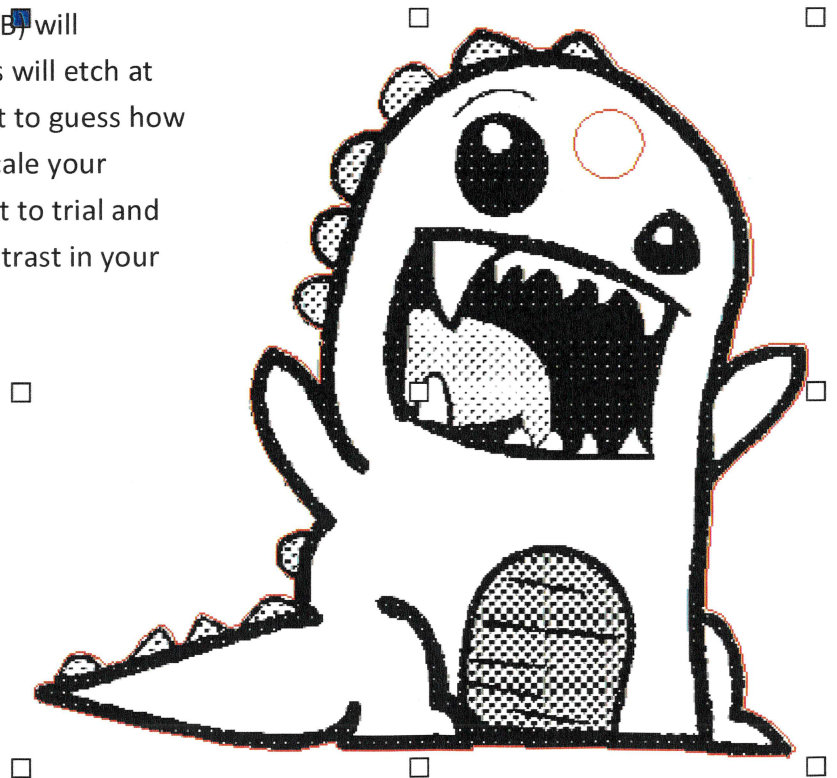
Create    Close

The ULS reads color as a numerical value that tells it to cut, engrave, or etch.

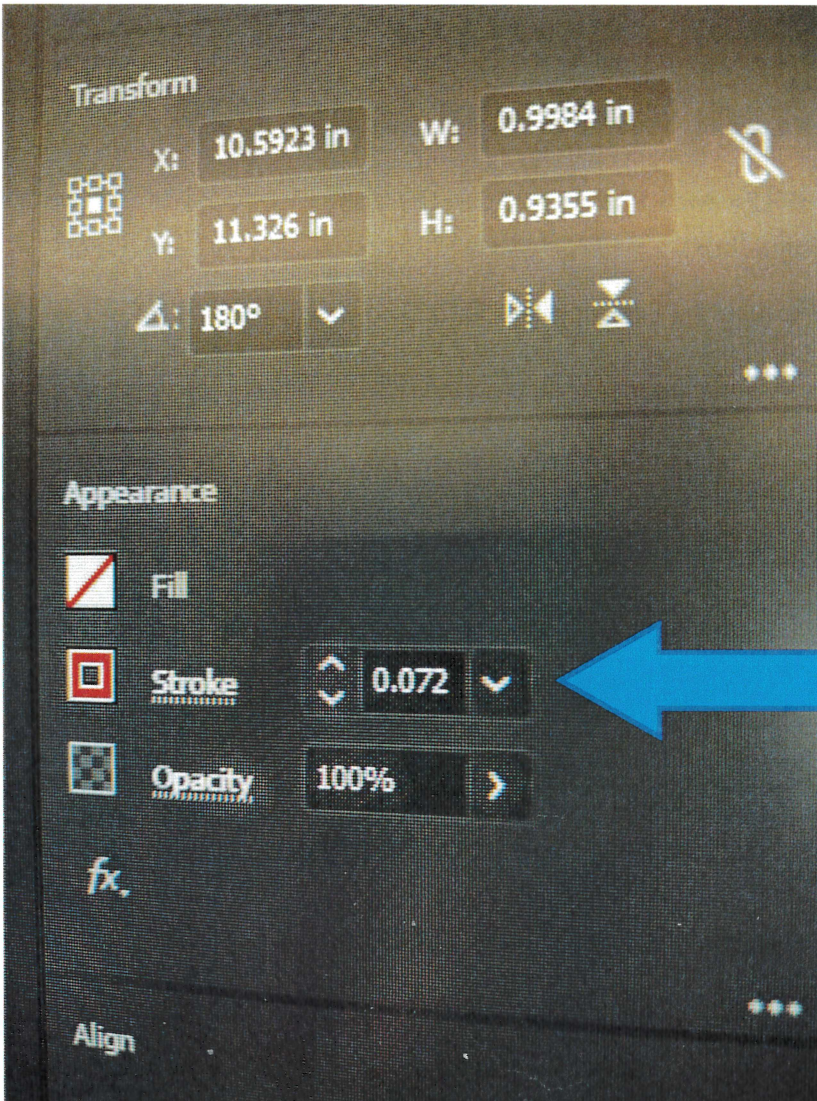
Full red (255 R, 0 G, 0 B) with a line thickness of .072 pt (.001 in) will tell the laser to cut. Only use this when your material can be cut (ie: do NOT use full red and hairline thickness (.072) when you are using cork, or it will just melt and smolder).

Full blue (0 R, 0 G, 255 B) will tell the laser to etch that thin line when set at .072.

Everything else (grayscale, colored vector images that do not have a .072 stroke outline, raster images, etc, will raster engrave. Full black (0 R, 0 G, 0 B) will engrave deepest, and grayscale or colors will etch at different depths. Colors are more difficult to guess how they will etch, so you may want to grayscale your image to get a better idea. You may want to trial and error some grayscale to get the most contrast in your lasered image.







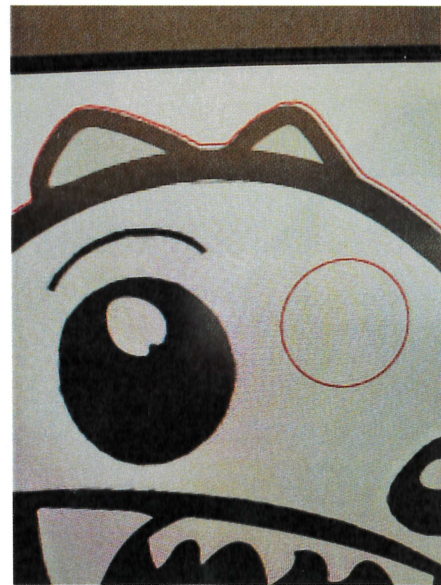
Make sure your Stroke is full red (255 R, 0 G, 0 B) and the width of the stroke is .072 (.001 in).  
<sup>^</sup>  
 pt.

*If you are working on a file in CorelDraw, this would be called "hairline" instead of having a number value.*

*If you are working on a file in Inkscape, do not add a cut line in Inkscape, as it will never transfer. This is a glitch they are aware of. Just add a cut line here in Illustrator before sending the file to the laser.*

You can see the cut lines clearly in both Illustrator and in the UCP (User Control Panel) of the laser. If you get to the UCP screen and nothing is red, but you expect to cut, come back and check your settings here. If the stroke is too thick, is CMYK, or is not full red, it will revert to grayscale in the UCP, and will etch but not cut.

*You will see this with all cut lines set in Inkscape software, which is why you need to wait until you are using Illustrator or CorelDraw to set cut lines.*



**Need more instruction on your laser file? Sign up for our Illustrator for Laser Cutting class!**

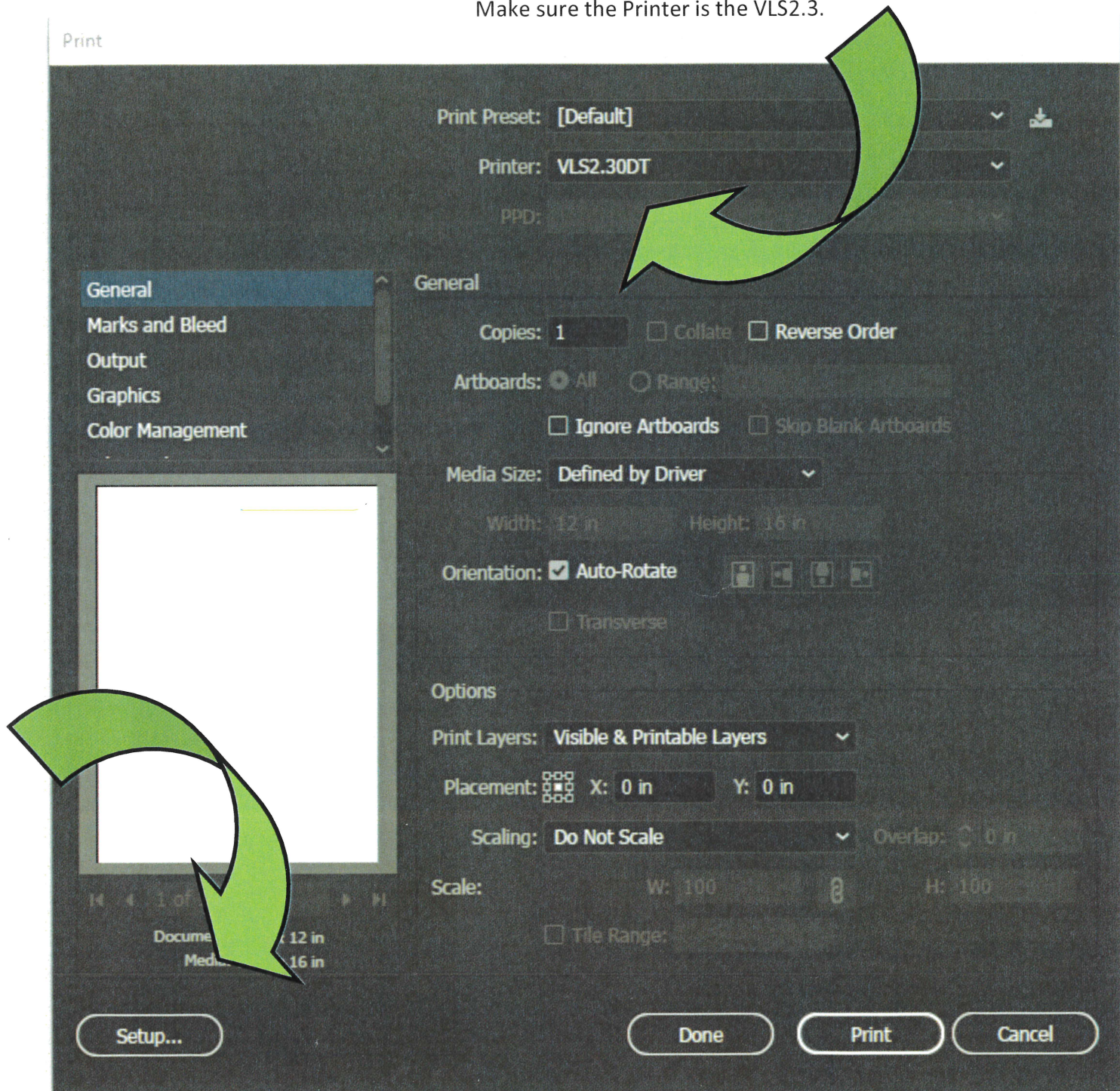


# Your Printer Settings

## Sending your file from Illustrator to the UCP

Hit <FILE> and <PRINT> to open the print dialogue box.

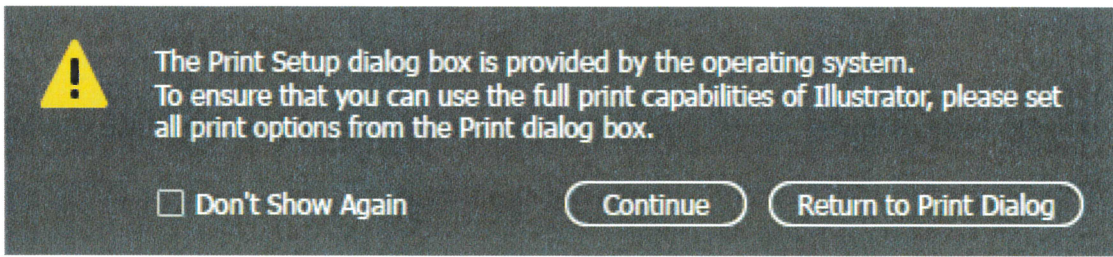
Make sure the Printer is the VLS2.3.



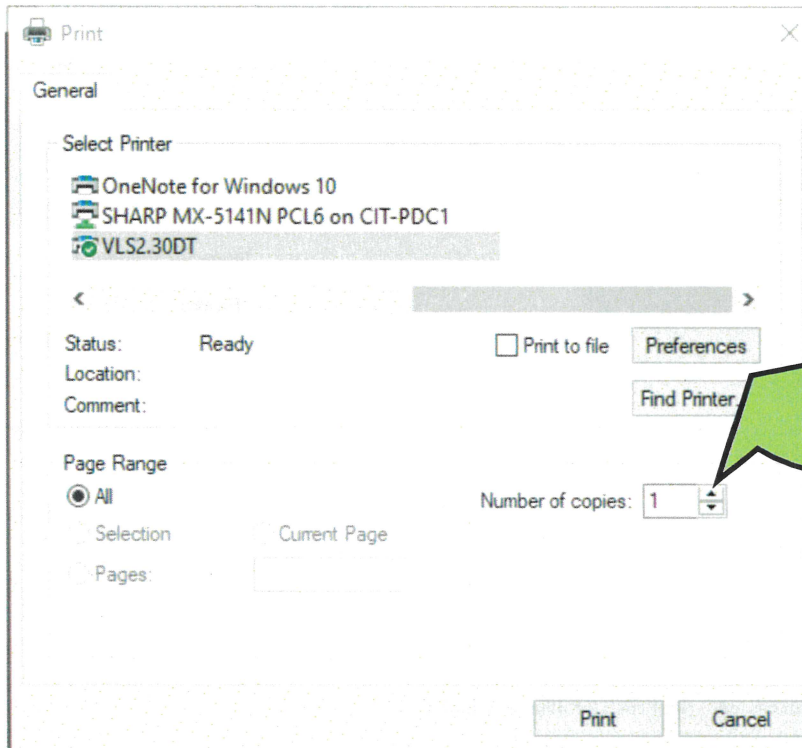
Select the Setup button to get to the laser settings.

Alternatively, you can hit <PRINT> and select your settings in the UCP software.





If you see this warning, just click <CONTINUE>.



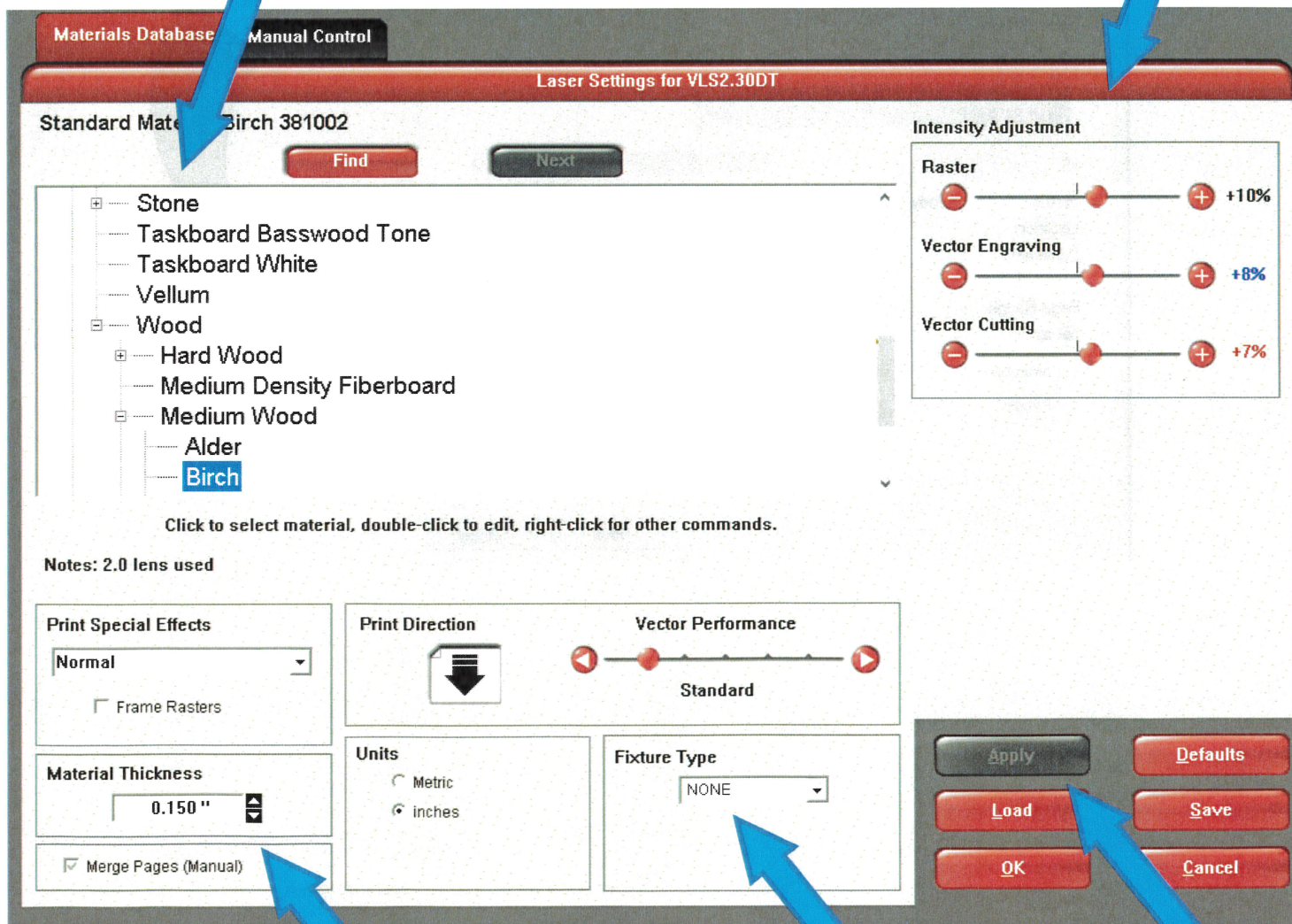
Click on <PREFERENCES>.

# Welcome to the User Control Panel (UCP)!

## Choose your material, input measurements, set your print bed, and find the laser intensity sweet spot

Choose your material.

See more about adjusting the intensity on the next page.



Measure your material with the calipers. See caliper section for more info.

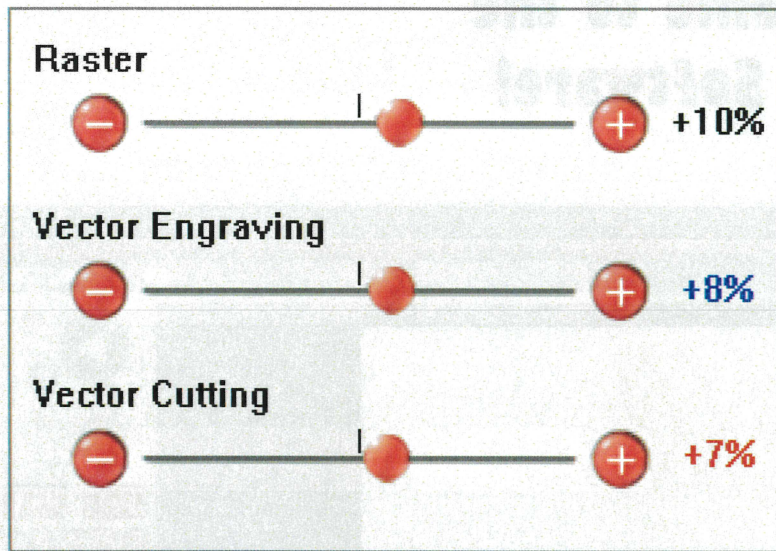
Select the correct Fixture type.

If Rotary, a box will pop up under this asking the diameter of your material. Enter the diameter for rotary items here and in thickness.

Always click APPLY.



## Intensity Adjustment



This is to adjust the intensity of the laser up or down from 100%. If you are getting scorching and burning, you may wish to go down in intensity.

If your cuts are not cutting through on one pass, you will want to make a choice:

- 1: Do you do two passes at a lower intensity (less scorching), or
- 2: Increase the intensity (although you never want to go above +15%, unless you are working on a powder-coated mug).

The numbers are color-coded to help you remember which you are adjusting.

### TROUBLESHOOTING WITH INTENSITY:

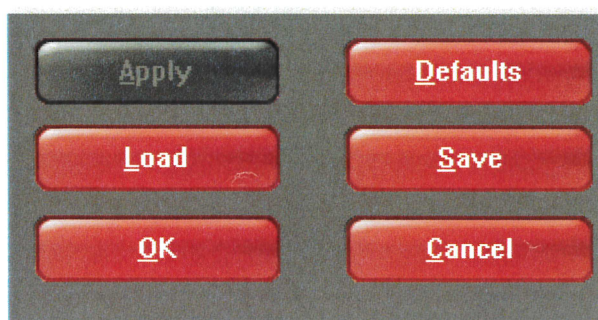
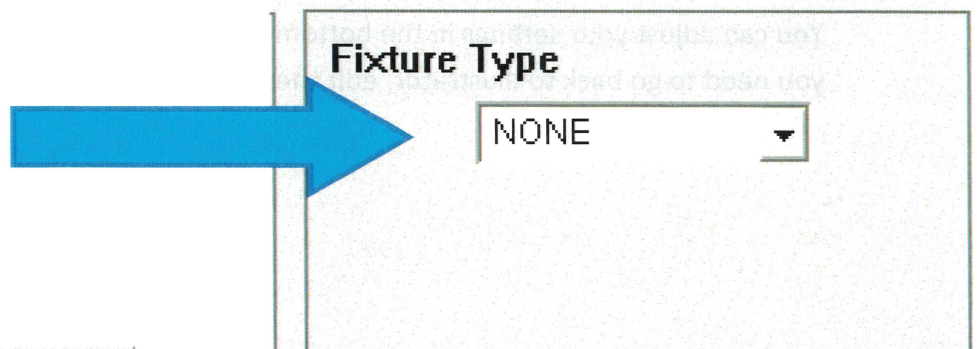
If you cannot cut through on 2 passes, or find yourself tempted to go above 15%, there is probably something wrong with another setting, or the laser needs recalibration or cleaning.

First, check to make sure your material is right, as well as the thickness of the material. Some veneered plywoods may act like a different wood based on how thick the veneer (ie: is that maple on the outside of the plywood thicker than the central core of the plywood?, is it 5-layer plywood instead of 3-layer?).

If you are still having trouble, contact staff to look at your material and check the equipment. We cannot promise a knowledgeable staff member will be in the building at the time.

For the cutting bed and engraving bed, your Fixture Type will be NONE.

For the rotary fixture, choose ROTARY.



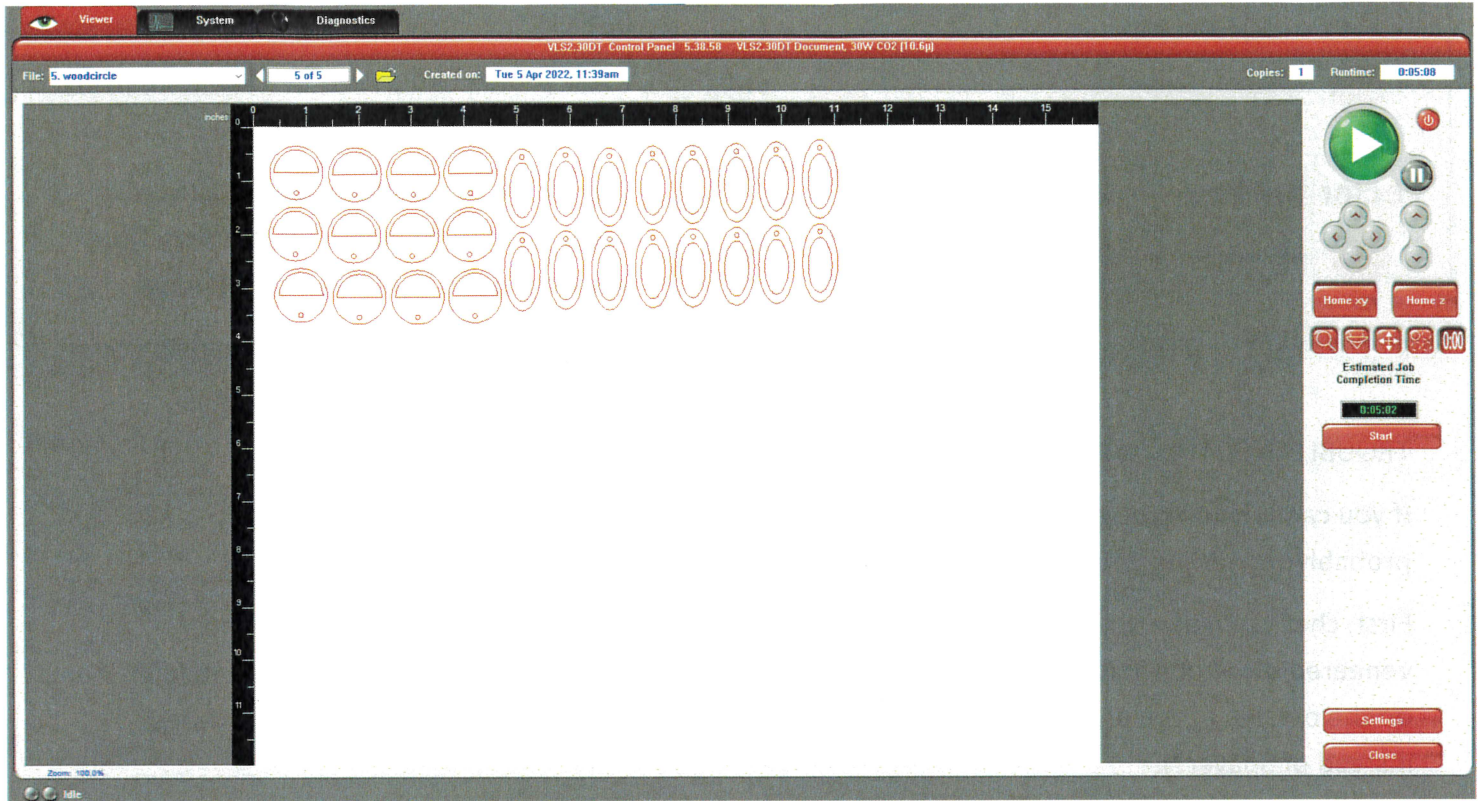
Always hit <APPLY> when done adding your settings, or it will revert back to the settings for the last print.

After you hit <APPLY>, hit <OKAY>.

Then hit <PRINT> on each dialogue window open to send the file to the UCP. Minimize Illustrator.

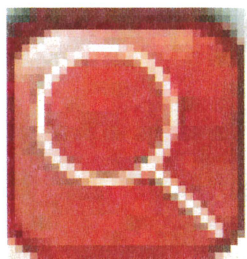


# Welcome to the ULS Software!

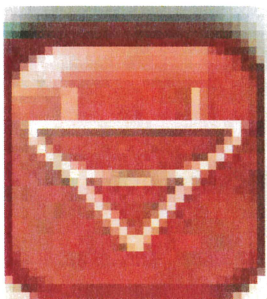


99% of the tools you need are in the control panel at the right of your screen.

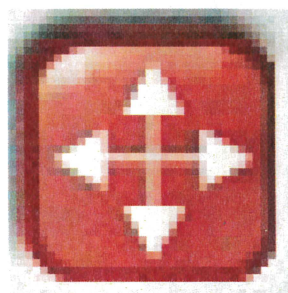
You can adjust your settings in the bottom right corner, but if you need to edit your file, you need to go back to Illustrator, edit there, and re-send your file.



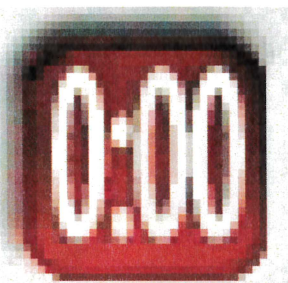
ZOOM in and out using the scroll wheel of your mouse.



FOCUS. As long as the lid is open, you can select the FOCUS tool, click on parts of your file, and the red focus dot in the machine will show you where your design will print. (See next page.)



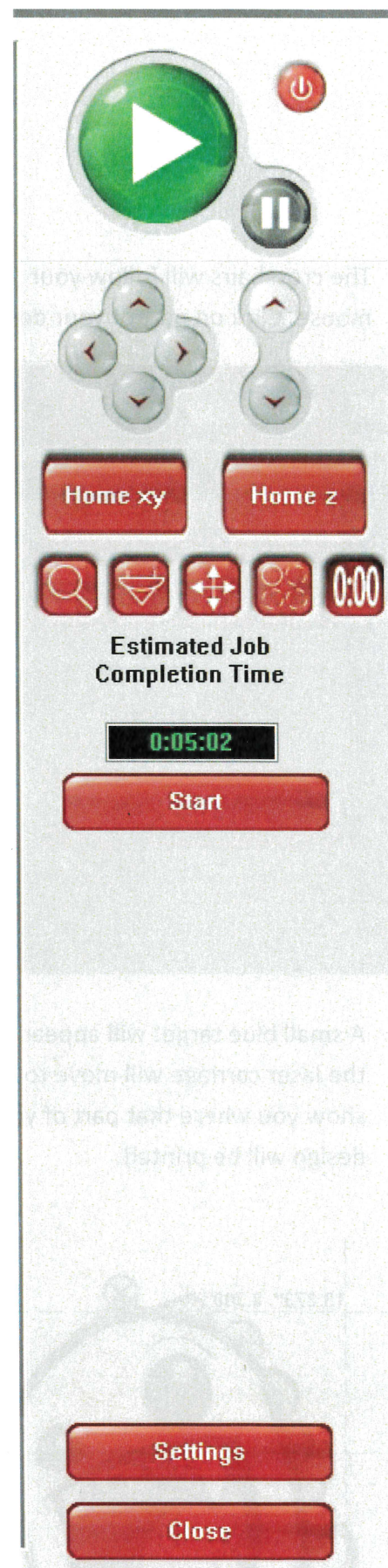
RELOCATE. Use this to move your design around the screen. Use it in conjunction with FOCUS to get your design exactly where you need it on your material.



Always check the time estimate to see how long it will take to print. Depending on how many people are booked for the laser, you may not have time to print everything in one day.

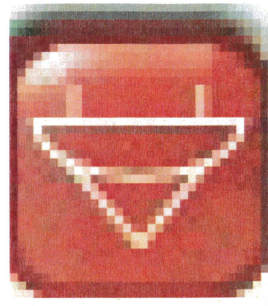
After you select this button, click the RED start button to see the estimated time.

The big green button will start your project as long as the lid is closed. Make sure the vent is on BEFORE pushing this button or the machine (and possibly the room) may fill with smoke quickly.



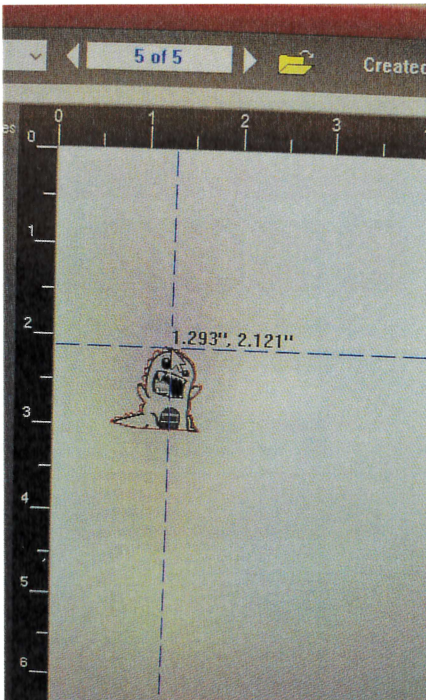


# Put Your Material in the Laser

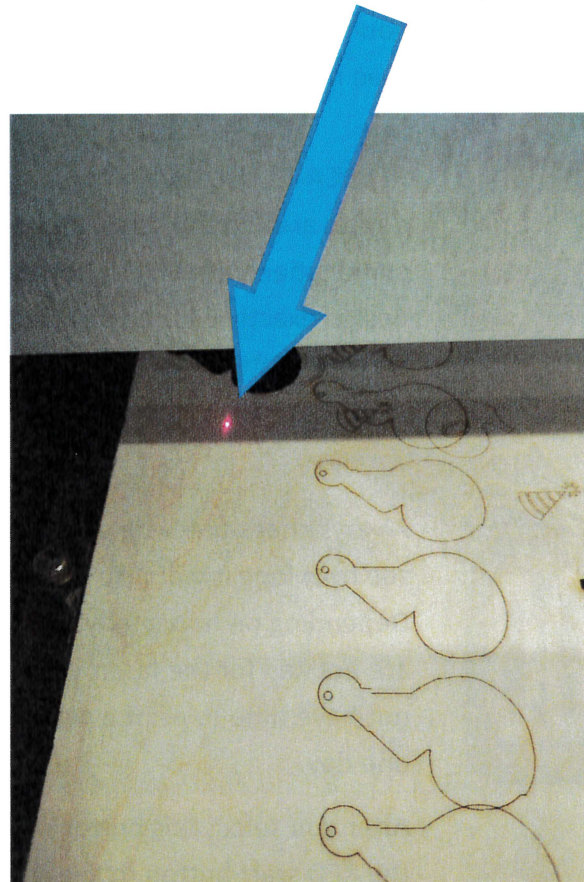


Select the focus tool while the lid of the ULS is open.

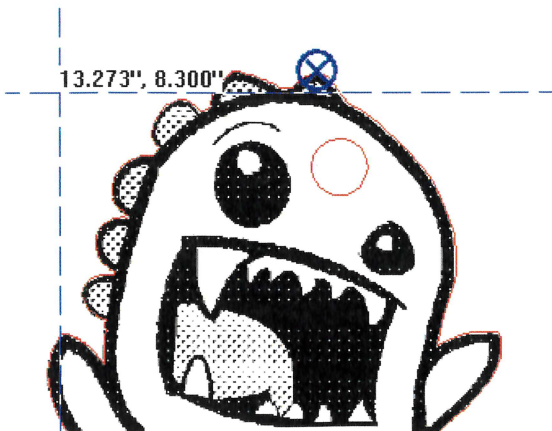
The crosshairs will follow your mouse. Click on part of your design.



Tiny focal dot.



A small blue target will appear and the laser carriage will move to show you where that part of your design will be printed.



This is very helpful for sneaking designs onto something already printed, a board that has lots of other things cut out, or to position specifically on a project.

# Don't forget to turn on the VENT!

The vent **MUST** be running when the laser is on.





# You may be Ready to Print

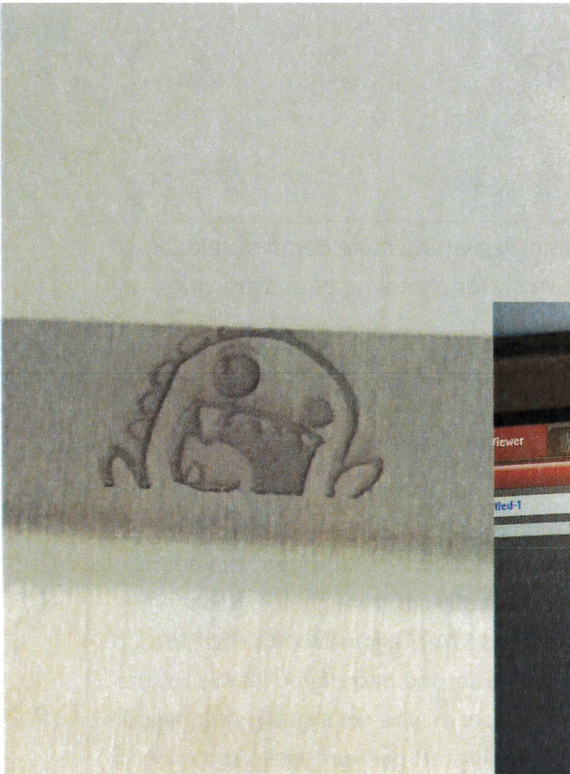


You may now print. Make sure the lid of the ULS is closed, then hit the big green button on your screen, or the **START** button on the machine.

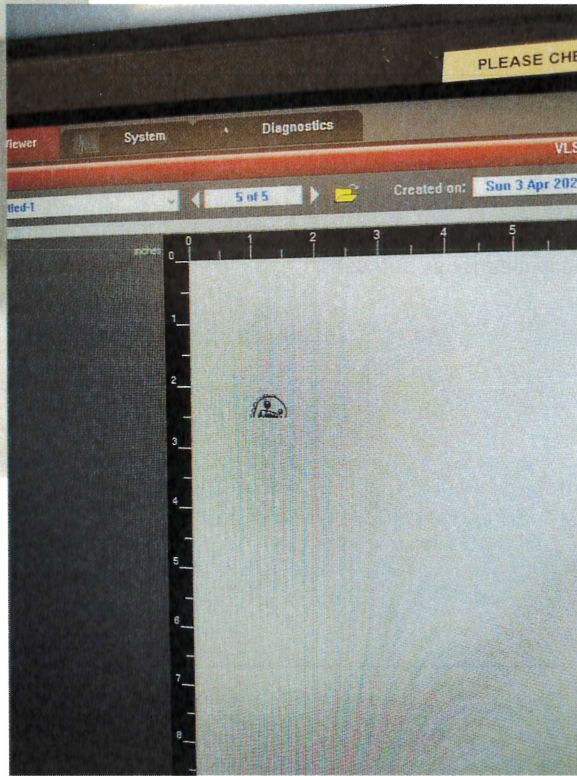


If you need to step away, press the **PAUSE** button on the screen or on the machine. This will pause the laser for safety. Press **PAUSE** again when you return. (If you hit **START**, it will start your print at the beginning.)





Watch the preview print on your screen instead of inside the machine. The light from the laser during etching and cutting can scar your eye the same as watching an eclipse without eye protection. Glancing at your project to make sure it is not on fire is okay, but do not watch the shiny part!

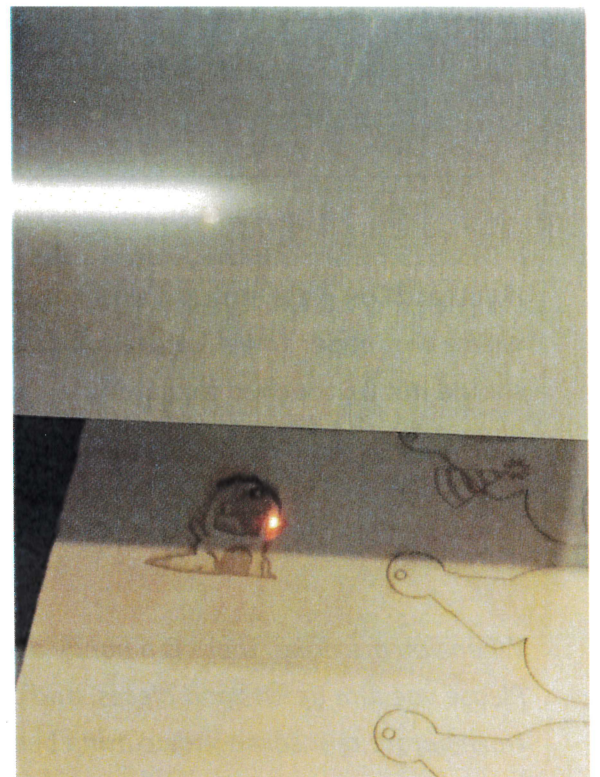


Is it on fire?

See the In Case of Fire page for full details, but here is the short version:

The ULS cuts with a flame. You will see a flame during cutting that is sized anywhere between the red spot in the photo to the right, up to a large birthday candle. As long as the flame is following the laser, it is cutting properly. If the flame starts to spread out horizontally, your material is on fire.

**DO NOT WATCH THE FLAME CUT. YOUR EYE DOCTOR WILL YELL AT YOU.**



## One pass or two?

Again, this is often trial and error, or personal preference.

One pass takes less time	Two passes may give you more depth of color and detail, especially for photographs and drawings.
If you are painting after the fact, one pass may be all you need for a guide.	Two passes may cut through more cleanly with less scorching at a lower intensity.
Glass etching is usually cleaner at one pass.	You may see your design “fall through” the board when it is successfully cut through. If in doubt, you may wish to press START again WITHOUT LIFTING THE LID, and do a second pass. If you lift the lid, the position of the laser may re-set slightly. As long as it is still closed, it will start over precisely. You may consider changing your settings in the SETTINGS button here if you want to dial back your intensity for the second pass.

**If you etch on glass, either flat or rotary, make sure to swipe over your finished etched material with a wet paper towel before touching the surface! The tiny shards from the microfractures should not be touched for safety.**

*When you are done, there is a handy dandy Shop Vac in the cupboard under the ULS computer! Please vacuum up bits and pieces, and carefully remove the cutting bed to tip fallen bits into the trash before re-inserting the cutting bed. Thanks for keeping our machines clean!*